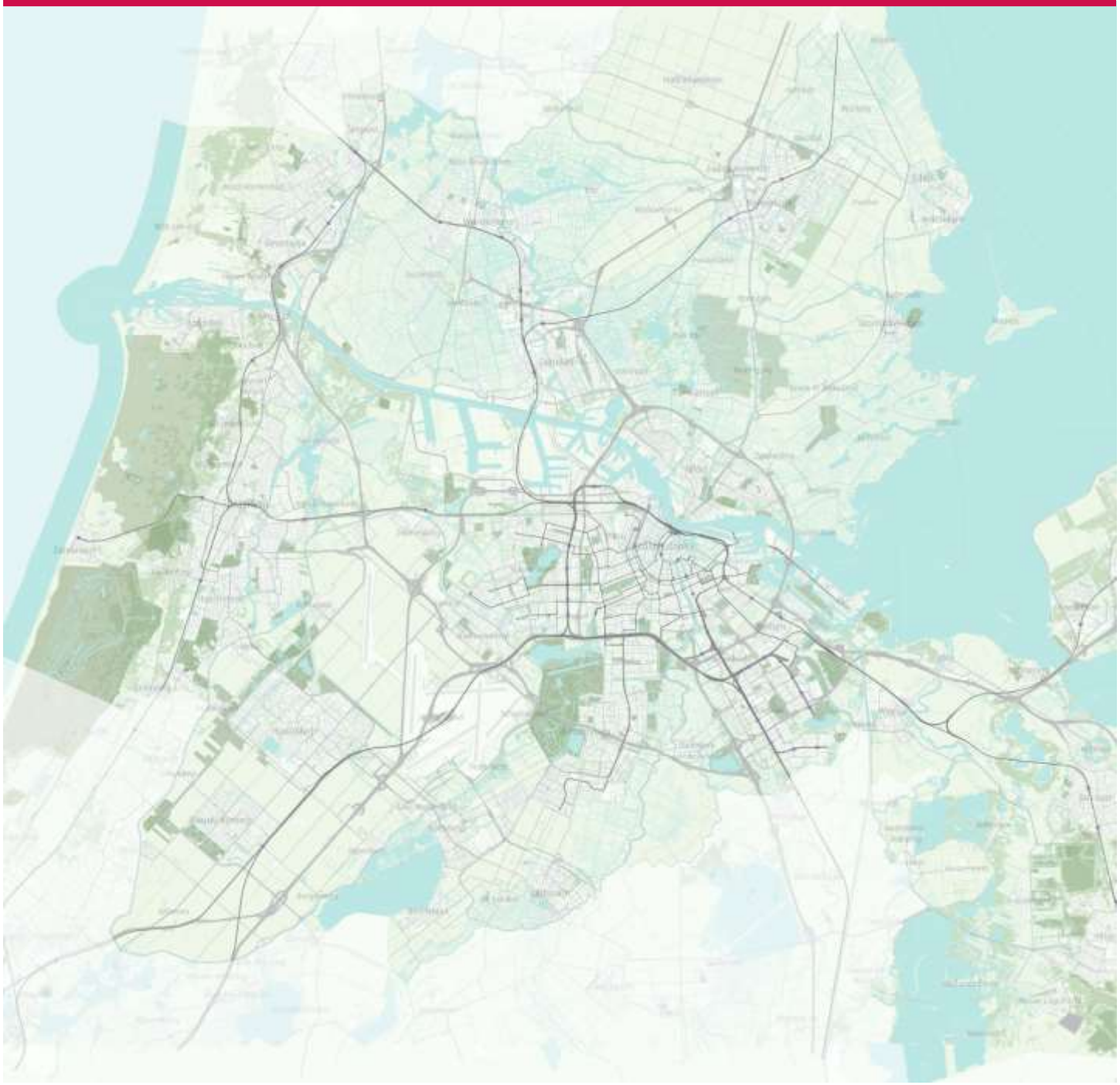
Analyzing citizens' views on new spatial-infrastructure projects:

From the average view towards various clusters within the Participatory Value Evaluation Method

L.J. Volberda

MASTER THESIS



Analyzing citizens' views on new spatial-infrastructure projects:

From the average view towards various clusters within the Participatory Value Evaluation Method

Master Thesis

by

L.J. Volberda

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Thesis committee:	Dr. Ir. M. Kroesen,	TU Delft (Chair)
	Dr. Mr. N. Mouter	TU Delft (TPM)
	Dr. Ir. N. van Oort,	TU Delft (CEG)
	Drs. J.I Hernandez,	TU Delft (TPM)
	Dr. N. Dogterom,	Goudappel Coffeng

Goudappel Coffeng created the cover image

TU Delft

mobility consultants Goudappel Coffeng

Preface

In front of you is my final thesis in fulfillment of obtaining a master's degree in Transport, Infrastructure, and Logistics at the Delft University of Technology. In the past six months, I have been working on the topic of analyzing citizens' preferences for new spatial-infrastructure projects using the Participatory Value Evaluation (PVE). This study was conducted on behalf of Goudappel Coffeng and in association with the Delft University of Technology.

I enjoyed carrying out this research step by step. I am proud to look back on the improvements of each version I saved in my documents, from the first draft to final version number 37, being afraid to lose some information. I am proud to contribute to the development of a newly designed methodology.

I want to thank everyone who has helped me during the process of writing my master thesis. I would like to thank my entire graduation committee for guiding me throughout the period. First, I want to thank Maarten Kroesen for his time and critical feedback to improve my thesis. I would like to thank Niek Mouter for being enthusiastic about PVE and getting seriously involved in the development of PVE. I would like to thank Niels van Oort for his enthusiastic feedback about my progress. I would like to thank Jose Ignacio Hernandez for being all the time available for feedback or brainstorming.

I would like to thank Bert van Wee of the Delft University of Technology and Paul Koster of the VU Amsterdam for their effort and time to do an interview. Furthermore, I want to thank Stefan Talen for bringing me in contact with his colleagues of Vervoerregio Amsterdam and scheduling two interviews. Besides that the interviews were useful for my research, I appreciated hearing the experts took my findings seriously.

Furthermore, I want to thank the colleagues of Goudappel Coffeng for including me in their work environment from the first day, having nice walks in The Hague during lunchtime, and organizing fun activities. A special thank for Nico Dogterom, for always making time to meet or call with me, being enthusiastic about my results and providing mental support. I had a pleasant time at Goudappel Coffeng and enjoyed my days working on my thesis there.

Lastly, I would like to thank my family and friends. My parents, for always supporting me during the time I was working on my thesis and telling me everything would turn well in the end. I would like to thank my friends in Delft for always listening to my struggles, being interested in my research, and keeping me motivated during the past half-year.

L.J. Volberda

Delft, February 2020

Scientific summary

Abstract

This study identified the distribution of citizens for the allocation of the public budget towards spatial-infrastructure projects using the Participatory Value Evaluation (PVE) tool. The dataset of a PVE experiment in the Region of Amsterdam (Vervoersregio Amsterdam) is used. A Latent Class Cluster Analysis model was estimated to identify citizens selecting a similar combination of spatial-infrastructure projects. The results of this study found that individuals are more likely to select projects in their living area. Furthermore, individuals prefer rather a higher number of projects having low costs than one expensive project, and individuals assign high values to safety compliance projects. The results indicate individuals do neither necessarily base their choice on quantitative attribute values, such as minutes of travel time reduction realized by a new project, nor do individuals select a combination of projects based on travel mode improvements realized by these projects. By doing experts' interviews, this study also provides a rich reflection of the implications of the clusters identified. The desirability of the location-effect depends on the aim of the experiment. The main implication of the results is that researchers have to be aware of the strong location-effect and that future research should control for this effect.

Keywords: *Decision-making, Infrastructure policy, Participatory Value Evaluation, Latent Class Cluster Analysis, Preference Assessment*

1. Introduction

The local government strives to improve the regional urban network while making the best use of the public budget (Van Wee, 2012). Traditional Cost-Benefit Analysis (CBA) remains one of the most popular evaluation methods for new infrastructure projects (Mouter et al., 2017; Annema et al., 2015). However, researchers criticize the monetizing principle (by using the private willingness-to-pay (WTP) approach), which is based on individuals' private budgets while infrastructure projects are realized from governmental budgets. Citizens' preferences using their private budget does not accurately reflect their expectations for governmental spending for public infrastructure (Alphonce et al., 2014; Mouter & Chorus, 2016). Participatory Value Evaluation (PVE) is a novel designed evaluation tool specifically designed to overcome this problem with CBA while preserving the positive aspects (Mouter et al., 2019). PVE involves citizens by asking them to advise the local government about the allocation of a fixed amount of public budget towards transportation projects. Consequently, the setting of PVE should more accurately reflect citizens' preferences for governmental spending. The analysis of PVE shows a portfolio of infrastructure, which should maximize social welfare increase (Mouter et al., 2019).

However, the portfolio presented by PVE only shows the projects that are highest ranked on average, which does not account for the distribution of preferences. Consequently, misinterpretations of citizens' preferences are risked. For example, if 80 percent of the citizens prefer car projects, while the remaining 20 percent prefer public transport projects, the average result would show that a portfolio including only car projects would maximize the welfare since the majority prefers car projects. The welfare analysis does not account for the structural loss of the remaining 20 percent. Eventually, the welfare analysis of the optimal portfolio does not account for the equal distribution of welfare (Kaplow, 2010). However, alternative evaluation methods like CBA are not able to provide this information either (Nyborg, 2012). However, decision-makers should understand the distribution of citizens' preferences for better facilitation of the democratic decision-making about public budget, of which PVE assumes all citizens to be co-owner (Mouter, 2019; Nyborg, 2012). However, considering all citizens' views separately would take too much time from busy politicians (Nyborg, 2012). There is a need for structural evaluation of citizens' preferences for spatial-infrastructure projects that covers the distribution of these preferences.

This study tries to identify homogenous groups of citizens, selecting a similar combination of projects

based on project-specific characteristics. The groups show to what extent individuals select projects based on travel mode improved, project location, or quantitative project attributes such as the minutes of travel time reduction. Subsequently, background characteristics that are related to the heterogeneity between the identified clusters are explored. These background relations show to what extent project preference is related to individuals' political orientation, favorite mode, or living area. For example, whether bikers select only bike projects, individuals living in remote areas more likely to select projects in remote areas or environmentalism-orientated individuals select projects having minimum environmental impacts.

This study aims at contributing to the literature by analyzing distributed profiles of preferences among citizens for the allocation of the public budget towards spatial-infrastructure projects using the Participatory Value Evaluation. This study helps in understanding the conflicting preferences among citizens and creates the opportunity to debate the best mix of infrastructure for people in a scientific way. Moreover, the analysis provides scientific insights into the degree of disagreement regarding budget allocations to spatial-infrastructure projects of the citizen in general. Furthermore, the implications of the distributed profiles of preference, if identified, are presented on the basis of several experts' reviews.

In the following sections, the applied methodology, including the Latent Class Cluster Analysis (LCCA), expert interviews, and the case study, are described. Subsequently, the quantitative results of the LCCA model are presented. Then, the experts' reviews on the implications based on the clusters, if identified, are presented. The final sections provide conclusions and discussions on the results.

2. Methodologies and data

This study applies a quantitative analysis of the data to identify distributed profiles of preferences. Subsequently, the implications of the results are reviewed by experts, which is a qualitative analysis.

2.1 Latent Class Cluster Analysis

A LCCA model is applied to identify the distributed preferences for public budget allocation towards spatial-infrastructure projects.

The LCCA maximizes homogeneity within the clusters and the heterogeneity among the clusters. Within the model, a discrete latent variable accounts for the associations between a set of indicators. Conditional on this variable, the associations become insignificant according to the assumption of local independence (Vermunt & Madigson, 2002). The clusters show individuals having a similar response pattern, which enables LCCA to identify groups of respondents selecting similar combinations of spatial-infrastructure projects. Furthermore, the LCCA presents statistical criteria to choose the number of clusters (Kroesen, 2019). The cluster model is estimated using the dedicated software Latent Gold (Vermunt & Magidson, 2005).

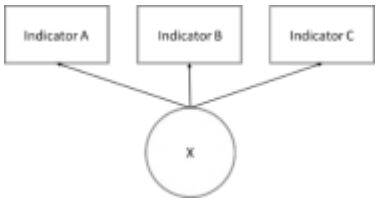

Figure 1 LCCA including three indicators and latent class cluster variable X

First, the model that includes only indicators is estimated to assess only the measurement part of the model, as presented in figure 1 (Molin et al., 2016). Based on this model estimation, the optimal number of clusters is determined using two types of criteria. The prior applied method to assess model fit in case of sparse data is the Bayesian Information Criteria (BIC), which weight model fit and parsimony in terms of the number of estimated parameters (Molin et al., 2016). However, if the BIC criteria show a high number of clusters that are too complex to communicate, the BVR's as a local measure of model fit is applied (Molin et al., 2016). The Chi-square distributed BVR's were estimates of the improvement of model fit when a direct effect between two indicators was included. The number of significant BVR's (>3.84) and the highest BVR value are included as additional indicators to determine the optimal number of classes.

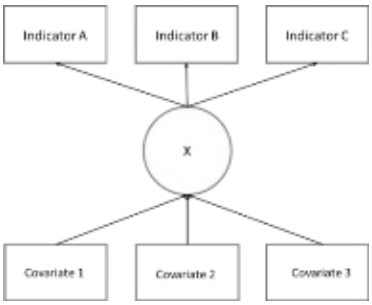

Figure 2 LCCA model including covariates

Subsequently, as presented in figure 2, the model is expanded by adding covariates to the model, which represents the structural part of the model. It is assumed that individuals have a probability of belonging to each class, depending on their background characteristics. These observed characteristics are called covariates (Molin et al., 2016).

Wald statistics are used to determine whether the indicators and covariates within the model are significant. The corresponding p-values assess whether or not scores differ significantly across clusters (Molin et al., 2016). The traditional value of 5 percent is used.

2.2 Semi-structured interviews

Qualitative semi-structured interviews with experts are conducted to review the results of the estimated cluster model. The interviews aim to consider whether the implications of the results are desirable for the scientific evaluation of citizens' preferences for spatial-infrastructure projects and to further substantiate PVE as an evaluation method and policy-making instrument. Three different points of view are approached for the interviews, being 1) a scientific PVE expertise, 2) a scientific CBA expertise, and 3) policymaking expertise. The aim of the interviews is to find out respectively 1) the implications for the scientific evaluation of citizens' preference and using PVE, 2) the implications for scientific evaluation and the fit of PVE from an alternative perspective, and 3) the practical implications for policymaking. One interview with a PVE expert, one interview with a CBA expert, and two interviews with two policymaking experts were conducted in January 2020.

2.3 Data case study Vervoerregio Amsterdam

An experiment should be carried out on a regional level since infrastructure projects are predominantly developed on a regional scale. Furthermore, different travel modes should be proposed to identify if individuals have a preference for a particular travel mode. The area of the case should have a relatively high number of inhabitants to gather responses. Therefore, Vervoerregio Amsterdam is selected as a case study. The data of a recent PVE experiment in Vervoerregio Amsterdam of Mouter et al. (2019) is used. Each of the 16 projects included focuses on the improvement of public transport, car, active modes, active mode safety, or safety compliance. Figure 3 presents an overview of the geographical location of the projects and the mode improved by the project.

The survey design included a short instruction movie about the idea of the survey. Subsequently, an overview of projects is presented, including the project titles of table 1.

Individuals could read more information about the project by selecting a project or compare some projects based on quantitative attribute values. Individuals had to select projects within a fixed budget of 100 million. Participants were aware that the budget not allocated would be shifted to the budget of the next year for transportation projects. Two different experiments of Mouter (2019) were used, one including only one design of parameters and a second using multiple designs for project attribute values. The use of multiple designs indicates that respondents received one of the 64 designs for the attribute values.

Table 1 The 16 project included in the PVE experiment selected in collaboration with Transport Authority Amsterdam (TAA)

NR.	COSTS	PROJECT DESCRIPTION
1	50	Faster connection bus and car traffic Zaandam
2	3	Ilpendam pedestrian tunnel
3	40	Fly-over A10 at junction Amsterdam Noord
4	10	Extending the MacGillavrylaan to Middenweg
5	10	Widening the Bovenkerkerweg to 2 lanes per direction
6	50	New bus connection Ijburg – Bijlmer Arena
7	5	Acceleration of the bus connection Amsterdam CS – Zaandam
8	15	Improvement tram connection Diemen- Linnaeusstraat
9	8	Cycling highway Hoofddorp – Schiphol – Aalsmeer
10	6	Cycling highway Amstelveenseweg
11	4	New bridge for cyclists and pedestrians Purmerend (Hoornselaan)
12	40	Guisweg bike tunnel
13	35	New cycling bridge Zeeburg
14	40	Stadhouderskade car tunnel at the entrance of the Vondelpark
15	50	Traffic education for children in the age group 4 – 18
16	20	Five police officers sanction violation of traffic regulations

Figure 3 Geographical locations of projects and travel mode improved. No location is assigned to safety compliance project numbers 15 and 16

2.4 Data analysis

First, the dataset is cleaned. Individuals shifting the full budget to the next year by not selecting any project are excluded from the dataset. These responses are assumed to be outliers since these are not suitable for the evaluation of what kind of spatial-infrastructure projects are preferred by citizens. In total, 6 respondents were removed and excluded from the dataset. Consequently, 1037 number of observations were used for the analysis. Table 2 summarizes the descriptive statistics of the socio-demographic background characteristics.

Table 2 Descriptive statistics socio-demographic background characteristics

DEMOGRAPHIC VARIABLE	CATEGORIES	DISTRIBUTION SAMPLE
AGE	18-25	4.53 %
	25-45	26.81 %
	45-65	41.85 %
	65-80	24.69 %
	80+	2.12
GENDER	Male	54.97 %
	Female	45.03 %
INCOME	Average income	46.57 (x €1000)
EDUCATION	No/elementary education/LBO/VBO/VMBO	7.86 %
	MAVO/VMBO/MBO1	8.68 %
	HAVO/VWO/MBO2,3,4	28.45 %
	HBO/WO bachelor	33.46 %
	WO master	21.02 %
LIVING AREA	Zaanstad	15.12 %
	Purmerend	9.61 %
	Amsterdam West	31.89 %
	Amsterdam Oost	13.13 %
	Haarlemmermeer	20.52 %
	Amsterdam Zuid-Oost	9.85 %

The chi-square tests are applied to test if the sample is representative compared to the population of Vervoerregio Amsterdam (CBS, 2019). These tests showed that males and high educated respondents were overrepresented. Furthermore, the average income of respondents was significantly higher, and living areas Zaanstad, Amsterdam Zuid-Oost were overrepresented, while Amsterdam West and Amsterdam Oost were underrepresented. However, all categories are presented in the sample. Consequently, all categories can be included in the analysis. Although, average results should correct for significant background characteristics that are not representative.

3. LCCA model estimation & results

Three different LCCA models are estimated. The models differ in terms of indicators included in the model. The included covariates are similar. First, a model based on specific project selection is estimated. Project choices are included as indicators to show a combination of projects selected by individuals. The common characteristics of the projects selected are reviewed in the cluster interpretation.

3.1 Project selection

A cluster model is estimated, including all 16 projects as indicators of the model. Each project choice was added as a binary variable. Consequently, the model contains 16 indicators. According to the BIC values of table 3, 9 clusters would be the optimal number of clusters. However, that number of clusters is too complex to communicate. Therefore, the number of significant BVR's and the maximum BVR value, presented in table 3, are considered as well. After 7 clusters, the BIC, maximum BVR, and in particular, the number of significant BVR's does not decrease a lot. Consequently, the number of 7 clusters is selected.

Table 3 BIC and BVR values as criteria to determine the optimal number of clusters

NUMBER OF CLUSTERS	BIC	#BVRS>3.84	MAX BVR
1	19254	91	87
2	18721	68	60
3	18526	45	69
4	18382	36	51
5	18320	33	59
6	18295	41	46
7	18282	29	51
8	18279	28	47
9	18253	27	52
10	18305	25	48

The Wald test statistics and corresponding p-values indicate that all 16 indicators are significant. Consequently, the cluster values per project choice indicator differ significantly over the clusters. The cluster values of table 4 present per indicator the average score for a project per cluster between 0.00 and 1.00. The higher the score, the more frequently the project is selected by individuals belonging to the cluster.

Table 4 Cluster profiles based on project selected

CLUSTER NR	1	2	3	4	5	6	7	WALD VALUE	P VALUE
CLUSTER SIZE	0.26	0.16	0.16	0.13	0.11	0.10	0.08		
PROJECT NR									
1	0.03	0.08	0.06	0.52	0.00	0.00	0.13	101.14	0.00
2	0.21	0.13	0.74	0.27	0.63	0.68	0.69	181.26	0.00
3	0.17	0.16	0.28	0.34	0.00	0.00	0.54	51.91	0.00
4	0.44	0.09	0.63	0.06	0.70	0.45	0.27	103.93	0.00
5	0.08	0.26	0.61	0.07	0.48	0.50	0.08	147.51	0.00
6	0.24	0.04	0.17	0.01	0.00	0.00	0.00	24.17	0.00
7	0.20	0.06	0.56	0.56	0.53	0.48	0.28	103.85	0.00
8	0.29	0.04	0.47	0.05	0.54	0.21	0.05	104.35	0.00
9	0.12	0.43	0.71	0.04	0.55	0.66	0.07	164.34	0.00
10	0.16	0.30	0.59	0.13	0.68	0.51	0.16	141.98	0.00
11	0.18	0.09	0.68	0.27	0.52	0.56	0.64	150.76	0.00
12	0.05	0.10	0.30	0.60	0.05	0.00	0.20	116.48	0.00
13	0.47	0.15	0.41	0.09	0.19	0.00	0.04	79.99	0.00
14	0.54	0.62	0.02	0.08	1.00	0.00	0.34	66.34	0.00
15	0.24	0.57	0.00	0.21	0.00	1.00	0.45	50.29	0.00
16	0.30	0.19	0.48	0.16	0.62	0.79	0.22	119.71	0.00

The Wald statistics of the included covariates, presented in table 5, show that individuals' living area, level of education, age, gender, car ownership, and expectation to move do significantly predict class membership. The other covariates are not significant. Remarkable is that individuals living areas are significant, while individuals' political orientation and favorite travel mode are not.

Table 5 Wald test of covariates

COVARIATES	WALD	P-VALUE
ORIENTATION	51.31	0.15
LIVING AREA	137.01	0.00
FAVORITE TRAVEL MODE	27.31	0.29
EDUCATION	61.70	0.00
AGE	27.18	0.00
INCOME	10.67	0.10
GENDER	16.47	0.01
EXPECT TO MOVE	25.61	0.01
CAR OWNERSHIP	34.56	0.00
DRIVING LICENSE	19.02	0.09
PT COMMUTATION	15.98	0.19

Clusters identified

Table 6 shows the cluster sizes, a cluster description that characterizes the combination of projects predominantly selected, and the living area and demographic groups that predominantly belong to the cluster.

Table 6 Cluster interpretation

CLUSTER	CLUSTER SIZE	DESCRIPTION	LIVING AREA	DEMOGRAPHIC VARIABLES
1	26 %	Projects within Amsterdam	Amsterdam Oost + Amsterdam West	High educated, No car owner, Expectations to move
2	16%	Traffic education & Stadshouders kade	Amsterdam West and Haarlemmer meer	Women, Age 20-30
3	16%	Many cheap projects scattered over the area	-	Men, High educated, Middle age
4	13%	Accessibility Zaanstad	Zaanstad	Low educated, Elderly, Car owner
5	11%	Stadshouders kade and cheap projects close to Amsterdam	Amsterdam West	High educated, Men
6	10%	Traffic Safety combined with cheap active mode projects	Haarlemmer-meer (*slight overrepresented)*	Age 20-40
7	8%	Accessibility Purmerend	Purmerend	Elderly, Low educated

The cluster characteristics show that the location of the projects selected directly overcomes the living area of individuals that are most likely to belong to the cluster for cluster numbers 1, 4, and 7. The results show that individuals are more likely to select projects in their living area. However, alternative strategies are visible either. Table 7 presents an overview of the (combination of) strategies applied by each cluster.

Table 7 Applied strategies per cluster

CLUSTER	CLUSTER SIZE	PROJECTS WITHIN THE LIVING AREA	SAFETY COMPLIANCE PROJECTS	AS MANY CHEAP PROJECTS
1	26 %	X		
2	16%	X	X	
3	16%			X
4	13%	X		
5	11%	X		X
6	10%		X	X
7	8%	X		
TOTAL		63 %	26%	37%

Individuals seem to attach much value to safety compliance. Furthermore, many individuals decided to select many cheap projects, which are

mostly spread over the region, which strategy indicates a preference for 1) many projects over one prestigious project and 2) spatial-equality of budget allocation over the region. The demographic background characteristics show that high educated individuals are more likely to select several-low costs projects, while low educated more likely select projects within their living area.

Besides, the demographic background characteristics show women and individuals between the age of 20 and 40 are more likely to select safety compliance projects. The variables 'car ownership' and 'expect to move' do only differ among individuals living in Amsterdam. More data is required to identify if this relation also occurs in other living areas.

3.2 Cluster models based on quantitative attribute values or travel mode preference

A second LCCA model based on quantitative attribute preference is estimated. Quantitative attribute values were included as indicators of the model showing whether participants prefer projects based on one of the qualitative attribute values, as presented in table 8.

Table 8 Indicators model quantitative attributes

ATTRIBUTE	DESCRIPTION
TRAVELERS	Number of travelers with reduced travel time on an average working day
TIME SAVINGS	Average minutes of travel time gained by travelers
DEATHS	The average reduction of traffic injuries
INJURIES	The average reduction of traffic deaths
NOISE	Increased number of households that experience noise pollution
TREES	Number of trees that have to be cut

Nevertheless, no clear clusters based on attribute values were visible. The cluster presented seem to be related to alternative project characteristics, like safety improvement. Consequently, individuals seem not to base their choice for a project on quantitative project attributes.

A third LCCA model based on travel mode preference is estimated. The travel modes included are presented in table 9. It is assumed that the total budget allocated to a travel mode reflects the relative preference for the travel mode. In addition, the remaining budget shifted to the next year is included as an additional indicator of the model.

Table 9 Indicators of the model based on travel mode preference

TRAVEL MODE	DESCRIPTION
PUBLIC TRANSPORT	New or acceleration of tram and bus lines
CAR	Faster connections for car traffic, improvement in car traffic flow
ACTIVE MODE	New cycling connection or highways to improve the cycle traffic flow
ACTIVE MODE SAFETY	Separate car and cycle/pedestrian traffic lanes to reduce the number of accidents due to collisions
SAFETY COMPLIANCE	General safety instruction and control

The results showed clusters which were strongly related to individuals living area. Consequently, the clusters appear to reflect groups of individuals selecting projects in their living area. No clusters of individuals having a preference for a particular travel mode were visible. However, the model did show a large cluster allocating a large share of the budget towards safety compliance projects.

Cross-table based on posterior membership

Posterior membership classification of the first and the third model were used to construct a cross-table of clusters, being the project choice model and travel mode preference model. The cross-table analysis shows if individuals are classified to a similar cluster in the first model as in the third model. The analysis aims to show if the two models estimate similar clusters. The results showed similarities in clusters. Both models show a strong relationship with individuals living areas and projects selected. However, the cross-table showed that individuals of participants of all clusters in the first model belong to the safety compliance cluster in the second model. Consequently, the first model based on project choice underestimates the preference for safety compliance. Whereas the project choice model can show individuals selecting many projects having low costs since the project choice model better reflects specific projects selected by a cluster. However, both models show a similar effect of individuals having a preference for projects in their living area.

3.3 Location-effect

The results show that individuals are more likely to select projects in their living area. However, the results do not clearly show the share of individuals selecting only projects in their living area. The statistics of table 10 clearly shows that individuals do not just select all projects in their composed portfolio of projects. Only 15 to 28 percent selected all projects in their living area. However, 60 to 92

percent selected at least one project within their living area. In conclusion, individuals intend to include a project located in their living area in their portfolio.

Table 10 Distribution of individuals selecting all projects within their living area

PROPOSED PROJECTS (#)	LIVING AREA	NUMBER OF PROJECTS WITHIN LIVING AREA SELECTED			
		All (%)	At least 2 (%)	At least 1 (%)	0 (%)
3	Zaanstad	16	81	92	8
	Purmerend	28	74	94	6
	Haarlemmermeer	24	58	88	12
2	Amsterdam Oost	26	-	80	20
	Amsterdam Zuid-Oost	8	-	63	37
1	Amsterdam West	60	-	-	40

4. Interview results and reflection

The results are reviewed by experts. The interview aims to reflect the implications of the results, showing a strong location-effect. The interviews are used to reflect whether it is desirable that individuals select projects in their living area.

4.1 Implications evaluation citizens preferences

The two main implications are that 1) welfare increase of projects located in living areas that are overrepresented in the sample is overestimated and 2) projects in high populated areas are more likely to end up in the optimal portfolio, while expensive projects in remote areas end up in the bottom of the ranking of projects.

The scientific CBA expert and the scientific PVE expert argue that the first implication is problematic. Therefore, the PVE analysis to determine the optimal portfolio should correct for the representative living area for an accurate ranking of projects on average preferred by citizens.

All the experts agree that the second implication is not problematic since more individuals benefit in these areas. The CBA expert argues the budget allocation should be proportional, however, if the optimal portfolio would include only projects in high populated areas, it is not the problem of the evaluation tool itself, but up to policymakers to correct for proportional distribution. The policymakers mention that indeed a large share of the budget is allocated to highly populated areas. However, the regional government is responsible for maintaining the regional network as a whole. Consequently, not all budget is allocated to projects in high populated areas.

Apart from this, the experts reviewed to what extent it is desirable individuals select projects in their living area. The PVE expert argues that participants should be allowed to select projects in their living area. In contrast, the CBA expert argues it is not desirable only to measure that citizens prefer projects in their living area since there are less complex tools to measure that effect. Policymakers argue that the information that individuals prefer projects in their living area is not directly applicable in policymaking.

However, this study shows that individuals do not only select projects in their living area. The results show different strategies and interests come together in PVE, being among else economic interests (e.g., projects in living area), social interests (e.g., safety compliance), and ethical interests (e.g., spatial equality). Providing information on project locations enables exploring the combination of these interests. Furthermore, this setting, including the location of projects, explores among else to what extent individuals account for spatial-equality by allocating budget to other living areas instead of their living area.

4.2 PVE compared to CBA

The PVE expert argues that the location-effect is in line with the concept of PVE. The setting of PVE aims to allow participants to apply whatever strategy they prefer. If individuals prefer to include projects located in their living area, these results reflect their preferred strategy. In contrast, the CBA expert stated it would be problematic if individuals would only select projects in their living area since less complex tools could be used to measure that.

However, the results show that the experiment does not only measure individuals selecting projects in their living area.

4.3 Policy implications

The scientific CBA and PVE experts argue that an evaluation method like PVE should provide accurate information to policymakers. It is up to policymakers what to do with the results.

Policymakers argue that knowing that citizens prefer projects in their living area over projects in other areas is not useful information for policymaking. However, it makes sense that individuals include a project in their living area to

their portfolio. Individuals are more likely to know these traffic situations and make use of it. Consequently, the urgency of a project would be questionable when individuals living close to the project would not select the project.

Apart from this, individuals select projects spread located over the region, which indicates citizens attach value to spatial-equality. The local government does not apply strict guidelines for spatial-equality to their program of investments. According to this study, if policymakers are willing to respond to citizens' preferences, the program of investment should account for spatial-equality.

Instead of strict guidelines for the budget allocated to each region, the regional government had these guidelines for the budget allocated to each of the modalities. However, the regional government of Amsterdam decided to switch from a fixed budget per travel modality to a flexible budget. This study shows that citizens do not compose the portfolio based on modalities but rather the location of projects. Consequently, regional governments should better apply guidelines for spatial- than modality distribution.

5. Conclusion

The distributed profiles identified in this study showed three types of strategies, being 1) selecting projects in their living area, 2) selecting as many low costs projects, and 3) allocating a large share of the budget towards safety compliance. Most individuals apply a combination of these strategies, where most individuals (60 to 94 percent per living area) include at least one project located in their living area to their portfolio. Consequently, a strong location-effect occurs.

This study showed that projects are predominantly selected based on project *location*, project *costs*, and improvement of *safety compliance*. In contrast, quantitative attributes had no effect. It is questionable to what extent individuals consider these values. Also, no clusters based on travel mode were identified. No background relations with favorite travel mode nor political orientation were found. Consequently, bikers do not predominantly select bike projects, and environmentally-oriented respondents do not consider only minimal environmental impacts.

In addition, the study showed that demographic variables such as gender, age, and education are significantly related to project preference. Women and individuals between the age of 20 and 40 are more likely to select safety compliance projects. Higher educated respondents are more likely to select low costs projects spread over the whole region, while lower educated respondents are more likely to select projects within their living area. Individuals' income, having a driving license and having a PT commutation had no significant effect.

Individuals selecting projects in their living area is in line with the concept of PVE. The location-effect does not contradict the concept of PVE since it correctly reflects individuals' preference for spatial-infrastructure projects. Consequently, individuals should be allowed to select projects in their living area. However, if the location-effect would be the only effect that exists in PVE experiments, methodologies that are less complex than PVE can be used to measure that effect.

This study shows that individuals do not *only* select projects in their living area. However, it is important to be aware of it and to control for the location-effect.

To what extent the location effect is desirable depends on the aim of the experiment. For the evaluation of alternative effects of a project, the location-effect dominating these effects might be undesirable.

6. Discussion

6.1 Implications

Theoretical implications evaluation citizens preferences

The main finding of this study is the location-effect, which implicates participants' tendency to select those projects that are close to the location where they live. Consequently, whether researchers control for the location-effect or not, they have to be aware of the existence of a strong location-effect.

Apart from the location-effect, the results show that individuals do include several low-costs spread located over the region, which might indicate a preference for spatial-equality. The results also showed that higher educated respondents are more likely to select various low-cost projects spread over the region, while lower educated respondents are more likely to predominantly select projects close to their living area. It could be lower educated respondents have more difficulties

with the complexity of the tool. However, Mouter et al. (2017) found the same relation between education and preference for spatial equality using a more simplistic design. Consequently, the study shows that citizens do attach value to spatial-equality.

PVE methodology implications

A problematic implication of the location-effect, where experts agree on, is that the welfare increase of projects in the overrepresented living area is overestimated. Therefore, the optimal portfolio analysis should correct for representative living areas to reflect the average ranking of projects.

Furthermore, this study shows that the closer a project is located to individuals' living location, the more likely individuals select the project. These results indicate that individuals assign more value to a project closer located to their living location. Consequently, in cases the location-effect exists, the PVE welfare computation should include an estimated parameter for this distance. The estimated distance parameter should probably be included in the individuals' utility function of the MCDEV model described by Dekker et al. (2019), which describes the welfare increase for individual citizens due to a project. It is expected, according to the findings of this study, the distance parameter would be negative for spatial-infrastructure projects. Further research should identify how the model should exactly cover for the location-effect.

The results show that project selection is predominantly based on *project location, project costs,* and improvement of *safety compliance,* which information was all included in the title of projects. The titles of all projects were presented to participants in the overview page. These results indicate that individuals do predominantly base their choice on the information provided in the titles of the projects. Consequently, the information presented in the project title does affect what projects individuals selected. Future experiments should carefully consider the information presented in the project title. For example, if one would decrease the location-effect, not naming the location in the project title can be considered. On the other hand, attribute values like the number of trees cut might have more impact on participants' decision-making process by naming it in the project title.

Policy implications

The location-effect implicates projects in high populated areas are higher ranked than projects in more remote areas. However, more strategies than individuals selecting projects in their living area are visible. The distributed results show the reasons policymakers needs, as stated by the theory of Nyborg (2012). This study shows individuals prefer projects 1) close to their living area, 2) that improve safety compliance, or 3) that have low costs (spread over the region). These insights provide a reason to 1) allocate *more* budget to the high populated areas than low populated areas and 2) allocate budget to safety compliance. Furthermore, these insights provide a reason to 3) include low costs projects, which are spread over the region, to the agenda of investments.

In terms of transport planning, these results incorporate citizen participation on a higher level, where citizen strategy over a bunch of projects is evaluated instead of an individual project. The strategies preferred by citizens can be compared to the total combination of projects on the agenda of investment. For example, if a large share is allocated to safety compliance.

6.2 Limitations and recommendations

No information about participants' travel behavior was available. This information is useful to explain individuals' choices better. For instance, participants might select projects improving the infrastructure they have to make frequent use of. An additional question is recommended for a future experiment, which asks participants' work location since that is probably the location individuals most frequently travel to.

Furthermore, the dataset contains only information if projects are in the optimal portfolio or not. One of the limitations is that no information was available whether projects are individuals' first choice or selected as a 'budget-filler.' The scientific PVE expert suggested that participants should rank the proposed projects. If participants have to rank the projects included in their portfolio, valuable information would be gathered. For example, if individuals prefer safety compliance projects over other projects in their living area.

6.3 Further research

This study shows that individuals are more likely to select projects close to their living location than projects located far-off their living area. The

statistics suggest a negative relation between the distance from individuals' living location to the project location and individuals' expected utility due to the project. Further research should identify the extent of the relationship more precisely by using individuals living location and the distance to the project location. This research could show whether this relation is linear or from what distance range (in kilometers) projects become less likely to select. The estimated parameter for distance from individuals living location to project location could be used in the MCDEV model to more accurately determine societal welfare increase due to a project. Further research should identify how welfare computation should account for the location-effect.

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AMS	Active mode safety
BIC	Bayesian Information Criteria
BVR	Bivariate Residuals
CBA	Cost-Benefit Analysis
LCCA	Latent Class Cluster Analysis
OEOV	One-euro-one-vote
OPOV	One-person-one-vote
PB	Participatory Budgeting
PT	Public Transport
PVE	Participatory Value Evaluation
VoT	Value of time
WTP	Willingness-to-pay

1. Introduction

1.1 Spatial-infrastructure project evaluation on a regional level

The local government strives to improve urban transport networks as the mobility demand of its users grows. The goal of the government regarding these public transport networks is to achieve an optimal infrastructure for inhabitants and make the best use of the public budget (Van Wee, 2012). The Cost-Benefit Analysis (CBA) remains one of the most popular methods to assess and rank proposed infrastructure projects, mainly because of its systematic process (Mouter et al., 2017a; Annema et al., 2015) for evaluating alternative investments in infrastructure projects. Time savings due to new infrastructure projects are monetized using the Value of Time (VoT) and are mainly based on willingness-to-pay (WTP) estimates (Annema et al., 2015). Many researchers have criticized this principle since the willingness-to-pay is determined on individuals' private budgets, while infrastructure projects are mainly realized from government budgets. Many studies have shown that individuals' priorities based on their private budgets do not accurately reflect their expectations of governmental spending for public infrastructure (Alphonce et al., 2014; Mouter & Chorus, 2016). For example, individuals expect a high priority to safety in case of government budget allocations, while as a user of mobility, they seem to set priority on travel time reductions (Mouter et al., 2017b). Consequently, using individuals' private willingness-to-pay results in incorrect evaluations of citizens' needs for public goods. To resolve these issues, a new enriched tool could give more value to support the decision-making of budget allocation to alternative transportation projects (Mouter et al., 2019b).

Participatory Value Evaluation (PVE) is a novel proposed economic evaluation framework specifically designed to overcome the problems with CBA while preserving the positive aspects of this evaluation method (Mouter et al., 2019a). PVE involves citizens by asking them to 'advise' the local government as both co-owner of the government and consumer of the public goods. The involvement of citizens should result in transportation project realizations that do more align with citizens' needs. In particular, citizens were asked to decide about the allocation of a fixed amount of public budget towards transportation projects. Consequently, the novel setting of PVE should more accurately reflect citizens' expectations of what should be invested in with the government budget. The output of PVE is an 'optimal' portfolio of infrastructure projects, which maximizes the social welfare increase (Mouter et al., 2019a).

1.2 Interpretation of citizens' preferences

However, politicians cannot just apply the optimal portfolio presented by PVE as a final ranking device, because politicians need more information about the distribution of citizens' preferences to avoid wrong decisions in the first place (Nyborg, 2012). Secondary, politicians do not predominantly attach value to the preference of the average individuals but are more specifically interested in the preferences of groups of citizens that they could advocate for in the public debate. Ranking projects for an individual according to their desirability like PVE is an explicitly normative task, which refers to the phenomena among humans of designating an outcome as good and others as bad (Hammitt, 2013). These normative views differ among citizens (Nyborg, 2012). Politicians should understand the different views of citizens since PVE assumes all citizens to be co-owners of the government budget, and decision-making is not an individual authoritarian process (Mouter et al., 2019a; Nyborg, 2012). Based on this information, politicians could formulate their normative views and make a well-founded final decision.

However, PVE presents no more than these aggregated results, which does not provide any information about the distribution of views towards public projects among citizens (Nyborg, 2012). No information about the distribution of preference might risk incorrect interpretation of citizens'

preferences. For example, if 80 percent of the citizens prefer car traffic projects, while the other 20 percent prefer public transport projects, the aggregated results would only show the majority prefers that car traffic projects. According to the welfare analysis, using all the government budget for realizing these car traffic projects would result in a maximum social welfare increase. However, these results reflect the average welfare increase, which does not account for the (structural) loss for the other 20 percent. In general, the social welfare function only considers the net welfare increase, not the equal distribution of welfare (Kaplow, 2010). However, other evaluation methods like CBA are not able to provide this information either (Nyborg, 2012). A policy evaluation method should be able to cover for distribution and the extent of disagreement among citizens, which presents an accurate mix of needs for transportation projects do align with citizens' preferences.

Furthermore, the distributed preferences for projects might be related to citizens' background characteristics like preferred travel mode, political orientation, or living area. First, individuals might prefer better infrastructure for their preferred travel mode. For example, citizens who have the car as their favorite travel mode might prefer projects that improve the car traffic network. However, it could be the case these car drivers do not have an explicit preference for car projects and prefer public transport or active mode projects as well. In that case, project preferences are distributed among these car drivers as well. Secondly, individuals' political orientation that they believe is the best for their fellow citizens could reflect their preference for certain infrastructure. For example, environmentalism oriented individuals might prefer cycle projects that have minimal climate impact. Thirdly, individuals' living area and preference for project location might be related. Individuals could decide to allocate the budget to projects in their living area or equally distribute the budget over the region. Not the dominant relation nor the existence of any of the three considered relations towards the distribution of project preference is evaluated by previous studies yet. By disaggregating the results of PVE in homogenous groups, this study can explore a broad scale of distributions in citizen's preferences.

All in all, current aggregated results are not able to provide information about the distribution of preferences, which insights should be used for better facilitation of the democratic decision-making process. The decision-makers should understand the distribution of citizens' preferences, who are assumed to be all co-owners of the public budget (Mouter et al., 2018). However, considering all citizens' views separately would take much time from busy politicians (Nyborg, 2012). There is a need for a disaggregated as well as a structured output of PVE, which relative easily presents politicians the information about the distribution of citizens' needs. Subsequently, it is crucial to know how to apply this information in theoretical and practical decision-making about investments for new spatial-infrastructure projects.

The main goal of this study is to extend the results of PVE with more information about the distribution of preferences, which enables accurate interpretation of the results. Subsequently, the study reflects the implications of these distributions for spatial-infrastructure project evaluations from both scientific and policymaking perspective. In the end, the study contributes to achieve an optimal transport infrastructure for people and to make the best use of public budget, due to a better mix of transportation project realizations that align to the distributed needs of citizens.

1.3 The scientific and societal relevance

Three different kinds of scientific or societal relevance can be distinguished. The study provides theoretical insights, methodological reflections to PVE, and contributions in policymaking.

First, from a theoretical and scientific perspective, the study contributes to identifying distribution among individuals' preferences towards the allocation of government budget towards spatial

infrastructure projects. The study provides crucial background information to understand the conflicting preferences among citizens about the allocation of government budget towards transportation projects, which also creates the opportunity to debate the best infrastructure for people in a scientific way. Moreover, the analysis provides scientific insights to the extent of disagreement towards infrastructure projects of the citizen in general. Even so, the regional population could be more unanimous than expected in preferences towards transportation projects. Furthermore, the research explores if the distribution of project preference is related to citizens' background characteristics. As described, the project preference might be related to individuals' preferred travel mode, political orientation, or living area. The existence of these relations is not evaluated in the context of allocating government budget towards public infrastructure nor in general yet. In the end, the study shows the theoretical implications of distributed preferences towards spatial-infrastructure projects for the evaluation of these projects.

Secondly, from a methodological and scientific perspective, this study contributes to the further development of PVE as a project evaluation tool. The project characteristics preferred and relations with background characteristics validate, to some extent, the measurements of PVE as a methodology. Eventually, these results provide more insights into the choice behavior of participants in PVE. For instance, whether individuals rather advise to allocate the budget towards one travel mode or to distribute the budget equally over various travel modes. Furthermore, the study reflects the design and project selection within PVE. Apart from this, the analysis reflects which background characteristics PVE should correct for. For example, if individuals who prefer to travel by car just select car projects, car projects become more popular, the more car drivers participate. On the other side, if all participants just select projects that improve the mode they prefer to travel, an advanced evaluation method like PVE would not add significant value compared to relatively easy statistics about citizens' mode preference.

Thirdly, from a policy and a more societal perspective, the study contributes to the facilitation of citizens' preferences in policymaking. The results show which particular projects are highly valued among citizens. Politicians could use the result to find out whether their favorite project is supported and among which groups of citizens. Furthermore, understanding the different views among citizens helps politicians to define their normative views. The disaggregated and structured results provide background information. In the end, this study reflects the integration of the information provided about the citizens' distributed preferences in the decision-making process about spatial-infrastructure-projects.

As a derivative scientific and societal relevance, different interest groups are identified. The results are useful for actors representing a specific segment of the society, like interest groups or political parties. The disaggregated results show the preference of their interest group and what to advocate for in the public debate.

1.4 Research questions

The following main research questions are addressed in this study:

1. Which distributed profiles of preferences can be identified among citizens *using the Participatory Value Evaluation (PVE)* for public budget allocation to spatial-infrastructure projects?
2. How do experts review the implications of the identified distributed profiles of preferences among citizens for public budget allocation to spatial-infrastructure projects?

3. On the reflection of experts' view, what are the implications of the identified distributed profiles of preferences among citizens for public budget allocation to spatial-infrastructure projects?

1.5 Research strategy

So it is unknown to what extent individuals' preferences for the allocation of the government budgets towards transportation projects differ and what background characteristics are related to these differences. Based on this defined knowledge gap, this study tries to identify distributed profiles of preferences towards regional spatial-infrastructure projects among citizens. The data of the Participatory Value Evaluation is used to evaluate citizens' allocation of the public budget towards spatial-infrastructure projects.

Using a cluster structure is a suitable method to identify groups with a homogenous preference within the society. The homogenous groups represent individuals' preference patterns and the distribution of preferences among citizens. The method can structurally and transparently show the mix of individuals' preferences. The data of a PVE can be used for identifying groups. This study applies a cluster analysis of the data obtained as the output of a PVE experiment to present the distribution of citizens' views towards the allocation of infrastructure projects. A novel context of a traditional cluster method is illustrated, which contributes to the further application of a clustering method to structure citizens' preferences in a PVE.

One PVE experiment focused on regional transportation projects is used as a case study. The case study is used as a tool to answer the research question by showing how the results of PVE can be disaggregated and structured. First, the selected experiment for the case should be on a regional level, since transportation projects are predominantly developed on a regional level. Second, different travel modes should be available in the selected region to compare the preference for these modes and estimate the relation with individuals' mode preference. Third, the selected region should have a relatively large number of inhabitants to collect enough respondents. That is why the case study focused on transportation projects in the region of Amsterdam, which is carried out by Mouter et al. (2019b). The case study shows how a cluster analysis is applied to prove the concept of disaggregating and structure the output of a PVE experiment.

1.6 Structure of the report

First, the newly developed PVE method is discussed in more detail, and the limitations of the PVE method are described according to the theory of Nyborg in Chapter 2. At the end of Chapter 2, the sub-questions per each of the three main research questions are presented with the corresponding conceptual model. Chapter 3 presents the LCCA as methodology for quantitative analysis of distributed views, interviews as methodology for qualitative analysis of experts' reviews and the applied case study in Vervoerregio Amsterdam is described. Section 4 describes the univariate results and the ranking of the projects selected on average. Furthermore, the bivariate distribution of preferences among different classes of political orientation, favorite mode, and living area are presented in Chapter 4. The distributed clusters as a result of the LCCA are presented in Chapter 5 to show individuals with a homogenous choice pattern. After this, the findings of the cluster analysis are reviewed by experts' interviews, which empirical results are presented in Chapter 6. Chapter 7 reflects to the experts' reviews. Finally, chapter 8 provides the main conclusions of this study and Chapter 9 the main implications, limitations and suggestions for further research.

2. Participatory Value Evaluation

The first part of this chapter aims to present the idea of PVE in more detail and discuss the (dis)advantages of PVE by comparing the method to other evaluation methods. The first section describes the most relevant limitations of the traditional CBA that PVE overcomes. PVE is presented as an alternative perspective to evaluate infrastructure projects. Besides, PVE includes a balanced level of citizen participation compared to time-consuming participation in citizen panels. The first part ends with a critical reflection of the design of PVE. The second part reflects the outcome of the PVE, and two additional arguments are discussed why the result of PVE should cover for distribution in the decision-making process. The secondary aim of the second part of this chapter is to reason why and how PVE that covers for distribution should theoretically enrich the decision-making process. Based on the theoretical discussions, sub-questions are derived, which try to answer the main research question. Subsequently, a conceptual model for the research approach is presented.

2.1 Problems with CBA

CBA functions as a support for decision-making in the ex-ante evaluation of spatial-infrastructure projects (Jones et al., 2014; Van Wee, 2012; Thomopoulos et al., 2009; Asplund & Eliasson, 2016). The CBA is officially used to provide transparent information about the impacts of infrastructure projects. The government applies a CBA as a tool to decide about the extent of financial funding that is assigned (Mouter et al., 2013b). All social, environmental and economic impacts are monetized (Mackie et al., 2014). The positive and negative impacts created by a project are systematically weighed against each other to appraise the efficiency of policies, of which a human cognitive ability is limited because humans are even with the best intentions not able to evaluate the impacts unbiased (Kahneman, 2011). The main principle for the valuation is that the consequence of the project is worth what the population, in total, is willing to pay for it (Nyborg, 2012). Individuals' private willingness-to-pay is used to value the social welfare effects (Schläpfer, 2016). The presented monetary efficiency of a project has mandatory to be taken into account by decision-makers (Mackie et al. 2014). Besides the common use, the evaluation method has its limitations (Persky, 2001; Mouter et al., 2013a).

PVE is specifically designed to overcome the problems with CBA. Table 1 presents an overview of the relevant differences between CBA and PVE that cause the limitations that are discussed in this section. Other differences that cause limitations of CBA that PVE might overcome are discussed in Appendix A. This study compares the CBA with a *fixed budget* PVE. The fixed budget PVE assumes a fixed public budget is available for transportation projects. If the budget is not allocated this year, the budget is shifted to the budget available for infrastructure next year. A fixed budget does not allow for more or fewer taxes paid to alter the budget available for infrastructure projects or to allocate the shifted budget towards an alternative purpose.

Table 11 Overview of relevant difference between CBA and PVE method

	Cost-Benefit Analysis (CBA)	**Participatory Value Evaluation (PVE)**
Principle to monetize	Willingness-to-pay	Willingness-to-allocate
Budget evaluated from	Private after-tax income	Fixed public budget
Given approach	Should we finance a public good through private contributions?	Should the government allocate public budget to a project, to other projects or shift the budget to the next year?
Voting principle	One-euro-one-vote (OEOV)	One-person-one-vote (OPOV)
Individuals included	Affected individuals	All citizens who are 'co-owner' of the allocated budget

The CBA applies the private willingness-to-pay (WTP) principle to monetize all impacts. Gained travel time due to new infrastructure projects are monetized using individuals' private willingness-to-pay for time reduction, also known as the value of time (VoT). Additional increased social welfare effects like improved safety and reduction of noise pollution due to the projects are also monetarized using this private WTP (Annema et al., 2015). The private WTP is based on individuals' after-tax income, which reflects whether we should finance public goods through private contributions (Persky, 2001). However, studies stated that individuals' WTP based on private choices does not reflect their public choices. Individuals make different decisions with their private budgets compared to their expectations from the public budget (Mackie et al., 2001; Nyborg, 2012; Mouter et al., 2018). Consequently, the projects are evaluated from a different budget than realized, since transportation projects are realized from the public budget. Studies in a wide range of fields showed individuals' preferences using their private budget differs from their expectations from the public budget (Alphonce et al., 2014; Defila et al., 2018; Barr et al., 2011). For instance, individuals expect the government assigns more value to safety than they do as a user of the system. Individuals choose the fastest route as a user of mobility while recommending the local government to prioritize road safety (Mouter et al., 2018; Mouter & Chorus, 2016).

Furthermore, the CBA applies the one-euro-one-vote principle (OEOV) to evaluate welfare effects, which means the votes available to an individual depends on how scarce money is for that individual. Whereas, the principle one-person-one-vote (OPOV) results in majority voting (Nyborg, 2012). The OEOV principle of CBA assigns a higher weighted vote to individuals with a higher willingness-to-pay. For instance, if a majority votes for project *a*, while the minority who has a higher willingness-to-pay prefers project *b,* project *b* is ranked the highest by CBA. Eventually, individuals with a higher ability-to-pay have a higher weighted vote, which is not in line with the voting procedure in democratic political processes. A project should not be approved because individuals who would benefit are rich (Nyborg, 2012).

Additionally, the total welfare effects of a proposed project are determined by summing all individuals' welfare effects. Only individuals who are affected by the project are included in the welfare analysis of CBA (Persky, 2001). However, these are not all individuals where the public budget is intended for. Only including the affected people is not in line with the principles of democracy (Mouter et al., 2019b).

Because of the stated issues with the CBA, a new tool applying an alternative perspective could provide added value to the decision-making of transportation projects.

2.2 PVE to overcome the problems with CBA

PVE is a novel designed method to overcome the problems with CBA while preserving the advantages of the CBA. PVE creates more citizen participation and focusses on individuals' willingness-to-allocate instead of individuals' private willingness-to-pay. In PVE, individuals are asked to advise the local government as both co-owner and consumers of the system. Individuals have to select a portfolio of projects in their favor within the available fixed governmental budget. For each project, the societal impacts and corresponding price tags are presented. After they submitted their selection of projects, respondents were asked to motivate their choices (Mouter et al., 2018).

PVE could be used to present the optimal portfolio of projects according to the involved citizens. Furthermore, the result of PVE reflects whether to allocate the budget to a particular project or better shift the budget to the next year by presenting the net societal value of projects. Individuals are asked to allocate the governmental budget instead of making trade-offs with their after-tax income. Citizens are conceptual co-owners of the public budget (Mouter et al., 2019a; Schläpfer, 2016). The projects are evaluated in the same context and from the same budget as realized. Consequently, it is assumed that the approach of PVE directly and more accurately considers citizens' preferences for spatial-infrastructure projects.

It is assumed PVE applies the one-person-one-vote (OPOV) principle instead of the OEOV principle of the CBA. The OPOV assigns an equal-weighted vote to each person, which is in line with majority voting (Nyborg, 2012; Schläpfer, 2016). If the majority votes for project *a*, while the minority who has a higher willingness-to-pay prefers project *b*, project *a* is ranked the highest by the OPOV principle. PVE strives to social equity. People their ability-to-pay does not affect the project appraisal, which is *more* in line with the democratic political process (Nyborg, 2012).

PVE considers all citizens from the age of 18, having voting rights. All citizens are considered as co-owners of the public budget, of which the public infrastructure projects are realized. Both citizens who are affected by the project as those who are not, decide over the allocation of the public budget. Besides reviewing the effects which they will experience themselves, individuals have to review the effects experienced by others as well. Individuals have to make a trade-off between private and societal impacts of projects, which is in line with the democratic principles. However, making these trade-offs creates other challenges, which are described in the article by Mouter et al. (2019a).

2.3 Achievements of involvement

One of the main advantages of PVE is citizen involvement in public decision-making, which creates more legitimacy among citizens. PVE experiments resulted in the mass participation of citizens, which is quite uncommon for an evaluation tool (Mouter et al., 2019a). Citizens receive reliable information about actual projects, and participants have to trade-off real projects, of which they are expected to experience the consequences themselves. The severe implications of (dis)advantages should motivate participants to compose a well-considered portfolio and creates more sense of involvement. Furthermore, the participants of PVE take governmental budget constraints into account in their choice for a selection of projects, which creates awareness among citizens that not all projects could be realized. When PVE shows a strong preference for a particular policy, the results could be used as a statement in the stakeholder debate (Mouter et al., 2018).

2.4 Citizen involvement in citizen panels

PVE creates more direct citizen participation in the project evaluation compared to the traditional CBA. However, one of the alternatives to involve citizens are citizen panels. Public participation meetings are organized to allow local citizens to advocate for their position. Eventually, these citizen

panels are very time-consuming. The meetings are location and time-restricted. Several studies show that retired high-educated white men are mainly overrepresented at these meetings (Irvin & Stansbury, 2004; Day, 1997). Furthermore, those who strongly benefit from the project are often overrepresented as well. The 'silent majority' is not represented. Table 2 presents an overview of the issues with citizen panels and how PVE overcomes these issues. However, the citizen panel provides the opportunity to have conservations with citizens about their doubts and concerns. PVE partly fulfills this requirement by asking respondents to motivate their choice per project. However, the participants do not have the option to motivate why they are (strongly) against a project they did not select.

Table 12 Overview of relevant disadvantages of Citizen panels that are overcome by the PVE method

	Citizen panels	**Participatory Value Evaluation (PVE)**
Duration	Very time consuming	Easy to fill in and takes 20-30 minutes
Location	Time and location restricted	Where and whenever respondent wants
Amount of people	Small group	Large group
Representation	Overrepresentation of certain types of citizens	A more representative group of citizens
Restriction	No	Budget constraint

2.5 Participatory budgeting

PVE can be compared to Participatory Budgeting (PB) as well. Participatory Budgeting is a more or less comparable method to create citizen involvement. PB started in Brasil intending to understand the demand and requirements to develop poor neighborhoods, like water connections, street paving, or health centers (Franco & Assis, 2019). Neighborhood meetings per region of the city are organized, where forms are distributed per administrative neighborhood. The citizens of the neighborhood fill in one form together. The citizens have to indicate on the form the priority work for their neighborhood. The municipality receives the form, analyses the demand and evaluates the feasibility with the community (Cabannes, 2004; Franco & Assis, 2019). PVE is similar to PB in the sense that it allows for citizen-level participation, which is conducted by a public authority. However, PVE considers individual choices, while in PB an elected body represents the neighborhood. In PVE, all individual choices have equal weight, while the PB deliberates groups of citizens based on administrative neighborhoods. Besides, the PB meetings are repeated every two years, while PVE is a one-shot process (Sintomer et al., 2008). Therefore, PB is a suitable methodology to investigate the shortcomings per neighborhood. However, PB would, just like citizen panels, be time-consuming and result in an overrepresentation of retired high-educated white men, which makes the tool-less useful in Western cities. Table 3 presents an overview of the differences between PB and PVE.

Table 13 PVE compared to Participatory Budget

	Participatory Budgeting (PB)	**Participatory Value Evaluation (PVE)**
Frequency	Repeated on schedule	One-shot
Budget limit	Not specified	Budget specified per category
Level	Representative per neighborhood	Each individual of the neighborhood
Contact	Organized meeting per neighborhood	Online survey
Projects	Themes of need	Real projects with specified attribute values
Restriction	Ranking priorities	Budget constraint
Voting	Representative per neighborhood	One-person-one-vote (OPOV)

2.6 Design PVE

The experiments contain 'real' projects. In the setup of the PVE experiment, it is important to select the projects carefully. Participants have to make a trade-off among realistic projects. The number of proposed projects should be limited to make a reasonable trade-off as a participant. The impacts per project should be known, such as reduced travel time, additional traffic deaths, and additional noise pollution. First, a general overview of all projects, including a short title and the budget per project, is presented. Participants could select one project to read a more elaborate description of the project. Furthermore, the participants could select a few projects to compare the numbers of project-specific attributes, such as reduced travel time (Mouter et al., 2019b).

PVE offers participants the option to delegate their choice of projects towards one of the experts to avoid forced decisions. Participants who have ethical problems or perceive not having sufficient knowledge to choose by themselves could delegate their choice. In case the participant decides to delegate the choice, the participant has to decide towards which expert as well, for example, a transport consultancy or an academic in the field of transport. The experts base their choice on average impact values of each project (Mouter et al., 2018).

2.7 Limitations design PVE

As stated, the projects of PVE should be carefully selected in the design of a PVE experiment. It should be noted that the short title of the projects, which is the first impression, could influence participants' perception of a project. The framing of short titles could even result in misinterpretations of the project. For example, a hypothetical project titled 'pedestrian tunnel' could be interpreted as a solution for active traffic in terms of reduced travel time and increased safety. However, when a participant carefully reads the description, mainly the car traffic benefits because traffic does not have to wait for traffic lights. Due to the framing of titles, participants could be misled by the title of the project.

It is questionable if people make a rational trade-off between all the proposed projects. PVE asks participants to process such information. It is not clear to what extent participants process, read or make use of all the available information. Consequently, it is not clear whether participants make their choice based on project titles, elaborate project description or precisely compare all the attribute values; the choice behavior of participants is a black box. It is questionable if participants base their choice on attribute values, since the attribute values in the analysis of Dekker et al. (2019) are not significant, while the high project constants are also highly significant. Consequently, other project-specific characteristics could contribute as well. For example, participants might select projects in their neighborhood or transportation projects that improve the transport situation they frequently make use of. Apart from this, it could be the case participants prefer to promote a particular travel mode in the region or do prior regional transport safety. Altogether, it is unknown what project aspects are considered by participants to make up their choice.

Furthermore, PVE assumes that the more frequently a project is included in the portfolio of participants, the higher the probability the social welfare is improved by the project. However, PVE does not distinguish participants who did not select a project because it was not their first priority and participants that are (strongly) against a particular project. Some citizens might have a disadvantage by realizing the project. For instance, a new bridge that connects two neighborhood could result in reduced travel time for travelers that have to cross the river. However, inhabitants of these adjacent neighborhoods might not appreciate the new connection that results in additional traffic in their neighborhood. PVE does not provide any information about participants that are against a project

since there is no option to 'vote' against a project. PVE just shows the people that vote in favor, which presents a distorted view of the situation.

In addition, PVE assumes to involve all citizens the budget is intended for. However, this definition remains vague since it is hard to determine who these citizens are, especially in the field of transportation. So far, all citizens of the transportation region are included. However, citizens that work in the region are excluded, while these citizens might use the infrastructure of the region on a daily basis.

2.8 Output PVE

PVE directly applies the Social Welfare Function (SWF) to rank the public projects and show policymakers the optimal selection of projects within the available budget. Dekker at al. (2019) established an advanced choice model to analyze the best portfolio of projects according to the corresponding social welfare effects. Consequently, projects that are frequently selected by participants are more likely included in the best portfolio, under the condition the project fits in the available budget. The economic evaluation of policies is built on the multiple discrete-continuous extreme value (MDCEV) model. The model takes into account both private and public budget constraints. All individual choices are included in behavioral choice models. Economic theories are combined with behavioral choice models. In the end, the model represents the portfolio with the highest societal welfare value within the available budget. Through a sensitivity analysis, the results show under which conditions a project becomes socially (un)desirable (Mouter et al., 2019b). A sensitivity analysis could investigate the changes in portfolio ranking due to changes in project costs or project impacts. Respondents are not forced to use the total budget. This property allows evaluating whether a project is considered to be more attractive than shifting the budget to the next period (Dekker et al., 2019). The analysis reflects for each project the probability that a project improves societal value (Mouter et al., 2019b).

2.9 Limitations output PVE

The 'optimal' portfolio, according to the preferences of citizens, is an aggregated output that reflects the preference of the average citizen. A positive aggregated net benefit as a result of PVE does provide some information. Based on majority voting, the project has a positive effect. However, the result does not provide proof whatsoever that the project is uncontroversial or distributional concerns, which is essential for a well-founded decision-making process (Nyborg, 2012). Three problems with the aggregated results in decision making are exemplified.

Firstly, the aggregated average result does not account for the distribution of preferences or normative disagreement among citizens. Ranking the projects according to the social desirability like PVE is an explicitly normative task; one might designate a policy as desirable and others as undesirable. Attitudes and needs towards transportation projects might be distributed among citizens, of which the aggregated result does not provide any information (Cai et al., 2010). As illustrated in the introduction, in case 80 percent prefer car traffic projects, but 20 percent prefer public transport projects, the aggregated result would show allocating the entire budget towards projects that improve the car traffic network results in maximal welfare increase, which is the majority vote. Eventually, the aggregated result does not account for one's structural loss and the equal distribution of resources. It is important to at least be aware of these different normative views as a decision-maker to make a deliberate choice (Mouter et al., 2017b; Nyborg, 2012). An evaluation method like PVE should be able to show the information about this distribution.

Secondly, the fairness of a majority vote reflected by PVE is questionable in a democracy like the Netherlands. Deciding on the vote of the majority does not always result in ideal policy implications,

which is the so-called tyranny of the majority against the minorities (Nyborg, 2012). In a democracy, the government also has to take care of minorities with conflicting preferences and limited resources. In the case of the illustrating example, it would not be fair to allocate the entire budget towards projects that improve the car traffic network. The ethical responsibility of fairness creates a second argument of why an evaluation method should cover for distribution. If the evaluation method shows the distribution, it is up to decision-makers what is the fairest decision. However, the distributed results enable the decision-makers to consider the fairness implications of decision alternatives.

Thirdly, the aggregated results of PVE presents a final ranking, which is a conclusion. If politicians or decision-makers would just apply the aggregated result of a PVE as a final ranking device, politicians would be redundant.

''A list of aggregated results provides a conclusion, not a set of reasons; to make one's well-founded judgment, reasons are what one needs.'' (Nyborg, 2012)

Even with the best intentions on the policymakers' part, evaluation methods presenting an aggregated result may be poorly suited as input into a decision-making process, because of the lack of information on the distribution of preferences (Nyborg, 2012). These public conflicts of interest do occur in most public projects (Cai et al., 2010). Politicians need background information about these conflicts to understand and take part in the public debate. In the case of the illustrated example, politicians should at least understand the conflicting desires of which transport mode network should be improved. It is part of the political and democratic decision-making process to understand disagreement and allow for negotiations (Nyborg, 2012).

All in all, it is part of the decision-making process to understand the mix of normative views. In general, decision-making is not an authoritarian task, but there is a group of decision-makers. So politicians need more information than aggregated results. PVE considers all citizens as co-owners of the public budget and to take part in the decision-making process. However, considering each individual response would take too much time for busy politicians. Information about citizens their preference could be sufficient if reported by groups, provided that decision-makers agree that for everyone within a given group, welfare weights are equal (Nyborg, 2012). A structured overview would provide the needed background information to have both scientific as social conversations, which should result in a fair well-founded decision.

2.10 Phases of decision-making according to Nyborg

As reasoned in the previous section, the primary purpose of an evaluation tool is not to determine one factual ranking of projects that would reflect the majority vote, but rather to achieve a well-founded ranking in accordance with citizens' needs (Nyborg, 2012). The latter avoids distortion and unfair presentation of individuals' preferences by showing the distribution of citizens' views. Understanding the distribution allows for negotiations among decision-makers. Consequently, the evaluation method functions as a provision of background information to make a well-founded final decision (Nyborg, 2012).

Figure 1 provides a schematic overview of the decision-making process, including the results of the retrieved dataset by PVE as an input for the background information about citizens' normative views. The analysis phase is the contribution of this study.

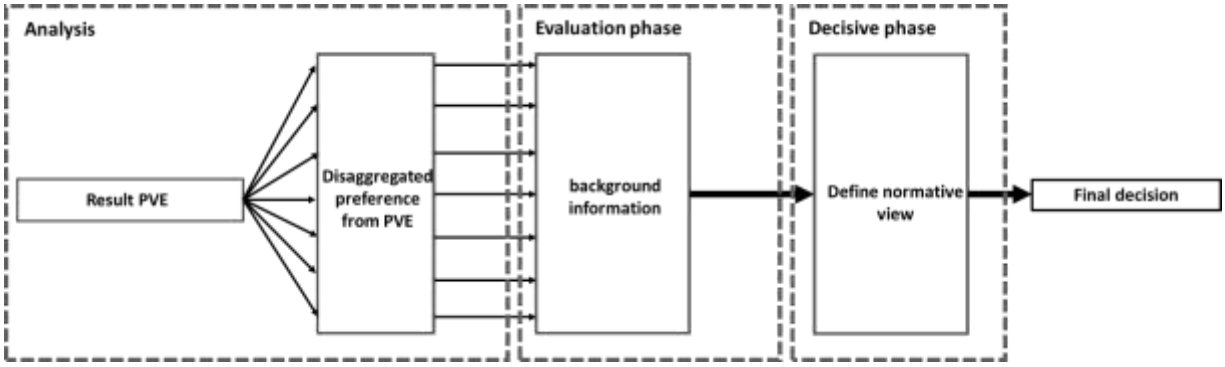


Figure 3 The phases of the decision-making process including the analysis phase as a contribution of this study (own work inspired by Nyborg (2012))

The decision-making process starts with the aggregated result of PVE. The aim of this study is to disaggregate the result of PVE and to provide structured information about citizens' preferences. The disaggregated results provide background information in the evaluation phase, which is the reason one needs (Nyborg, 2012). In traditional decision-making, there is a group of decision-makers. To feel a responsible decision-maker, you need actively make your own evaluation based on explicit reasons. The purpose of the evaluation phase is for the decision-maker to understand the others' normative views as a basis to define his own normative view (Nyborg, 2012). Since all citizens where the budget is intended for are co-owner of the budget, the purpose of the evaluation phase is to provide background information of the normative view of all these citizens. After processing all the normative views, the decision-makers have to define a normative view to forming a fair and well-founded final decision. The last phase is called the decisive phase by Nyborg.

2.11 Research questions

Citizens' preferences should be structurally presented to busy politicians and open the scientific debate about citizens' expectations of governmental budget allocations to spatial-infrastructure projects. It is assumed, the respondents make rational decisions based on provided project characteristics rather than randomly fill the budget. There might be groups of citizens with a homogenous preference of projects. This research tries to identify those homogenous clusters of citizens, determine to what extent their project preferences are conflicting, and if these are related to their background characteristics.

Various sub-questions are derived from the theoretical background in this chapter. The sub-questions together should provide an answer to the main research question. Again, the first addressed research question in this study is:

Which distributed profiles of preferences can be identified among citizens *using the Participatory Value Evaluation (PVE)* for public budget allocation to spatial-infrastructure projects?

First, the following questions should present whether groups with a homogenous preference could be identified based on the project characteristics of the PVE experiment. First of all, there might be individuals selecting the same combination of projects. Secondly, there might be citizens who prioritize the same quantitative attributes, such as the reduction in the number of traffic injuries. Thirdly, there might be citizens who prefer to allocate the budget towards projects improving the infrastructure of a specific travel mode.

1. Which cluster can be identified based on infrastructure project selection?
2. Which clusters can be identified based on quantitative project attribute preferences?

3. Which clusters can be identified based on preferences for transport mode that is improved by the project?

From a second scientific aspect, the distribution of preferred types of projects might be related to political orientation, favorite travel mode, or living area. First, political orientation explores if individuals are motivated by their general believes. For instance, if environmentalism oriented individuals are more likely to select projects having minimum environmental impacts, such as fewer trees cut for a project or stimulating environment-friendly travel modes like cycling. Secondly, favorite travel mode explores if individuals prefer to stimulate their preferred travel mode in the region, so they can make use of it. These individuals might feel satisfied when at least a substantial share of the budget is allocated to their preferred travel mode. For instance, individuals that travel by public transport might prefer public transport projects in the region. They could even feel disadvantaged when they perceive not a proportional part of the governmental budget is allocated to public transport projects in the region. Lastly, living area tests if project preference differs among citizens living in different areas. Citizens living in the city center might prefer cycle projects, while citizens living in more remote areas might rather prefer car projects. Furthermore, individuals might be attracted to select projects close to their living area because they are more likely to make use of it or better know these projects. These individuals might feel disadvantaged when they perceive more than proportional is allocated to other areas.

All in all, identifying to what extent these relations exist and which one dominates should show whether individuals' decisions in project selection are related to their political orientation, their preferred travel mode, or their preference of project realizations close to their living area.

4. To what extent does the political orientation of individuals affect the likelihood of belonging to a certain class?
5. To what extent does travel mode preference affect the likelihood of belonging to a certain class?
6. To what extent does individuals' living area affect the likelihood of belonging to a certain class?

The following questions answer whether the identified clusters based on project characteristics are related to other individuals' background characteristics, such as age and gender.

7. Which demographical groups most likely fit in a certain class?

Finally, the research tries to provide insights into the distribution of views among citizens. The following research question tries to answer the extent of contrary preferences among citizens

8. To what extent does the preference in terms of budget allocation to spatial-infrastructure projects differ among the identified clusters?

As a secondary research question, this study reflects the implications of the identified clusters. The results are externally reflected by experts to have a complete review of the implications. Again, the second addressed research question of this study is:

How do experts review the implications of the identified distributed profiles of preferences among citizens for public budget allocation to spatial-infrastructure projects?

The derived sub-questions tries to address the different fields of implications. First, the theoretical implications of the presented distribution of profiles by this study are addressed. The following

question should show experts' views about the implications and the desirability of the identified preference profiles for the evaluation of spatial-infrastructure projects.

1. How do experts reflect the implications of the obtained profiles of preferences for the evaluation of spatial-infrastructure projects?

Secondly, within PVE, all citizens the budget is intended for are considered as co-owner of the public budget and are included in the project evaluation. PVE can be applied to different levels of scale, for example, regional or a lower local municipality level. The following question should show experts' views about the fit of citizens' advice on a regional level.

2. How do experts reflect the fit of the level of scale for citizen participation?

Thirdly, it is described that PVE should overcome problems with the private WTP of CBA by applying the approach of the willingness-to-allocate with a fixed public budget. The following question should show experts' views to what extent the identified distribution underpins the performance of PVE as an evaluation method for new spatial-infrastructure projects.

3. How do experts reflect the identified profiles towards PVE as a new evaluation method for new spatial-infrastructure projects?

Fourth, as described, the design of PVE asks participants to process a lot of information. It is not clear to what extent participants process the provided information and how they decide what projects to select. The following question should show experts' views about the information provided to participants, selection of proposed projects and gathered information from participants in the PVE experiment.

4. How do experts reflect on the way the PVE tool is designed?

Lastly, the aim of the distributed results of PVE is to provide more information about citizens' preferences for spatial-infrastructure projects to policymakers. The following question identifies experts' reflections on the implications of these distributed results for policymaking and how PVE should enrich the decision-making process.

5. How do experts reflect the implications for policymaking and the integration of PVE into the decision-making process?

The statements made by experts are reflected. The aim is to identify whether the experts agree on implications and to what extent the statements are reasonable. Again, the third addressed research question of this study is:

On the reflection of experts' view, what are the implications of the identified distributed profiles of preferences among citizens for public budget allocation to spatial-infrastructure projects?

For the reflection of experts' views, the same structure as the five sub-questions of the second research question is applied.

2.12 Conceptual model

As stated, normative views differ among citizens. The project preference might be distributed among citizens. It is assumed individuals select a particular project because of the project-specific characteristics, such as safety implications or travel time savings. The preference or sensitivity for project characteristics might be related to individuals' personal prioritized themes in the field of transportation. For example, one might give priority to safety, while others rather prefer minimum

travel time. These individual infrastructure priorities might be related to citizens' background characteristics.

Besides these characteristics that are considered in this study, unobserved characteristics affect the project choice. This study identifies the relationship between the citizen characteristics towards the individual infrastructure priorities, which result in a project selection because of the preference for a certain project. Figure 2 shows the conceptual model of citizens' characteristics and the relation with the preference for a project.

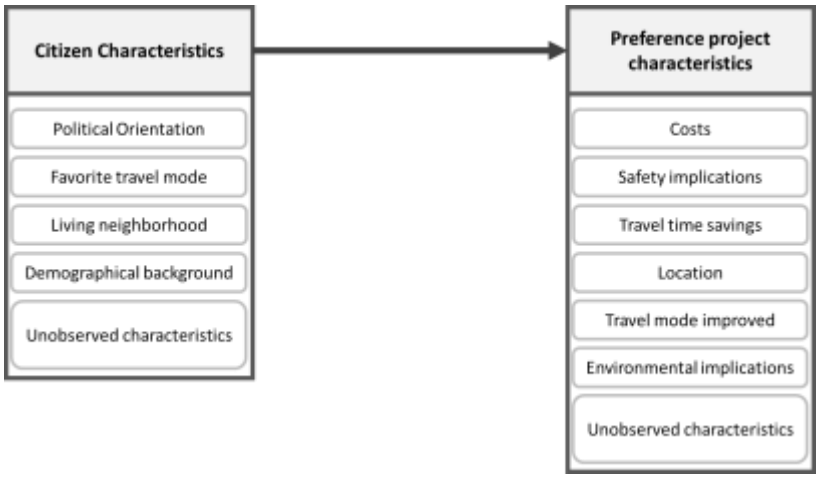


Figure 4 Conceptual model assuming project preference is related to preference for project attribute, which might be related to individuals background characteristics (own work)

The primary purpose of the analysis is to provide accurate background information about citizens' preferences for spatial-infrastructure projects. However, there are more applications for the identified background characteristics.

1. Clusters can be based on demographical groups like age, education level, or income. The preference of these clusters provides insights into the distribution of preferences in the public debate to satisfy the needs of these different societal groups.
2. Clusters can be based on preference for a particular travel mode. Some might prefer an improved public transport network because they like to travel by public transport. The interest of these specific groups is useful in particular for interest groups that represent travelers of one specific travel mode.
3. Clusters can be related to individuals' political orientation are useful for politicians to get insights on what to advocate for in the political debate.
4. Clusters can be related to individuals living area are useful for distribution of budget. Individuals living in the city center might have alternative mode preference compared to individuals living in rural areas. Insights might be useful for regional representatives.

3. Methodology

In this chapter, the applied methodology to answer the research question is stated. First, the scope of the experiment is presented, and the available dataset is described. The Latent Class Cluster Analysis (LCCA) is presented as a method to estimate a parsimonious model and structure the explored relations. Furthermore, qualitative interviewing is presented as a methodology to obtain experts' reviews. Subsequently, the applied case study in the region of Amsterdam (Vervoerregio Amsterdam) is described.

3.1 Scope & data

The study is focused on the Participatory Value Evaluation Method, which is meant for the ex-ante evaluation in the decision-making process. The data of one PVE experiment is used to show how the results of the PVE can be disaggregated and structured. As motivated in section 1.5, the data of the PVE experiment of Mouter et al. (2019b) in collaboration with Vervoerregio Amsterdam is used, which includes projects that improve 1) *Public transport*, 2) *Car*, 3) *Active modes*, 4) S*afety compliance, 5) Active mode safety*.

Participants were asked to advise the local government for the allocation of a fixed budget of 100 million euros. The participants could choose among 16 proposed transport-related projects, which had a total cost of 400 million euros. Respondents were collected via TNS NIPO panel using an online-survey. In total, around 2500 respondents filled in the survey.

Only citizens of Amsterdam from the age of 18 are included in the model to assume rational decisions., An introduction of the project and a mandatory movie to explain the questionnaire are included to avoid different perceptions among respondents. Respondents are directly asked to advise the regional government of Amsterdam (Vervoerregio Amsterdam).

Cluster analysis is applied to the data of the Participatory Value Evaluation experiment to analyze the hypothetical relations between the citizens, their background, and their preferred allocation of the budget towards the public projects in the field of transportation. The data set contains a lot of information about citizens' background characteristics, including favorite travel mode, political orientation, and living area.

3.2 Latent Class Cluster Analysis

A Latent Class Cluster Analysis (LCCA) is estimated to structure the model and reduce the number of estimated relations. Using the structure of LCCA is a suitable method to identify homogenous clusters. The LCCA maximizes the homogeneity within the clusters and the heterogeneity among the clusters. The principle of a LCCA is that a discrete latent variable accounts for the observed associations between a set of indicators. Conditional on this discrete latent class variable, the associations become insignificant according to the assumption of local independence. The LCCA is a statistical cluster technique that assigns individuals probabilistically to a cluster (Vermunt & Madigson, 2002). The clusters are based on response patterns, which enables to analyze the combination of projects selected by groups of respondents. Another advantage of LCCA is the mixed-scale variables that the model can accommodate, which enable the inclusion of both nominal and numeric variables. Furthermore, the LCCA presents the statistical criteria to choose the number of clusters (Kroesen, 2019). The statistical approach to determine the optimal number of clusters is explained in the next paragraphs. The clusters are estimated using the software Latent Gold. Latent Gold is a dedicated software package to estimate LCCA models (Vermunt & Magidson, 2005).

A LCCA is a useful method to show groups of individuals having a common choice pattern. These groups present clusters having a homogenous preference. First, a LCCA model like Figure 3 is estimated, including the indicators. The discrete latent class variable X accounts for the association between the indicators. Conditional on the latent class variable, the indicators are assumed to be independent. For example, a theoretically model including mode preference as indicators, presenting clusters having a strong preference for car projects and another for public transport.

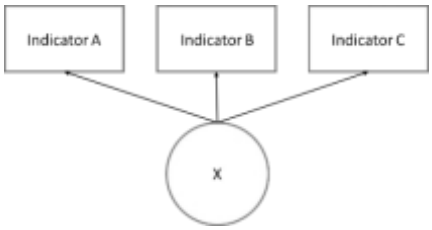


Figure 5 Latent Class model with three indicators and latent class cluster variable X

The model, just including indicators, is the measurement part of the model. In order to asses only the measurement part of the model, models are first estimated without covariates to determine the optimal number of clusters (Molin et al., 2016). Two types of criteria are used to determine the optimal number of clusters. The prior used method to access model fit in case of sparse data is the Bayesian Information Criteria (BIC), which weights both model fit and parsimony in terms of the number of estimated parameters (Molin et al., 2016). In case the BIC value indicates a high number of clusters that is too complex to communicate, multiple local (instead of global fit) measures of model fit are used to determine the optimal number of classes, which are the bivariate residuals (BVR) (Molin et al., 2016). The BVR's were estimates of the improvement of model fit when a direct effect between to indicators was included. The BVR's are chi-squared distributed with one degree of freedom. Therefore, BVR's with a higher value than 3.84 indicates a significant covariation remains between a pair of indicators (Vermunt & Magidson, 2005). The highest value of BVR and the number of BVR's higher than 3.84 are included in determining the optimal number of classes.

Subsequently, the model is expanded by adding covariates to the model, which is the structural part of the model. Figure 4 shows the theoretical LCCA model, including indicators and covariates. Each individual is assumed to have a certain probability of belonging to each class, which depends on the characteristics of the individual. These observed characteristics are called covariates. Examples of typical covariates are socio-demographic variables (Molin et al., 2016). For example, a theoretical model, including age as one of the covariates, could be used to show the elderly having a preference for public transport. The effects of the covariates are obtained by controlling for other covariates in the model (Molin et al., 2016).

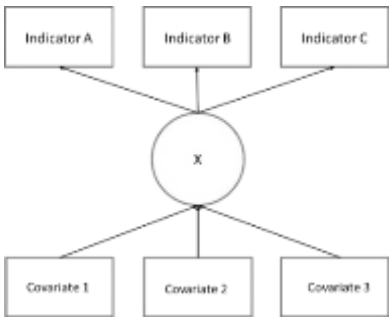


Figure 6 Latent Class model including covariates

Finally, the Wald statistics are used to determine whether the indicators and covariates within the LCCA model are significant. The Wald statistics and corresponding p-value are presented for all indicators and covariate parameters. The corresponding p-values assess whether or not the scores differ significantly for a certain indicator or covariate across the clusters (Vermunt & Magidson, 2005). In this study, the traditional value of 5 percent is used.

3.3 Interviews with experts

The second research question tries to provide insights on how experts reflect on the findings of the cluster analysis. These insights are conducted by personal interviews with experts. The findings of the quantitative results are presented to experts to review the implications and whether these are desirable or not, according to these experts.

The results are reflected from different perspectives; scientific PVE expertise, scientific CBA expertise, and policymaking expertise. By approaching both PVE and CBA expertise, the review should be unbiased. Policymaking expertise should help to identify practical implications for policymakers and how policymakers deal with these implications in practice. Figure 5 presents the triangle of different points of view that are approached by interviews. The purpose of the interviews differs to some extent per covered perspective, which is presented in Table 4.

Figure 7 Triangle of perspectives towards findings in the cluster analysis carried out (own work)

Table 14 Purpose of the interview for each perspective

Perspective	**The main purpose of the interview**
Scientific PVE expert	Implications scientific research and PVE as an evaluation tool compared to traditional CBA from a scientific PVE expertise's perspective.
Scientific CBA expert	Implications scientific research and PVE as an evaluation tool compared to traditional CBA from a scientific CBA expertise's perspective.
Policymaking expert	Implications policymaking and how to deal with these implications as a policymaker.

The structure of the interviews is established regarding the results of the interview and focused on the implications of knowing the results of the cluster analysis. Consequently, the setup, introduction of the interview and concrete questions are presented in Chapter 6. The following topics are reviewed in the interviews, which reflect the implications in different fields while knowing the results of the cluster analysis.

1. The desirability of implications caused by clusters shown by analysis
2. Evaluate the scale of the experiment
3. PVE compared to CBA
4. Design PVE
5. Policy implications

An interview with a scientific PVE expert, a scientific CBA expert and two interviews with two policymakers were conducted. Two interviews were conducted with policymakers of alternative departments; one department that focuses more on gathering information for policymaking and another department that focuses more on judging information for policymaking. For each of the four interviews, one hour was available in total.

3.4 Case study: Vervoerregio Amsterdam

As described, the data of a PVE experiment in the region of Amsterdam is applied as a case study. The project is set up by Mouter et al. (2019b) in collaboration with the Vervoerregio Amsterdam, the Transport Authority of Amsterdam (TAA). The design of the tool is presented in Appendix B. In total, 16 projects were selected in consultation with the program managers of the four different Investment agendas; Road, Public Transport, Cycling, and Safety. Of each investment agenda, 3 up to 5 useful projects were selected. The projects focus on improvement in public transport, active modes, car, active mode safety, general safety or a combination of these. Table 5 presents an overview of the selected project and the corresponding costs in millions. Figure 6 presents the geographical location of all projects, including the travel mode improved by the project; note projects 15 and 16 are safety compliance projects within the whole region. Therefore no precise location is indicated in the figure.

Table 15 The 16 project included in the PVE experiment selected in collaboration with Transport Authority Amsterdam (TAA) (Mouter et al., 2019b)

Nr.	Costs	Project description
1	50	Faster connection bus and car traffic Zaandam
2	3	Ilpendam pedestrian tunnel
3	40	Fly-over A10 at junction Amsterdam Noord
4	10	Extending the MacGillavrylaan to Middenweg
5	10	Widening the Bovenkerkerweg to 2 lanes per direction
6	50	New bus connection Ijburg – Bijlmer Arena
7	5	Acceleration of the bus connection Amsterdam CS – Zaandam
8	15	Improvement tram connection Diemen- Linnaeusstraat
9	8	Cycling highway Hoofddorp – Schiphol – Aalsmeer
10	6	Cycling highway Amstelveenseweg
11	4	New bridge for cyclists and pedestrians Purmerend (Hoornselaan)
12	40	Guisweg bike tunnel
13	35	New cycling bridge Zeeburg
14	40	Stadhouderskade car tunnel at the entrance of the Vondelpark
15	50	Traffic education for children in the age group 4 – 18
16	20	Five police officers sanction violation of traffic regulations

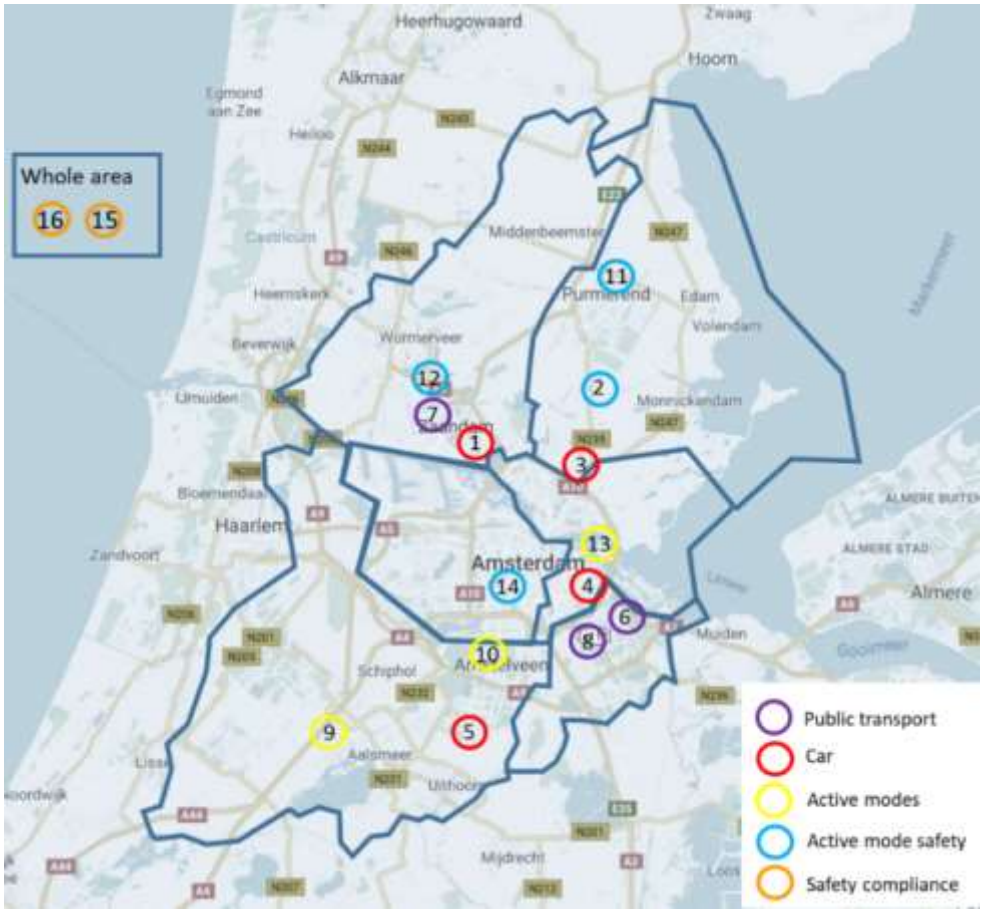


Figure 8 Geographical representation of the 16 selected projects, including the mode that is improved by the project. Note that project 15 and 16 have no specific location (own work)

The survey starts with a general introduction and a short movie to explain the idea of the survey. A demo version can be found on http://www.burger-begroting.nl. Thereafter, all the project titles are presented in an overview. Participants could select one project for more information about the content of the project and the corresponding attributes of the project. The more elaborate description and specific impacts of a project are established in consultation with the program managers, the municipality of Amsterdam and SWOV. The specific values of the following attributes are presented for each project:

- Number of travelers with reduced travel time on an average working day
- Average minutes of travel time gained by travelers
- The average reduction of traffic injuries
- The average reduction of traffic deaths
- Increased number of households that experience noise pollution
- Number of trees that have to be cut

Participants could select a few projects to compare these projects. An overview of the selected projects and the corresponding attribute values are presented, as presented in the screenshots in Appendix B. Participants have to select an optimal portfolio of projects in their favor within the available budget or delegate their choice to one of the experts. After selecting their perceived optimal portfolio of projects, participants have to motivate their choice per individual selected project. Furthermore, some questions about the perceived usefulness of the experiment and demographical

background are added to the survey, including the political orientation, individuals' zip code and preferred travel mode.

The large dataset contains the data of four experiments. Two experiments had a fixed budget. In the other two experiments, participants could alter the budget. Only the data of the experiments with a fixed available budget is used for the analysis (experiments 1 and 4) to guarantee an equal trade-off among participants. Table 6 presents an overview of the experiment overview.

Table 16 Setup four experiments by Mouter et al. (2019b)

	Multiple designs	**1 design**
Fixed available budget (selected)	Experiment 1	Experiment 4
Flexible available budget (not selected)	Experiment 2	Experiment 3

In experiment number 1 and 2, multiple designs for project attribute values are applied. In other words, the attribute levels differ per design. Each participant received one of the 64 designs. In experiment number 3 and 4, all participants received the same design. The latter could avoid a perceived disadvantage for respondents which neighbor has an alternative survey design. However, the design of attribute values does not affect the approach of budget trade-off. In both experiments, participants had a fixed governmental budget to allocate.

4. Univariate and bivariate results

In this chapter, descriptive statistics are presented. First, the available dataset is described. The representativity of the sample is tested, and the average ranking of projects is presented. Subsequently, the bivariate results are presented, showing the statistics of project selection per category of living area, favorite travel mode, and political orientation.

4.1 Data description

In total, 2498 inhabitants of the Vervoerregio Amsterdam participated the project, whereof 742 participated in experiment 1 with multiple designs, and 301 participated in experiment 4 with one fixed design. The number of participants shows a mass-participation of the experiment. This chapter describes the characteristics of the sample and the representativity of the sample for the population of Vervoerregio Amsterdam. In the end, the average preference for projects is described by presenting the frequency each project is selected. The numbers per region provided by CBS and statistics provided by Gemeente Amsterdam are used to determine the representativity of the sample according to the population of Vervoerregio Amsterdam in 2018 (CBS, 2019; OIS Gemeente Amsterdam, 2019).

First, the dataset is cleaned. Individuals shifting the full budget to the next year by not selecting any project are excluded from the dataset. These responses are assumed to be outliers since no utility trade-off can be retrieved from these observations for the evaluation of what kind of spatial-infrastructure projects are preferred by citizens. In total, 6 respondents were removed and excluded from the dataset. Consequently, 1037 number of observations were used for the analysis.

4.2 Representativity

Table 7 shows the distribution of demographical characteristics in the sample and the expected distribution according to the population of Vervoerregio Amsterdam. The statistical tests show a significant difference, which implies the sample is not representative of each of the demographic characteristics. The distribution shows an overrepresentation of inhabitants having an age between 45 and 80 years. Furthermore, males are, to some extent, overrepresented and the average income is significantly higher. The education level is not available on a regional level. Therefore, the education level is compared to the distribution on the national level, which shows high educated individuals are overrepresented.

For the living area, the Vervoerregio is divided into 6 areas based on project locations, local municipalities in the Vervoerregio and the distinct neighborhoods of Gemeente Amsterdam. The number of areas is reduced to 6 to limit the number of additional parameters in the analysis in chapter 6. The space of the areas is determined based on municipalities' and city districts' distinction in combination with project locations to determine which area a project belongs to. The municipalities' and city districts' distinction is presented in Appendix C. Figure 7 presents an overview of the geographical areas within the region, including the project locations. Table 8 shows which municipalities or neighborhoods of Amsterdam belong to each area. The short title based on the largest city or municipality of the area is used for clear interpretation and presentation of the results. Table 7 presents the number of inhabitants per living area and the expected number according to the population for the living area as well. The statistical test shows the sample is not representative of the living area. The distribution shows an overrepresentation of area A (Zaanstad) and E (Amsterdam Zuid-Oost) and underrepresentation of area C (Amsterdam West) and area D (Amsterdam Oost).

Table 17 Representativity sample compared to population Vervoerregio Amsterdam for age, gender, income, education and living area

Demographic variable	Categories	Distribution sample (%)	Expected according to population (%)	Statistical test	
Age	18-25	4.53	8.97	**Response rate**	100%
	25-45	26.81	38.86	**Chi-Square value**	171.06
	45-65	41.85	33.37	**Df**	4
	65-80	24.69	14.46	**p-value**	0.00
	80+	2.12	4.34		
Gender	Male	54.97	48.99	**Response rate**	100%
	Female	45.03	51.01	**Chi-square value**	13.43
				df	1
				p-value	0.00
Income	Average (x €1000)	46.57	41.96	**Response rate**	99.94%
				t-value	3.83
				p-value	0.01
Education	No/elementary education/LBO/VBO/VMBO	7.86	8.34	**Response rate**	99.42%
	MAVO/VMBO/MBO1	8.68	19.30	**Chi-square value**	233.81
	HAVO/VWO/MBO2,3,4	28.45	38.99	**Df**	4
	HBO/WO bachelor	33.46	21.14	**p-value**	0.00
	WO master	21.02	12.22		
Living area	A	15.12	6.80	**Response rate**	82.26%
	B	9.61	10.90	**Chi-square value**	130.26
	C	31.89	40.09	**Df**	5
	D	13.13	17.58	**p-value**	0.00
	E	20.52	14.89		
	F	9.85	9.73		

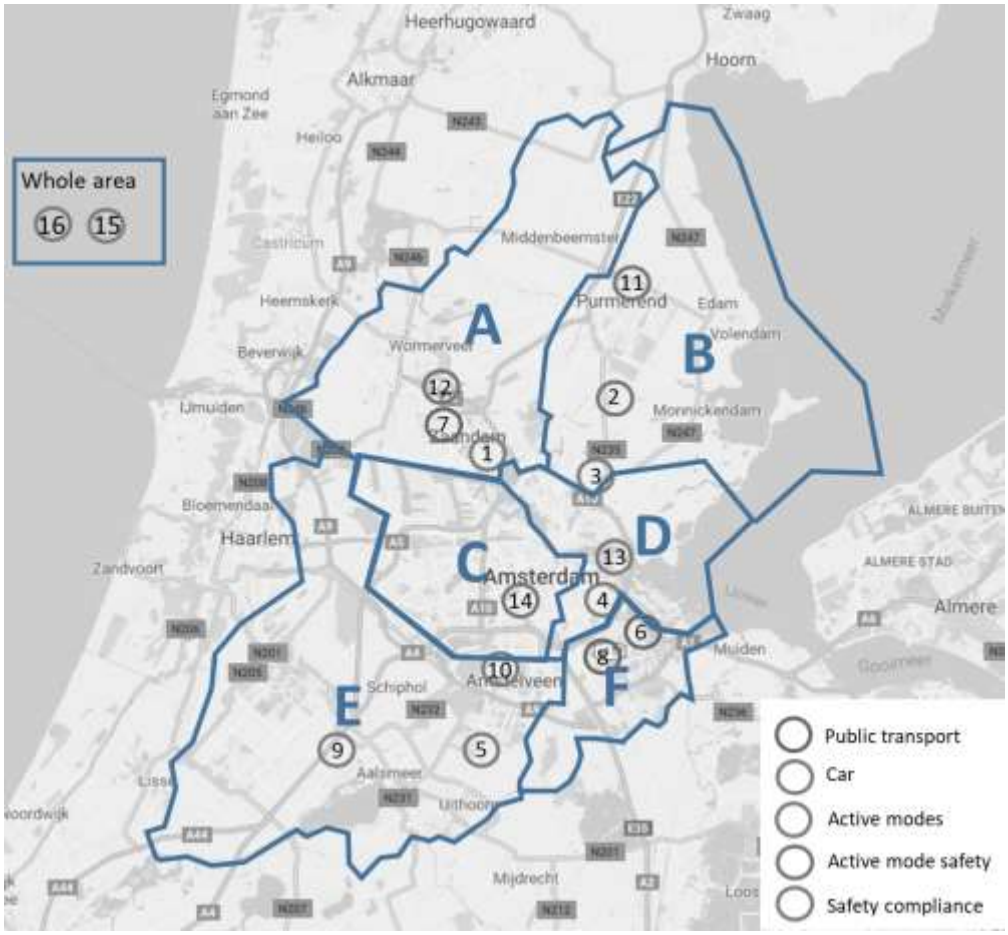


Figure 9 Geographical classification of areas (own work)

Table 18 Municipalities and neighborhoods that belong to each area and short title used in the report

Area	Title	Municipalities and city districts
A	Zaanstad	Beemster, Oostzaan, Wormerland, Zaanstad
B	Purmerend	Edam-Volendam, Landsmeer, Purmerend, Waterland
C	Amsterdam West	Amsterdam West, Amsterdam Nieuw-West, Amsterdam Centrum, Amsterdam Zuid
D	Amsterdam Oost	Amsterdam Oost, Amsterdam Noord
E	Haarlemmermeer	Aalsmeer, Amstelveen, Haarlemmermeer, Uithoorn
F	Amsterdam Zuid-Oost	Amsterdam Zuid Oost Bijlmermeer, Diemen, Ouder-Amstel

4.3 Conclusion representativity

As stated in section 2.4, the PVE should result in high participation and the respondents should be more representative compared to citizen panels. The first statement is true; the PVE experiment resulted in mass participation. However, the sample distribution is not representative of one of the background variables to the population of Vervoerregio Amsterdam. However, the univariate analysis shows for each background variable that in spite of the representativity, all classes are presented in the experiment, while in citizen panels, some societal segments are entirely missing. All in all, the respondents are more representative compared to citizen panels.

The overrepresentation of some classes should be taken into account by interpretation of the results. For instance, when a certain project is significantly more popular among a certain class of the society,

which class is overrepresented in the experiment, the project is probably less popular than the average results show. Consequently, the final interpretation should correct for the representation of background characteristics that significantly affect project preference.

4.4 Sample response favorite travel mode

Individuals are asked about their favorite travel mode on a daily basis. Table 9 presents the distribution of favorite travel modes among respondents. All travel modes are presented in the sample. Most respondents have a bike as their favorite travel mode. Further analysis should show if the favorite travel mode is related to project preference. If favorite travel mode is strongly related to project preference, mode distributions in the sample should be reconsidered in the general preference for a particular project. For instance, when bike projects are strongly preferred by bike users, the share of bike users participating in the experiment should be reviewed.

Table 19 Distribution of favorite mode

Mode	Distribution sample (%)
Bike	36.84
Car	32.88
Public Transport	19.19
Other	5.69
No answer	5.40

4.5 Sample response political orientation

The political parties are categorized into five tendencies, according to the Parliament Documentation Center (Parlementair Documentatie Centrum, 2019) presented in Table 10. The table shows the distribution of respondents per political orientation. Each political tendency is presented in the experiment. The leading tendency is liberalism, followed by social democrats and environmentalism. The social democrats and environmentalism tendency are both left-wing orientations. The Christian Democrats and Liberalism are both more right-wing orientations. Eventually, the experiment contains a more or less equal distribution between left and right-wing political orientation. No statistical test is carried out since individuals' preference for a political party could vary over the years. However, if political orientation strongly affects individuals' project preferences, the distribution of political orientation should be reviewed.

Table 20 Classification political orientation and distribution within the sample (Parlementair Documentatie Centrum,2019)

Political orientation	Political parties	Distribution sample (%)
Liberalism	VVD, D66	27.77
Social Democrats	SP, PvdA, DENK, 50+	20.25
Environmentalism	GroenLinks, PvdD	18.13
Not Voted	-	8.39
Christian Democrats	CDA, SGP, CU	7.62
PVV/FvD	PVV, FvD	6.36
Other parties	-	1.83
No answer	-	9.64

4.6 Project selected providing the average results

Table 11 presents an overview of the frequencies of respondents that included a particular project in their portfolio. The table shows the total results, which reflect which projects are on average the most popular and which are less popular. All projects are selected by between 10 and 40 percent of the total respondents, which suggests an interest group for all projects.

Table 21 Number of times a project is selected

Nr.	Costs (million €)	Project description	Frequency selected (#)
2	3	Ilpendam pedestrian tunnel	432
14	40	Stadhouderskade car tunnel at the entrance of the Vondelpark	407
4	10	Extending the MacGillavrylaan to Middenweg	391
11	4	New bridge for cyclists and pedestrians Purmerend (Hoornselaan)	382
16	20	Five police officers sanction violation of traffic regulations	382
9	8	Cycling highway Hoofddorp – Schiphol – Aalsmeer	362
7	5	Acceleration of the bus connection Amsterdam CS – Zaandam	361
10	6	Cycling highway Amstelveenseweg	349
15	50	Traffic education for children in the age group 4 – 18	328
5	10	Widening the Bovenkerkerweg to 2 lanes per direction	286
13	35	New cycling bridge Zeeburg	258
8	15	Improvement tram connection Diemen- Linnaeusstraat	253
3	40	Fly-over A10 at junction Amsterdam Noord	210
12	40	Guisweg bike tunnel	185
1	50	Faster connection bus and car traffic Zaandam	112
6	50	New bus connection Ijburg – Bijlmer Arena	104

Table 12 presents the characteristics of the top 5 on average most popular projects. It is remarkable, 3 out of the 5 most popular projects improve active mode safety. The project with the lowest project costs of all proposed projects is the most popular, which is not surprising since the project relatively easily fits in the budget of 100 million. However, relative expensive project Stadshouderskade number 14 is also one of the highest ranked projects. The top 5 ranked projects are located in areas B, C, and D; Purmerend, Amsterdam West and Amsterdam Oost. The precise location of the projects is presented in Figure 8.

Table 22 Top 5 most popular projects and its characteristics

Ranking	Project nr.	Project costs	Project description	Improved travel mode	Area located
1	2	3	Ilpendam pedestrian tunnel	Active mode safety	B
2	14	40	Stadhouderskade car tunnel at the entrance of the Vondelpark	Active mode safety	C
3	4	10	Extending the MacGillavrylaan to Middenweg	Car	D
4	11	4	New bridge for cyclists and pedestrians Purmerend (Hoornselaan)	Active mode safety	B
5	16	20	Five police officers sanction violation of traffic regulations	Safety compliance	-

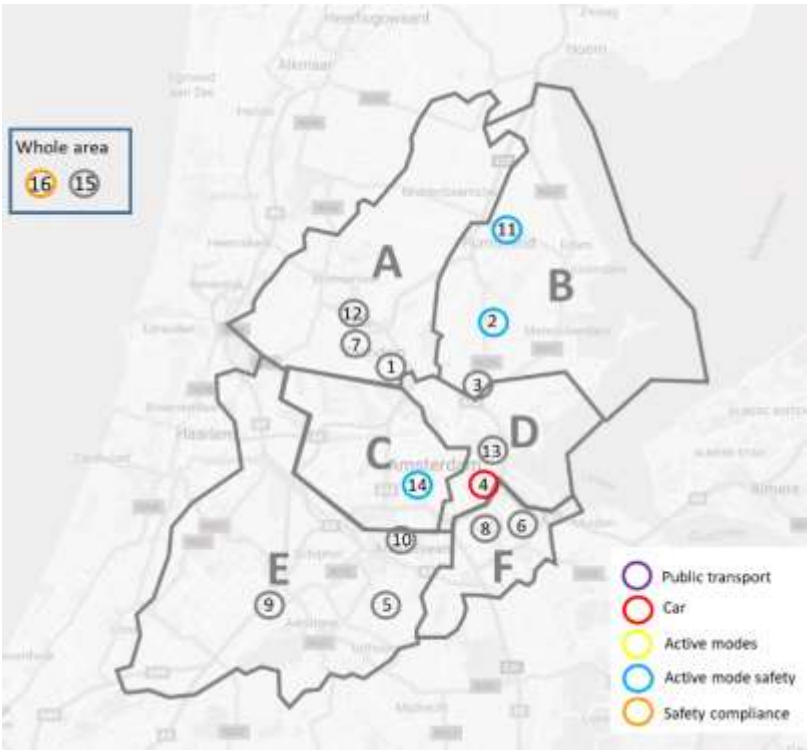


Figure 10 Top five most popular projects (on average) are colored (own work)

Further analysis of the descriptive data using Excel pivot tables is used to show the characteristics of individuals that selected a particular project. An overview of the characteristics of the respondents of the three most popular projects is presented in Table 13. It is remarkable that the main living area of the respondents corresponds to the area that the project is located in for all projects in the top 3. These results suggest a relation between individuals living area and project location. Individuals seem to prefer projects within their living area. Furthermore, the favorite travel mode corresponds to project 2 and 4 with the mode improved by the project, which suggests project choice is, to some extent, related to the favorite travel mode. In addition, the specific class of age, car ownership, education level, and political orientation preferring a project differs per project, which suggests a relationship between these individuals' characteristics and the project choice as well. No specific income class is overrepresented.

Table 23 Dominant characteristics of the respondents of the three most popular projects (empty cells indicate no particular category predominantly selected the project)

Project number	Living area	Favorite travel mode	Age	Income	Car owner	Educated	Political orientation
2	B	Car/Bike	Eldery	-	Yes	-	Christen Democrats
14	C	-	Young	-	-	High	Environmentalism
4	D	Car	Middle	-	Yes	-	-

4.7 Bivariate results for the living area, favorite mode, and political orientation

To identify whether the living area, favorite travel mode or political orientation is related to project preference, bivariate statistics are presented as a first analysis. Section 4.6 showed that the characteristics of the most popular projects correspond with the characteristics of the respondents that predominantly selected the project. In particular living area corresponds to all the most popular

projects with the area the project is located in. However, there seems to be a relation to some extent with favorite travel mode and political orientation as well. This section shows the bivariate relation of each of the characteristics separately.

The statistics presented in this section show the percentage per class of each characteristic selecting a particular project, which reflects the preference for a project within the group of respondents belonging to the category. The relative preference for a project is presented instead of the absolute number of respondents that selected the project, because of the unbalanced response per category, such as for living area, area C has more than three times as many inhabitants as area F. An illustrating example, when 50 out of 50 within a living area select a project, the project is more prefered among individuals belonging to this category compared to 50 out of 250 selecting a project. Consequently, relative percentages show a more clear distribution of project preference.

4.7.1 Living area

Figure 9 shows the project number and the percentage that selected the project 1) within the own area, 2) neighboring areas and 3) far off areas within the Vervoerregio Amsterdam. The neighboring areas are determined by the location of the project within the area and the areas that are close by the projects. For instance, for project 11, area B (Purmerend) is the own area, area A (Zaanstad) is a neighboring area and the other areas are far off. Project 15 and 16 are not included in the graph since these projects do not have a specific location.

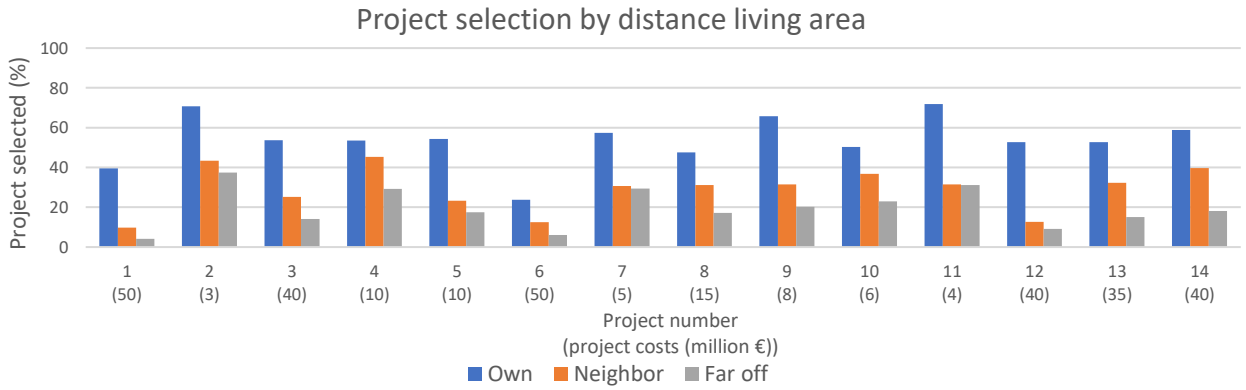


Figure 11 Project choice per project by 1) own region 2) neighbor region and 3) far off regions

Figure 9 shows all projects are predominantly selected by inhabitants of the area the project is located in. In particular, projects 1, 3, 5, 9, 11, and 12 are predominantly selected by inhabitants of the own area, which are located in areas A (Zaanstad), B (Purmerend), and E (Haarlemmermeer). Projects 1,3, and 5 are car projects. Projects 5,9,11 and 12 are relatively located in the outskirts of the region, and projects 1, 3, and 12 are one of the most expensive projects in the selection. In conclusion, the distance from individuals' living areas is probably negatively related to project preference. The effect remarkably occurs, the more expensive or remote located projects are. Furthermore, car projects in far off regions seem less popular compared to other modes proposed in far-off areas.

4.7.2 Favorite mode

In this study, it is assumed each of the projects included in the case study improves one travel mode. However, some projects improve a combination of projects. For example, the first project improves public transport and the car traffic network. However, predominantly car traffic benefits. Consequently, the project is classified as a car project. Table 14 shows the project classification of all projects, which correspond to the classification shown in the map of Figure 6 in section 3.4.

Table 24 Improved travel mode classification per project

Nr.	Costs	Project description	Improved travel mode
1	50	Faster connection bus and car traffic Zaandam	Car
2	3	Ilpendam pedestrian tunnel	Active mode safety
3	40	Fly-over A10 at junction Amsterdam Noord	Car
4	10	Extending the MacGillavrylaan to Middenweg	Car
5	10	Widening the Bovenkerkerweg to 2 lanes per direction	Car
6	50	New bus connection Ijburg – Bijlmer Arena	Public Transport
7	5	Acceleration of the bus connection Amsterdam CS – Zaandam	Public Transport
8	15	Improvement tram connection Diemen- Linnaeusstraat	Public Transport
9	8	Cycling highway Hoofddorp – Schiphol – Aalsmeer	Active modes
10	6	Cycling highway Amstelveenseweg	Active modes
11	4	New bridge for cyclists and pedestrians Purmerend (Hoornselaan)	Active mode safety
12	40	Guisweg bike tunnel	Active mode safety
13	35	New cycling bridge Zeeburg	Active modes
14	40	Stadhouderskade car tunnel at the entrance of the Vondelpark	Active mode safety
15	50	Traffic education for children in the age group 4 – 18	Safety compliance
16	20	Five police officers sanction violation of traffic regulations	Safety compliance

Figure 10 presents per group that has the car, PT, or bike as their favorite travel mode, the percentage that selected a car, PT or active modes project. The horizontal axis shows the project number and the mode that is improved by the project. The active mode safety and safety compliance projects are excluded in the graph since these are no available favorite travel modes that individuals can use. The distribution shows most car projects are most popular among individuals who prefer to use the car, PT projects among individuals who prefer to travel by PT and active mode projects among individuals who prefer to travel by bike. So the mode improved by the projects corresponds to the favorite travel mode of the group of individuals predominantly selecting the project. However, the extent of the differences per project between de modes is relatively low. In conclusion, the results suggest to some extent, a correlation between individuals' favorite travel mode and mode improved of selected projects. Further cluster analysis should test the extent of the direct relation and correct for indirect correlation, among other background characteristics like the living area.

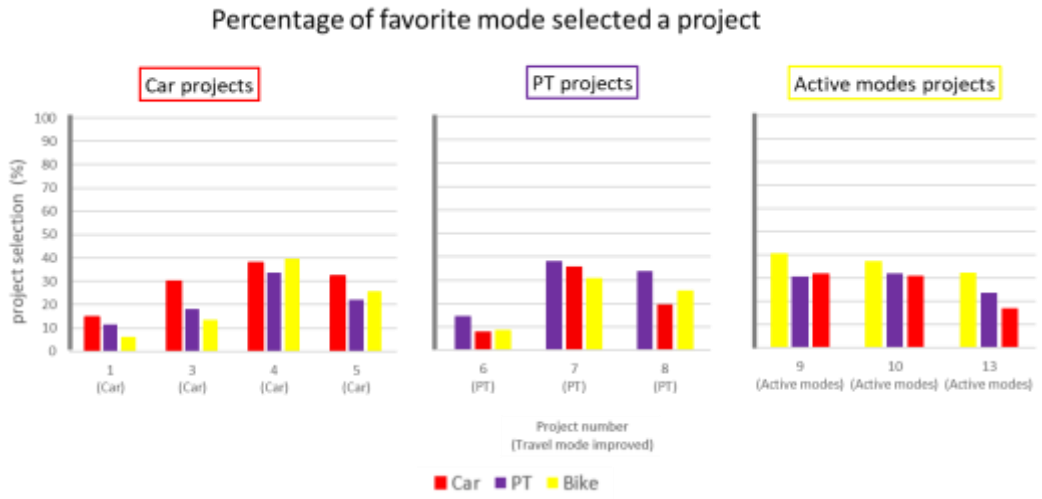


Figure 12 Project choice per project by individuals having 1) car, 2) bike or 3) PT as their favorite mode

4.7.3 Political orientation

Figure 11 presents an overview of project selection per political orientation class. The distribution shows projects 2 and 11 in area B (Purmerend), projects 5 and 9 in area A (Zaanstad) and traffic education is relatively frequently selected by Christen Democrats. Projects within the city of Amsterdam are less frequently selected by the Christen Democrats. The Social Democrats and Liberals do not seem to have a particular preference. However, projects in area E (Haarlemmermeer) seem the least popular among Social Democrats and PT, the least popular projects among Liberals. The Environmentalists seem to have a preference for Active Mode Safety (AMS) projects and projects within the city of Amsterdam. The PVV/FvD oriented individuals seem to prefer car projects 3,4 and 5, which are located in the east of the region. In conclusion, there seems a relation between individuals' political orientation and project preference. However, political orientation seems to be related to the travel mode improved by the project and area the project is located in. Further analysis should test the extent of the direct relation of political orientation towards project preference and correct for indirect correlations with other background characteristics like favorite travel mode and living area.

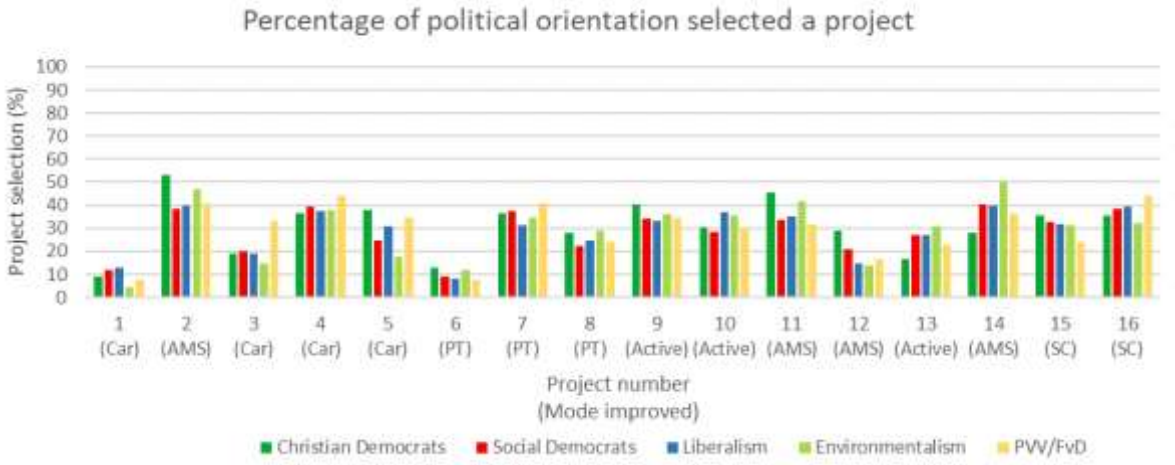


Figure 13 Project choice per project by individuals' political orientation

4.8 Living area distribution in more detail

The distributions suggest a strong correlation between project location and living area. Individuals seem to prefer projects located in their living area. Therefore, the statistics of project selection per living area are evaluated in more detail.

Table 15 presents the percentual distribution of respondents that selected a project per living area; each row sums up to 100 percent of the total votes for a project. The area the project is located is marked green. Project 15 and 16 that improve safety in the whole area are not assigned to a specific area. Only individuals of which their living area was known are included in the descriptive statistics of this subsection. Table 15 provides a lot of information about the number of respondents selected a project within their living area and the number that did not. In Appendix D, similar tables are presented for favorite travel mode and political orientation. However, these tables did not provide more insights compared to the presented graphs for these variables.

The one to the bottom row of Table 15 shows the overall distribution of respondents over the 6 living areas, which is not equally distributed. The bottom row shows the same distribution in percentages, which shows almost a third of total response lives in area C; the city of Amsterdam. For the

interpretation of Table 15, it should be considered a high percentage (32%) of the total respondents lives in area C (Amsterdam West), while only 10 percent lives in area F (Amsterdam Zuid-Oost).

For example, the table shows 19 percent of the respondents selecting project number 8 lives in area F and 39 percent live in area C. Considering the distribution of individuals living in area C and F show 50 percent of the individuals living in area F voted for project 8, while 30 percent of the individuals living in area C voted for project 8. Consequently, the project is relatively frequently selected by respondents living in area F. Therefore, the distribution of votes for a project should be compared to the distribution of respondents per living area.

The percentages per living area per project can be compared to the bottom row of the table. Of each project would be evenly popular among each living area, the percentual distribution of votes would be equal to the percentual distribution of respondents living in each of the areas. However, none of these distributions of votes corresponds to the distribution presented in the bottom row of the table. An overview of the deviations per project is presented in Appendix D.

Table 25 Distribution of living area of respondents that selected a certain project. The area that the project is located is marked green

Project nr.	**Project costs (million€)**	**Living area (%)**						**Total votes (#)**
		A	**B**	**C**	**D**	**E**	**F**	
2	*3*	16	16	27	12	20	9	**354**
14	*40*	6	5	47	14	18	10	**342**
4	*10*	9	9	36	18	16	12	**328**
11	*4*	16	19	31	9	18	7	**308**
16	*20*	9	10	32	12	24	13	**305**
9	*8*	7	5	32	9	38	8	**300**
7	*5*	25	9	29	11	18	8	**296**
10	*6*	10	6	34	9	30	11	**293**
15	*50*	12	12	30	11	26	9	**272**
5	*10*	8	7	27	6	40	12	**238**
13	*35*	7	3	40	27	16	8	**221**
8	*15*	5	5	39	17	14	19	**208**
3	*40*	20	25	17	15	15	8	**175**
12	*40*	47	9	18	9	15	2	**144**
1	*50*	57	9	18	2	10	3	**89**
6	*50*	1	2	41	16	16	23	**87**
Total respondents (#)		**129**	**82**	**272**	**112**	**175**	**84**	
Total respondents (%)		*15*	*10*	*32*	*13*	*20*	*10*	

The deviations show the highest positive deviation for the living area the project is located in, which last ones are marked green in Table 15. Especially expensive projects 1 and 12 are relatively popular within their own living area. Projects most popular in region A are the ones to most popular in region B and vice versa. The same trend is visible for regions C and D. As described in section 4.7.1, projects located on the outskirts of the region are relatively less popular in neighbor regions than projects close to other areas. Table 15 shows this effect more clearly. For instance, project 4, located in area D (Amsterdam Oost), but close to the border with area C (Amsterdam West) and F (Amsterdam Zuid-Oost), is relatively popular in these adjacent areas as well. The effect is reasonable since inhabitants

living in the north of area F (Amsterdam Zuid-Oost) live quite close to this project as well. The same pattern is visible for projects 6,8, 10 and 3 located close to the adjacently located areas. However, all projects are less popular among respondents in far-off regions. These results further suggest a negative relationship between distance from the living area to project location and project preference.

4.9 Conclusion bivariate results

The bivariate correlations of the living area, favorite travel mode and political orientation towards the project choice show a relation with all three background characteristics. The living area seems to have a major impact. However, these relationships do not correct for intercorrelations among living areas, favorite travel mode, political orientation or other demographical characteristics. Statistical cluster analysis is required to test the direct effect while controlling for intercorrelations. Furthermore, these statistics just shows the single selection of a project, while participants of PVE have to select a combination of the project in their favor. Further analysis in choice pattern provides better insights into the combination of projects selected and these projects have common characteristics.

5. Results cluster analysis

The univariate statistics present the most popular projects on average, which do not present any information about the distribution among individuals that have a preference for specific projects. There might be groups of individuals having a comparable pattern of project selection. A latent class cluster analysis (LCCA) is carried out to present these groups. Furthermore, covariates can be added to the model to predict class membership. The covariates show the effect of living area, mode preference and political orientation towards project preference while controlling for intercorrelations. The results of section 4 suggested relations for each of these background characteristics. In contrast to LCCA, these bivariate statistics did not control for intercorrelations.

This section first estimates a LCCA model based on project choice, showing groups of individuals having a homogenous choice pattern of project selection. The second LCCA based on project attributes presented in the experiment, trying to show individuals prefer one of the projects' attributes, of which the online tool provided the opportunity to compare. Finally, a third model is estimated based on budget allocated to a specific mode, trying to show groups of individuals having a preference for a specific travel mode.

5.1 Project choice

First, a model is estimated based on project selection. The project choices (a project is selected or not) are the indicators of the model to show homogenous clusters having the same pattern in project selection. For example, one cluster selecting the first 8 projects and a second cluster selecting the last 8 projects.

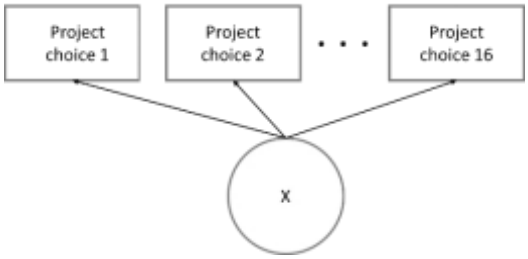


Figure 14 Cluster model including project choice as indicators

5.1.1 Model estimation

A cluster model is estimated, including all projects as indicators of the model. Each project choice is added as a binary variable (1=selected, 0 = not selected). The model contains 16 indicators in total since respondents could make their selection out of 16 projects, as presented in Figure 12. First, the optimal number of clusters is determined. Based on the BIC values of Table 16, 9 clusters would be the optimal number of clusters. However, that number of clusters is too complex to communicate. Therefore, the number of significant BVR's and the maximum BVR value are considered as well. After 7 clusters, the BIC, maximum BVR, and in particular, the number of significant BVR's does not decrease a lot. Consequently, the number of 7 clusters is selected.

Table 26 BIC and BVR values as criteria to determine the optimal number of clusters

Number of clusters	BIC	#BVRS>3.84	Max BVR
1	19254	91	87
2	18721	68	60
3	18526	45	69
4	18382	36	51
5	18320	33	59
6	18295	41	46
7	18282	29	51
8	18279	28	47
9	18253	27	52
10	18305	25	48

Table 17 presents the latent class profiles of the 7-class solution. The Wald test statistics and corresponding p-values indicate that all 16 indicators are significant. Consequently, the cluster values differ significantly among clusters and the model covers for heterogeneity between clusters for all indicators. If all respondents of a cluster selected a certain project, the presented value is 1.00. If none of the respondents of a cluster selected a certain project, the presented value is 0.00. The projects that are predominantly selected by a cluster are marked green (> 0.5). Furthermore, for the first cluster project number 4 and 13 are marked grey. Since project number 13 is selected the most by cluster 1 compared to other clusters. Furthermore, project number 4 scores almost similar to project 13. Therefore, project number 4 is marked as well, for cluster interpretation. Remarkable high loadings are marked dark green (> 0.9).

Table 27 Cluster profiles project choice (percentages divided by 100) and statistical Wald test (cells >0.50 are marked green. Cells marked grey are high compared to the loadings of other projects in the clusters, cells >0.9 are marked dark green)

Cluster Nr	Cluster1	Cluster2	Cluster3	Cluster4	Cluster5	Cluster6	Cluster7	Wald value	p-value
Cluster Size	0.26	0.16	0.16	0.13	0.11	0.10	0.08		
Project Nr									
1	0.03	0.08	0.06	0.52	0.00	0.00	0.13	101.14	0.00
2	0.21	0.13	0.74	0.27	0.63	0.68	0.69	181.26	0.00
3	0.17	0.16	0.28	0.34	0.00	0.00	0.54	51.91	0.00
4	0.44	0.09	0.63	0.06	0.70	0.45	0.27	103.93	0.00
5	0.08	0.26	0.61	0.07	0.48	0.50	0.08	147.51	0.00
6	0.24	0.04	0.17	0.01	0.00	0.00	0.00	24.17	0.00
7	0.20	0.06	0.56	0.56	0.53	0.48	0.28	103.85	0.00
8	0.29	0.04	0.47	0.05	0.54	0.21	0.05	104.35	0.00
9	0.12	0.43	0.71	0.04	0.55	0.66	0.07	164.34	0.00
10	0.16	0.30	0.59	0.13	0.68	0.51	0.16	141.98	0.00
11	0.18	0.09	0.68	0.27	0.52	0.56	0.64	150.76	0.00
12	0.05	0.10	0.30	0.60	0.05	0.00	0.20	116.48	0.00
13	0.47	0.15	0.41	0.09	0.19	0.00	0.04	79.99	0.00
14	0.58	0.62	0.02	0.08	1.00	0.00	0.34	66.34	0.00
15	0.24	0.57	0.00	0.21	0.00	1.00	0.45	50.29	0.00
16	0.30	0.19	0.48	0.16	0.62	0.79	0.22	119.71	0.00

Table 18 presents a short description that captures the characteristics of the combination of projects predominantly selected by each cluster.

Table 28 Short cluster description

Cluster	Cluster size	Description
1	26 %	Projects within Amsterdam
2	16%	Traffic education & Stadshouderskade
3	16%	Many cheap projects scattered over the area
4	13%	Accessibility Zaanstad
5	11%	Stadshouderskade and cheap projects close to Amsterdam
6	10%	Traffic Safety combined with cheap active mode projects
7	8%	Accessibility Purmerend

All the 11 covariates presented in Figure 13 are added to the model; demographic background characteristics, living area, favorite travel mode, and political orientation. All covariates are included as active covariates to predict class membership. One of the main advantages of a LCCA is that it controls for correlations among covariates. Consequently, the model shows in what extent living area, favorite travel mode, political orientation, and demographic characteristics predict class membership and which covariate dominates.

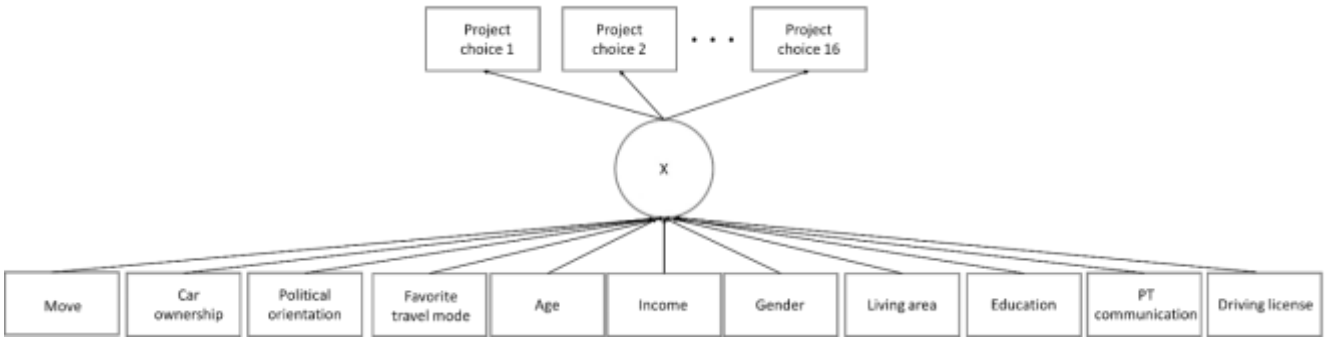


Figure 15 Cluster model including covariates

Table 19 presents the significance of covariates. Individuals' Living area, level of education, age, gender, and expectation to move do significantly predict class membership. Other covariates are not significant. As stated, LCCA covers for intercorrelations among covariates, which implies only the significant covariates directly predict class membership. These results show living area is highly significant, while favorite mode and political orientation are not. In contrast to the suggested relations of each of the three variables in section 4.7, these results show project choice is predominantly affected by the living area rather than favorite mode or political orientation. Table 20 presents the profile distributions of the significant covariates, which should be used for cluster interpretations. Appendix E shows the profile distribution of insignificant profiles, which show deviations of political orientation and favorite mode. Since these covariates are not significant, these deviations are related to other covariates that are significant and do not directly affect project preference itself. If the covariate living area is excluded from the model, political orientation and favorite mode are both significant, which disappears after the inclusion of individuals' living areas in the model. Consequently, the deviations among clusters for political orientation and favorite travel mode in section 4.7 are related to individuals' living area; only living area directly predicts class membership out of these three.

Table 29 Wald test of covariates

Covariates	Wald	p-value
Orientation	51.31	0.15
Living area	137.01	0.00
Favorite travel mode	27.31	0.29
Education	61.70	0.00
Age	27.18	0.00
Income	10.67	0.10
Gender	16.47	0.01
Expect to move	25.61	0.01
Car ownership	34.56	0.00
Driving license	19.02	0.09
PT commutation	15.98	0.19

Table 30 Cluster profile distribution significant covariates (percentages divided by 100)

	Cluster1	Cluster2	Cluster3	Cluster4	Cluster5	Cluster6	Cluster7
Neighborhood							
No answer	0.15	0.10	0.15	0.29	0.21	0.21	0.10
A	0.01	0.03	0.10	0.60	0.01	0.08	0.19
B	0.01	0.00	0.08	0.00	0.01	0.08	0.69
C	0.38	0.37	0.26	0.05	0.39	0.15	0.02
D	0.30	0.00	0.09	0.05	0.04	0.06	0.00
E	0.00	0.47	0.23	0.01	0.24	0.31	0.00
F	0.15	0.03	0.09	0.01	0.10	0.12	0.00
Education							
No answer	0.09	0.03	0.05	0.14	0.03	0.08	0.13
No/elementary/ LBO/VBO/VMBO	0.08	0.13	0.06	0.09	0.05	0.11	0.10
MAVO/VMBO/MBO1	0.19	0.31	0.27	0.47	0.21	0.36	0.31
HAVO/VWO/MBO2,3,4	0.41	0.31	0.33	0.22	0.33	0.31	0.37
HBO/WO bachelor	0.22	0.22	0.29	0.08	0.38	0.14	0.07
WO master	0.01	0.01	0.01	0.00	0.00	0.00	0.02
Age							
18 – 19 year	0.29	0.26	0.14	0.13	0.21	0.12	0.11
20 – 31 year	0.16	0.22	0.15	0.18	0.25	0.25	0.17
32 – 41 year	0.20	0.19	0.26	0.22	0.15	0.26	0.23
42 – 50 year	0.17	0.17	0.26	0.25	0.21	0.18	0.23
51 – 70 year	0.17	0.16	0.19	0.23	0.18	0.18	0.27
Gender							
Male	0.52	0.46	0.59	0.58	0.69	0.55	0.50
Female	0.48	0.54	0.41	0.42	0.31	0.45	0.50
Expected to move							
No answer	0.08	0.02	0.03	0.09	0.02	0.08	0.03
No	0.83	0.93	0.90	0.85	0.89	0.86	0.93
Yes	0.09	0.05	0.07	0.06	0.09	0.06	0.05

Car ownership							
No answer	0.04	0.04	0.19	0.09	0.15	0.16	0.04
No	0.49	0.24	0.21	0.08	0.27	0.16	0.05
Yes	0.47	0.72	0.59	0.83	0.58	0.68	0.92

5.1.2 Cluster interpretation

Each of the 7 clusters can be interpreted in terms of the projects that are selected by this group of individuals and what kind of individuals have a high probability of belonging to the cluster. The latter can be derived from the distribution of the covariates. For example, when gender is a significant covariate and shows a high percentage of males in a cluster, males have a high probability of belonging to this cluster. Table 20 presents the significant covariates. Appendix E presents the distribution of all covariates.

This section describes the interpretation of each of the 7 clusters by describing what kind of projects are selected and how these are related to their background characteristics. The predominantly selected projects are presented and ranked by the frequency the project is selected by the cluster. In addition, a label for each visually shows the common characteristics of the projects selected by the cluster. These common characteristics exist based on travel mode, project costs or project locations. Furthermore, significant background characteristics having a relatively high probability belonging to the cluster are presented in an additional table per cluster. Background characteristics not included in the table, no specific category of the background characteristics belong to the cluster.

Cluster 1: Projects within Amsterdam (26%)

Table 31 Ranked selection of projects by cluster 1

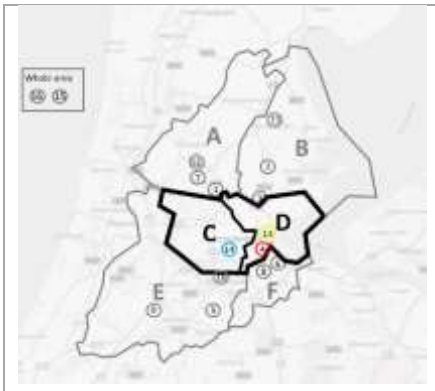
	Nr.	Costs (million)	Project description
	14	40	Stadhouderskade car tunnel at the entrance of the Vondelpark
	13	35	New cycling bridge Zeeburg
	4	10	Extending the MacGillavrylaan to Middenweg

Table 32 Background characteristics having a relatively high probability belonging to cluster 1

Living area	C & D (City of Amsterdam)
Education	High
Car-ownership	No
Expected to move	Yes

Individuals that belong to cluster 1 predominantly select project 4,13 and 14, as presented in Table 21. These projects are located in areas C or D, which is the city of Amsterdam. The covariates of Table 22 show nearly all individuals belonging to this cluster live in are C or D either. These individuals have a strong preference for infrastructure projects within or close to their living area. The cluster size of

this cluster is the largest. However, clusters C and D have the most inhabitants compared to the other regions. The individuals of this cluster seem to prioritize location more than the improved mode since all three projects improve a different mode. However, these individuals prefer to allocate the budget towards expensive new infrastructure in their living area over safety compliance in the whole region. Especially, car projects outside Amsterdam and projects located in the outskirts are relatively fewer chosen. The demographic covariates show young, highly educated individuals without owning a car have a high probability of belonging to this cluster. In addition, individuals expecting to move within 5 years have a higher probability of belonging to the clusters, which suggests individuals are feeling less bounded to their neighborhood. The combination of these covariates implies many students living in Amsterdam belong to this cluster having a preference for infrastructure projects within the city of Amsterdam.

Cluster 2: Traffic education + Stadshouderskade (16%)

Table 33 Ranked selection of projects by cluster 2

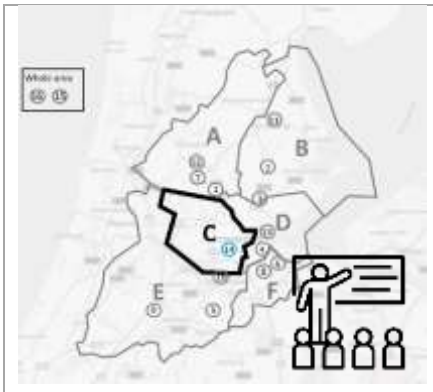
	**Nr.**	**Costs (million)**	**Project description**
	14	40	Stadhouderskade car tunnel at the entrance of the Vondelpark
	15	50	Traffic education for children in the age group 4 – 18

Table 34 Background characteristics having a relatively high probability belonging to cluster 2

Living area	C & E (Amsterdam West and Haarlemmermeer)
Gender	Women
Age	20-30

Individuals who belong to cluster 2 predominantly select the relatively expensive projects 14 and 15, as presented in Table 23. These projects are a combination of traffic education for children and the active mode safety Stadshouderskade project in the south of area C; Amsterdam West. The covariates of Table 24 show these individuals predominantly live in area C and E; Amsterdam West and Haarlemmermeer. Individuals of area C selected a project in their living area combined with traffic education. Individuals living in Haarlemmermeer selected an expensive project out of their region. However, individuals living in the north of Haarlemmermeer live relatively close to area C in Amsterdam and maybe frequently visit Amsterdam. Demographic covariates show women between the age of 20 and 30 have a high probability belonging to the cluster, which might indicate mothers who prefer to allocate a large share of the budget towards traffic education for children belong to the cluster.

Cluster 3: Many cheap projects scattered over the area (16%)

Table 35 Ranked selection of projects by cluster 3

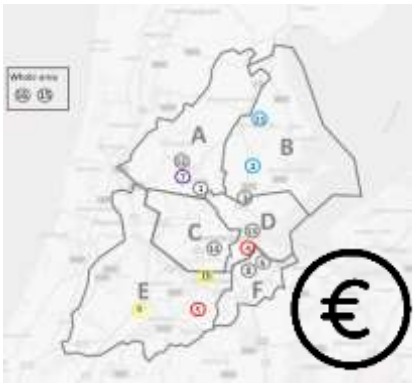
	Nr.	Costs (million)	Project description
	2	3	Ilpendam pedestrian tunnel
	9	8	Cycling highway Hoofddorp – Schiphol – Aalsmeer
	11	4	New bridge for cyclists and pedestrians Purmerend (Hoornselaan)
	4	10	Extending the MacGillavrylaan to Middenweg
	5	10	Widening the Bovenkerkerweg to 2 lanes per direction
	10	6	Cycling highway Amstelveenseweg
	7	5	Acceleration of the bus connection Amsterdam CS – Zaandam

Table 36 Background characteristics having a relatively high probability belonging to cluster 3

Education	High
Age	Middle age
Gender	Men

Individuals belonging to this cluster apply the strategy to select as many projects as possible within the available budget by selecting all the less expensive projects, as presented in Table 25. The locations of these projects are scattered across the whole region and improving various travel modes. Individuals belonging to this cluster might prefer to distribute the budget equally over the region or equally over the travel modes. Another reason could be these individuals prefer to realize more small projects instead of allocating a large share of the budget towards one prestigious project. However, less expensive active mode projects are more popular than equally expensive projects improving car or PT. Furthermore, the remoteness of projects does not dominantly affect project preference since projects number 9 and 11 are the 2nd and 3rd popular projects within this cluster. The covariates of Table 26 do not show a dominant living area among individuals belonging to the cluster. However, the demographic covariates show highly educated middle-aged men predominantly apply the strategy of this cluster. Individuals belonging to this cluster seem to prefer spatial equality of budget allocation and have a collectivist view towards infrastructure for the region.

Cluster 4: Accessibility Zaanstad (13%)

Table 37 Ranked selection of projects by cluster 4

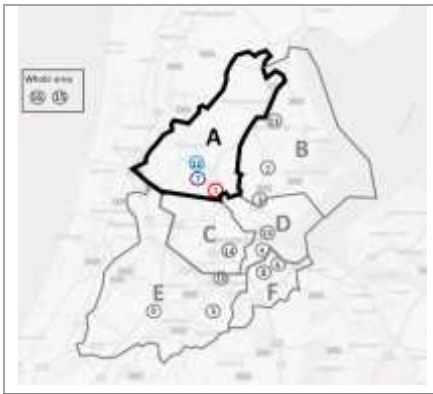
	**Nr.**	**Costs (million)**	**Project description**
	12	40	Guisweg bike tunnel
	7	5	Acceleration of the bus connection Amsterdam CS – Zaandam
	1	50	Faster connection bus and car traffic Zaandam

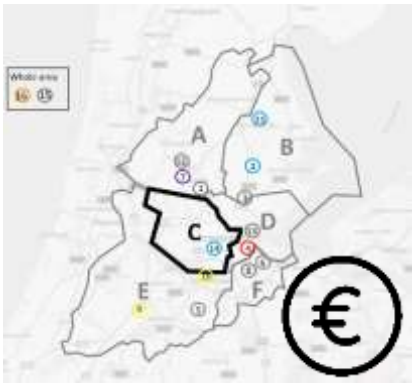
Table 38 Background characteristics having a relatively high probability belonging to cluster 4

Living area	A (Zaanstad)
Education	Low
Age	Elderly
Car ownership	Yes

Individuals belonging to this cluster predominantly select project 1,7 and 12, as presented in Table 27. The projects are located in area A and improve the accessibility of Zaanstad. The covariates of Table 28 show Individuals belonging to the cluster prefer to include all projects proposed in area A in their portfolio, no matter what travel mode, since each project improves an alternative travel mode. Table 17 shows projects located in area B (Purmerend) are also selected to some extent. Remarkable is that projects in all other areas are barely selected by individuals belonging to this cluster. The covariates of Table 28 show almost all individuals belonging to this cluster live in area A (Zaanstad). Consequently, individuals belonging to this cluster seem to mainly prefer projects within their own northern located living area. If not other northern in the region located, projects are preferred over projects located more southern or within Amsterdam. The demographic covariates show predominantly low educated elderly having a car do belong to this cluster. Nonsignificant covariates related to the living area show these individuals have the car predominantly as their favorite travel mode and Christian Democratic orientated. All in all, these individuals living in Zaanstad prefer projects in their living area or other in the northern outskirts located projects.

Cluster 5: Stadshouderskade + cheap projects close to Amsterdam (11%)

Table 39 Ranked selection of projects by cluster 5



Nr.	Costs (Million)	Project description
14	40	Stadhouderskade car tunnel at the entrance of the Vondelpark
4	10	Extending the MacGillavrylaan to Middenweg
10	6	Cycling highway Amstelveenseweg
2	3	Ilpendam pedestrian tunnel
16	20	Five police officers sanction violation of traffic regulations
9	8	Cycling highway Hoofddorp – Schiphol – Aalsmeer
8	15	Improvement tram connection Diemen-Linnaeusstraat
7	5	Acceleration of the bus connection Amsterdam CS – Zaandam
11	4	New bridge for cyclists and pedestrians Purmerend (Hoornselaan)

Table 40 Background characteristics having a relatively high probability belonging to cluster 5

Living area	C (Amsterdam West)
Education	High
Gender	Men

Individuals belonging to this cluster all selected project number 14, Stadshouderskade, which is indicated by the cluster profiles of overview Table 17, showing 100 percent selected project number 14. In addition to project number 14, relatively less expensive projects are selected, improving all kinds of travel modes, as presented in Table 29. However, the projects presented in Table 29 are ranked by the percentage of the cluster that selected the project, which shows projects more close located to area C are higher ranked. The covariates of Table 30 show individuals belonging to this cluster predominantly live in area C, Amsterdam West. The demographic covariates show predominantly high educated men belong to this cluster. All in all, these individuals predominantly living in Amsterdam are willing to allocate a large extent of the budget to projects in their living area in combination with less expensive projects in the neighborhood. Within the less expensive projects, the closer located to Amsterdam, the more frequently the projects are selected.

Cluster 6: Traffic Safety combined with cheap active mode projects (10%)

Table 41 Ranked selection of projects by cluster 6

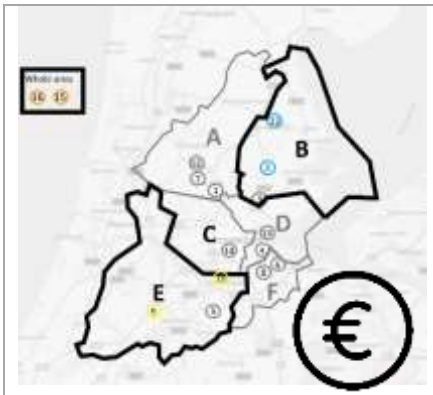
	**Nr.**	**Costs (million)**	**Project description**
	15	50	Traffic education for children in the age group 4 – 18
	16	20	Five police officers sanction violation of traffic regulations
	2	3	Ilpendam pedestrian tunnel
	9	8	Cycling highway Hoofddorp – Schiphol – Aalsmeer
	11	4	New bridge for cyclists and pedestrians Purmerend (Hoornselaan)
	10	6	Cycling highway Amstelveenseweg

Table 42 Background characteristics having a relatively high probability belonging to cluster 6

Living area	E (Haarlemmermeer) *slight overrepresentation*
Age	20-40 years

Individuals belonging to this cluster do all select traffic education project 15 and frequently add the other safety compliance project number 16 as well, as presented in the overall cluster profiles of Table 17. Furthermore, Table 31 shows the remaining budget is predominantly allocated towards active mode projects in area E (Haarlemmermeer) and active mode safety projects in area B (Purmerend), which combination is remarkable since these project locations are quite scattered over the region. The covariates show no dominant living area among individuals belonging to the clusters. However, a slight overrepresentation of area E (Haarlemmermeer) is visible. The remaining covariates of Table 32 show predominantly individuals between the age of 20 and 40 have a higher probability belonging to the clusters, which might be individuals having children since the traffic education project 15 is the most popular (100%). Furthermore, the nonsignificant covariate show individuals belonging to this cluster prefer to travel by bike, which might explain why active mode projects are more frequently selected than car and PT projects. All in all, individuals belonging to the cluster are willing to allocate a large extent of the budget towards traffic safety. The remaining budget is predominantly allocated towards active mode projects, their preferred travel mode.

Cluster 7: Accessibility Purmerend (8%)

Table 43 Ranked selection of projects by cluster 7

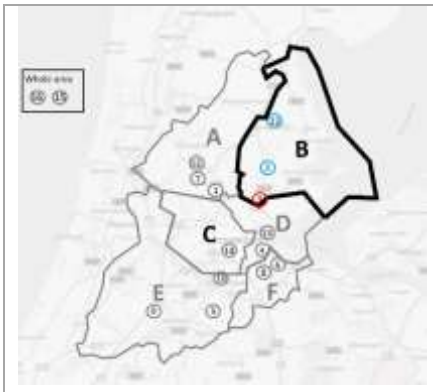
	Nr.	Costs (million)	Project description
	2	3	Ilpendam pedestrian tunnel
	11	4	New bridge for cyclists and pedestrians Purmerend (Hoornselaan)
	3	40	Fly-over A10 at junction Amsterdam Noord

Table 44 Background characteristics having a relatively high probability belonging to cluster 7

Living area	B (Purmerend)
Age	Elderly
Eduction	Low

Individuals belonging to this cluster do predominantly select projects 2,3 and 11, as presented in Table 33. These projects are all the proposed projects in area B (Purmerend). The living area profile shows almost all individuals also live in this area B. These individuals seem to prefer new infrastructure within their own area over safety compliance in the whole region or projects in other regions. Except for projects located in the other northern area A and safety projects, other projects are barely selected by this cluster. The remaining covariates of Table 34 show older low educated individuals have a higher probability of belonging to the cluster. Nonsignificant covariates show individuals belonging to this cluster predominantly travel by car and are environmentalism oriented, which is related to the living area. All in all, individuals living in Purmerend predominantly belong to the cluster, who have a strong preference for projects within their living area.

5.1.3 Conclusion clusters based on project selection

The clusters show three different strategies; 1) Individuals selecting projects in their living area, 2) individuals selecting projects that increase safety compliance, and 3) individuals selecting cheap projects. Table 35 shows an overview of identified strategies per cluster, which shows 4 out of the 7 clusters apply among else the first strategy, which reflects the majority of the participants (63%). These results show individuals living area and project (location) preference are strongly related. Individuals predominantly prefer projects within their living area and preference for a project is frequently negatively related to distance towards project location. However, 53 % of the participants apply among else the second, third or a combination of these two strategies. Cluster 2 and 5 (27%) select an expensive project in their living area and allocate the remaining budget to projects, which are not per definition in their living area. Despite many respondents select projects in their living area, which might be in their own interest, alternative strategies are visible as well.

Table 45 Strategy per cluster in allocation fixed budget

Cluster	Cluster size	Description	Projects within the living area	Safety compliance projects	As many cheap projects
1	26 %	Projects within Amsterdam	X		
2	16%	Traffic education & Stadshouderskade	X	X	
3	16%	Many cheap projects scattered over the area			X
4	13%	Accessibility Zaanstad	X		
5	11%	Stadshouderskade and cheap projects close to Amsterdam	X		X
6	10%	Traffic Safety combined with cheap active mode projects		X	X
7	8%	Accessibility Purmerend	X		
Total			63 %	26%	37%

5.2 Quantitative project attributes

Besides making a trade-off among project titles, individuals had the option to compare quantitative attribute values of projects. According to the conceptual model in section 2.12, one might prefer projects that improve a specific mode, and others might prefer projects that result in the maximum reduction of travel time. As described in Chapter 2, the PVE provides the opportunity to compare the quantitative impact of projects. This section determines whether the extent of individuals making a trade-off based on project values is distributed among participants in PVE and therefore answers the second sub research question.

5.2.1 Operational model quantitative attribute values

A second model is estimated based on the quantitative project attribute values of the selected projects. The comparison tool of PVE presents the quantitative numbers of the attributes of Table 36. Participants could compare projects based on quantified project impacts.

Table 46 Description quantitative project attributes

Attribute	Description
Travelers	Number of travelers with reduced travel time on an average working day
Time savings	Average minutes of travel time gained by travelers
Deaths	The average reduction of traffic injuries
Injuries	The average reduction of traffic deaths
Noise	Increased number of households that experience noise pollution
Trees	Number of trees that have to be cut

All six quantitative project attributes are added as indicators in the model, which is presented in the operational model of Figure 14. A LCCA based on the project attribute values can be used to show groups of individuals that make a similar trade-off among attributes or focus on similar attributes. For instance, a theoretical model could show one group of individuals preferring projects that reduce the number of traffic injuries, while other prior time savings for travelers. Furthermore, some might be more sensitive to one additional traffic injury due to a project than others. For instance, some individuals might not be willing to allocate 40 million to a project that saves one traffic injury per year but is willing to allocate the 40 million if it saves 4 traffic injuries per year.

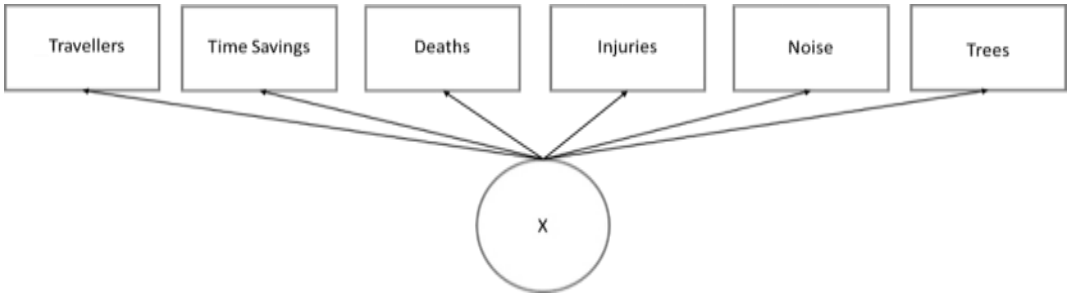


Figure 16 Cluster model with project attributes as indicators

The estimated model and its results are presented in Appendix F since the clusters showed no clear interpretable clusters based on project attributes. The 4 clusters presented seemed to be related to alternative characteristics, of which these projects are strongly related. For instance, the number of deaths and traffic injuries are strongly related to projects that improve traffic safety.

5.2.2 Conclusion clusters based on quantitative project attributes

The clusters do not show to what extent individuals trade-off attribute values. No clear distributed profiles based on project attribute preferences can be identified. Further research should identify to what extent participants take attribute values in considering their project selection.

5.3 Travel mode preference

A third model is estimated to identify groups of individuals having a preference for a certain travel mode. The first cluster model estimated showed one cluster selecting safety projects, which is one of the travel mode categories. This section explores if clusters exist allocating a large extent of the budget towards a certain travel mode. In contrast to the first model, the unit of the attributes is million euros allocated to a certain travel mode instead of specific projects that are selected. It is assumed that the more budget allocated to a certain travel mode, the more this travel mode is preferred. In addition, the budget shifted to the next year is included in the model to show the total budget allocated. Figure 15 presents the operational model, including the budget allocated per mode and the shifted budget as indicators of the model.

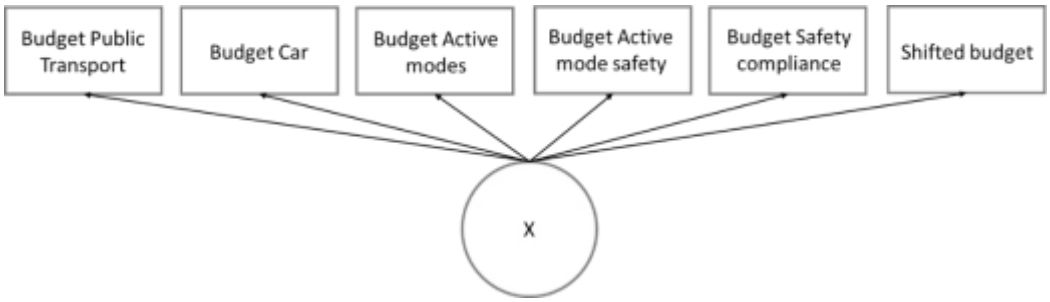


Figure 17 Cluster model with mode improved as indicators

5.3.1 Focus per project

Table 37 shows the 5 different categories into which the projects are classified. As mentioned, each project improves public transport, car, active modes, active mode safety, safety compliance or a combination of these. It is assumed each project improves one travel mode, which is the mode that is mainly improved by the project.

Table 47 Description of transport modes

Transport mode	Description
Public Transport	New or acceleration of tram and bus lines
Car	Faster connections for car traffic, improvement in car traffic flow
Active mode	New cycling connection or highways to improve the cycle traffic flow
Active mode safety	Separate car and cycle/pedestrian traffic lanes to reduce the number of accidents due to collisions
Safety compliance	General safety instruction and controls

5.3.2 Concerns to determine mode preference

There are unlimited alternatives to determine participants' preferences for a certain travel mode. In this study, it is assumed the amount of budget allocated to a certain mode indicates the relative preference for this particular travel mode. Apart from this, three concerns are taken into account.

Firstly, the maximum available budget is fixed to 100 million. Consequently, individuals are not allowed to allocate more than 100 million in total or towards a particular travel mode. The relative budget of the total budget allocated towards a certain mode reflects travel mode preference.

Table 48 Maximum budget participants can allocate towards a travel mode due to set project costs. Projects are ranked by project costs. For instance, three PT projects are available, which respectively costs 50, 15 and 5 million.

Travel mode	Project 1	Project 2	Project 3	Project 4	Available budget per travel mode (million€)
PT	50	15	5	-	**70**
Car	50	40	10	10	**110**
Active modes	35	8	6	-	**49**
Safety compliance	50	20	-	-	**70**
Active mode safety	40	40	4	3	**87**

Secondly, the maximum available budget per mode differs. Table 38 presents the distribution of project prices per mode, ranked by the height of project costs. The project costs and the number of proposed projects differ per travel mode. However, relatively cheap and expensive projects are available for all modes. Nevertheless, it is possible to fulfill the total budget of 100 million with car projects, while all active mode projects together have a budget of 49 million. Consequently, just the budget allocated to a travel mode does not wholly reflect travel mode preference. For example, if an individual '*a*' allocates 49 out of 49 million towards active mode projects, the individual strongly prefers active mode projects. Individual '*b*' allocates 49 million towards car projects and is assumed to prefer car projects. However, individual '*b*' decides to allocate the remaining budget to an alternative travel mode, while individual '*a*' had no choice of allocating more budget towards active modes. Consequently, individual '*a*' has a more definite preference for active modes than individual b for car projects. Therefore, the 'available budget per travel mode' should be considered in the travel mode interpretation of clusters.

Thirdly, the total allocated budget differs per participant since they are not forced to allocate the full budget. The relative preference for a travel mode depends on how the participants allocate the remaining budget. For example, if individual '*a*' allocates 60 million to car projects and shift the remaining budget to the next year, while individual '*b*' allocates 60 million to car projects and the remaining budget to another travel mode, individual *'a'* has a more definite preference for car projects

than individual *'b.'* Therefore, the shifted budget is included as one of the indicators and should be taken into account for the interpretation of the clusters. However, the shifted budget is not expected to seriously affect clusters in this experiment, since Figure 16 shows most individuals completed the full budget.

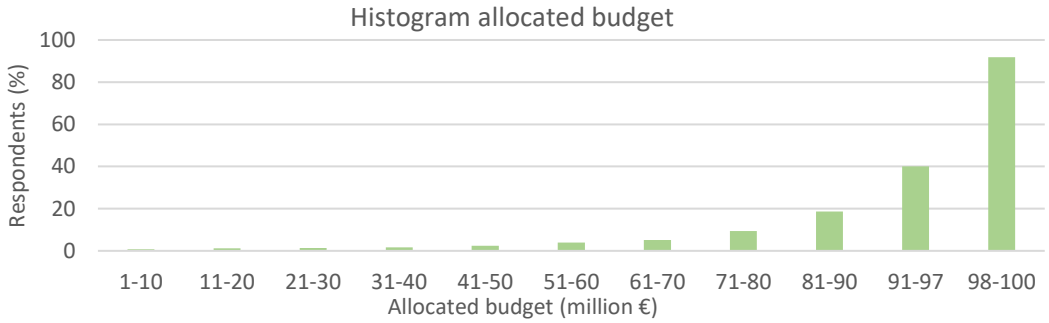


Figure 18 Distribution allocated budget. Individuals who allocate 98 million or more allocate the full budget since the least expensive project is 3 million

5.3.3 Operational model

First, a cluster model, including only the indicators, is estimated to determine the optimum number of clusters. The budget allocated to each mode and the budget shifted are added as indicators, as presented in Figure 15. Consequently, the model contains 6 indicators in total. The BIC values of Table 39 are used as the first criterium of the optimal number of clusters, which shows 13 clusters as an optimum. However, that number of clusters is too complex to interpret. Therefore, the number of significant BVR's and the maximum BVR values are used as criteria to determine the number of clusters. After 6 clusters, the number of significant BVR's does not decrease a lot anymore. However, the model with 7 clusters shows an additional cluster of individuals allocating budget to PT and no high BVR between active modes and PT anymore. Therefore, the model, including 7 clusters, is selected.

Table 49 BIC and BVR values as criteria to determine the optimal number of clusters

Number of clusters	BIC	#BVRS>3.84	Max BVR
1	54502	14	137
2	52243	15	122
3	50629	12	42
4	49187	12	35
5	48527	14	29
6	47437	14	28
7	47335	13	26
8	47075	12	26
9	46282	13	21
10	46189	12	16
11	45987	14	15
12	45987	10	13
13	45478	13	11
14	45480	11	9

Table 40 presents the latent class profiles of the 7-class solution. The Wald test statistics indicate all 6 indicators are significant. Consequently, all indicator values differ significantly among clusters. The

cluster profile distribution of Table 40 presents the average budget allocated to a certain mode by each cluster.

Table 50 Cluster profiles mode preference including maximum available budget per mode and statistical Wald test

	Cluster1	Cluster2	Cluster3	Cluster4	Cluster5	Cluster6	Cluster7	**Maximum available budget**	Wald value	p-value
Cluster Size	0.26	0.25	0.12	0.11	0.10	0.10	0.06			
PT	5.83	22.87	0.00	0.71	2.59	9.08	35.20	**70**	715.22	0.00
Car	19.64	21.40	16.62	2.70	57.43	10.38	4.16	**110**	812.33	0.00
Active modes	14.49	22.16	14.00	2.29	0.00	15.22	3.60	**49**	956.52	0.00
Safety Compliance	48.97	0.00	9.83	51.43	0.00	19.29	23.32	**70**	13611.95	0.00
Active mode safety	3.72	30.57	34.54	39.71	34.80	44.04	15.66	**87**	205.66	0.00
Shifted	7.36	3.01	29.02	3.16	5.18	2.00	18.06		205.66	0.00

Table 41 presents a short description that captures the mode or combination of modes predominantly preferred by a certain cluster.

Table 51 Short cluster description

Cluster	Short cluster description
1	Safety compliance + cheap car and active modes
2	Active mode safety
3	Active mode safety + cheap active mode projects and shift the remaining budget
4	Safety in general
5	Active mode safety + car
6	Active mode safety + cheap active mode and car projects
7	Public Transport

Similar to the first model based on project choice, all the 11 covariates of Figure 17 are added to the model, being demographic background characteristics, living area, favorite travel mode, and political orientation. All covariates are included as active covariates to predict class membership.

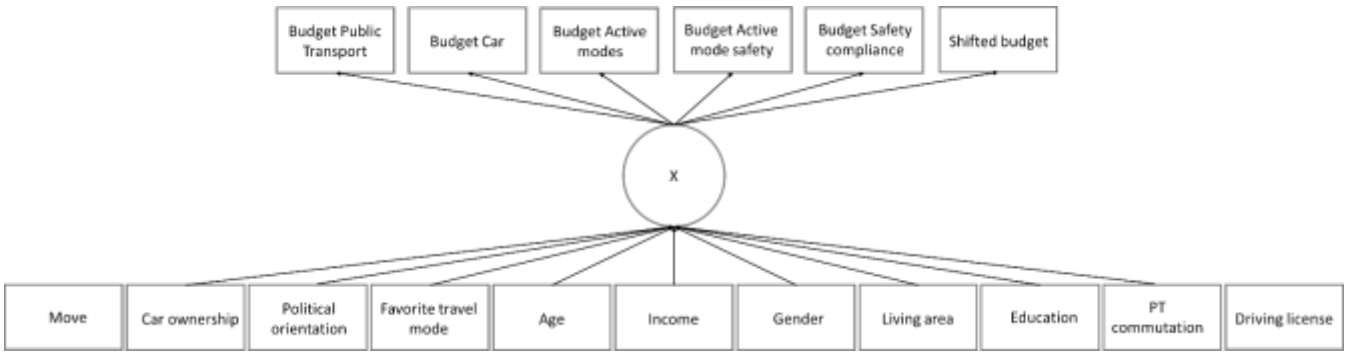


Figure 19 Cluster model including covariates

Table 42 presents the significant covariates. Only living area and gender are significant. All other covariates are not significant. One of the main advantages of a LCCA model is that it covers for correlations among covariates, which implies only the significant covariates predict class membership. These results mode preference is predominantly related to the living area rather than favorite mode or political orientation. Table 43 presents the profile distributions of the living area and gender, which should be used for cluster interpretations. Appendix G shows the profile distribution of insignificant profiles, which show deviations of political orientation and favorite mode. Since these covariates are not significant, these deviates imply both are related to other covariates, which are significant.

Table 52 Significant covariates

Covariates	**Wald**	**p-value**
Orientation	51.99	0.14
Living area	114.02	0.00
Favorite travel mode	30.33	0.17
Education	35.78	0.22
Age	6.72	0.35
Income	3.40	0.68
Gender	16.01	0.01
Expect to move	6.22	0.90
Car ownership	13.08	0.36
Driving license	12.53	0.40
PT commutation	15.66	0.21

Table 53 Cluster profiles significant covariates

	Cluster1	Cluster2	Cluster3	Cluster4	Cluster5	Cluster6	Cluster7
Living neighborhood							
No answer	0.19	0.14	0.16	0.18	0.22	0.18	0.13
A	0.09	0.09	0.10	0.11	0.40	0.09	0.10
B	0.12	0.04	0.11	0.06	0.14	0.02	0.05
C	0.18	0.32	0.27	0.38	0.12	0.37	0.24
D	0.11	0.16	0.14	0.08	0.05	0.07	0.08
E	0.23	0.17	0.20	0.15	0.01	0.18	0.15
F	0.08	0.09	0.03	0.03	0.07	0.09	0.26
Gender							
Male	0.52	0.54	0.49	0.46	0.61	0.70	0.61
Female	0.48	0.46	0.51	0.54	0.39	0.30	0.39

5.3.4 Cluster interpretation

Table 44 provides an overview of the characteristics of each of the 7 clusters. Each cluster is interpreted in terms of the budget allocated to a certain mode and the relation towards the background characteristics of individuals belonging to the cluster. The latter can be derived from the covariate distribution of the living area and gender in Table 43. The last column of Table 44 shows the dominant category of living area and gender belonging to each cluster. There seems to be a strong relationship between the travel mode most of the budget is allocated to and individuals' living area.

The following paragraphs present a description of each cluster. The average budget allocated per cluster and the available project costs of Table 38 can be used to determine if individuals select multiple cheap projects of a travel mode or one expensive of this certain travel mode. For example, if a cluster allocates 50 million on average towards safety compliance, they probably select the expensive safety compliance project. If a cluster allocates on average of 20 million towards safety compliance, they probably select the less expensive safety compliance project.

Table 54 Dominant covariate categories per cluster
**Only a slight overrepresentation*

Cluster	Cluster size	Short cluster description	Dominant living area	Dominant gender
1	26%	Safety compliance and cheap projects all modes	E* Haarlemmermeer	-
2	25%	Active mode, active mode safety, and PT	C, D Amsterdam	-
3	12%	Active mode safety, cheap active mode projects and shifted budget	C, E Amsterdam West, Haarlemmermeer	-
4	11%	Safety in general	C Amsterdam West	Female
5	10%	Active mode safety and car	A, B Zaanstad, Purmerend	-
6	10%	Active mode safety, cheap active mode, and car projects	C Amsterdam West	Male
7	6%	Public Transport	F Amsterdam Zuid Oost	-

Cluster 1: Safety compliance + cheap projects all modes (26%)

Table 55 Travel mode relatively a large share of the budget is allocated to by cluster 1

Modes	Budget allocated
Safety compliance	49

The first cluster allocates the largest share of the budget towards safety compliance, as presented in Table 45. The remaining budget is distributed over all different modes. Probably individuals select an expensive safety compliance project in combination with cheap projects improving different modes. Table 44 shows individuals predominantly live in area E, Haarlemmermeer. However, all other regions are presented to some extent. When looking at the projects proposed in region E, no expensive project is proposed in this region. Results of section 4.7.1 showed individuals are less intended to select expensive projects outside their living area than cheap projects outside their living area. Area E is the only area where no relative expensive project is proposed, which might the reason individuals living in area E have a higher probability belonging to the cluster.

Cluster 2: Active mode safety + PT (25%)

Table 56 Travel mode relatively a large share of the budget is allocated to by cluster 2

Modes	Budget allocated
Active mode safety	31
Public transport	23
Active modes	22

The second cluster allocates the largest share of the budget towards active mode safety and a relatively large share to active modes, as presented in Table 46. The dominant covariates of Table 44 show these individuals predominantly live in areas C and D, the city of Amsterdam. Eventually, relative expensive projects number 14 (Stadshouderskade) that improves active mode safety and number 13 (Cycling bridge Zeeburg) are located in these areas C and D. Also PT project number 8 and 6 are located close or partially in area D. Individuals seem to allocate the budget towards projects in and close to their living area instead of having a preference to stimulate active modes and PT in the region.

Cluster 3: Active mode safety + cheap active mode projects and shift the remaining budget (12%)

Table 57 Travel mode relatively a large share of the budget is allocated to by cluster 3

Modes	Budget allocated
Active mode safety	35
Shifted budget	30
Active modes	14

The third cluster allocates the largest share of the budget towards active mode safety. The remaining budget is partially allocated to less expensive active modes project and partly shifted to the next year, as presented in Table 47. Remarkably is that the third cluster is the only cluster shifting budget to the next year. However, the budget shifted is the average of individuals that belong to the cluster and shifted the budget. As Figure 16 showed, a relatively small part of the participants shifted the budget. Only a very few shifted a large part of the budget. These individuals influence the average number of shifted budgets. Therefore the average number presented presents a distorted view. In conclusion, individuals belonging to this cluster shifted some of the budgets.

The dominant covariates of Table 44 show these individuals predominantly live in areas C and E, Amsterdam West and Haarlemmermeer. The expensive active mode safety project Stadshouderskade number 14 is located in area C, and less expensive active mode projects 9 and 10 are located in area E (Haarlemmermeer). Individuals seem to allocate the budget towards these projects in their living area instead of having a preference for active mode and active mode safety. Furthermore, these individuals rather shift the remaining budget than allocate the remaining budget towards other projects in the area.

Cluster 4: Safety in general (11%)

Table 58 Travel mode relatively a large share of the budget is allocated to by cluster 4

Modes	Budget allocated
Active mode safety	40
Safety compliance	51

The fourth cluster allocates the full budget to safety projects, being safety compliance and active mode safety projects, as presented in Table 48. The dominant living area of Table 44 shows these individuals predominantly live in area C, which is Amsterdam West, and the area where relative active mode safety project 14 is located. Probably these individuals only select project 14 Stadshouderskade within their own area and the safety compliance project. The average budget allocated towards safety compliance indicates project number 15 of 50 million is predominantly selected, which is the traffic education project. The distribution of gender shows women have a higher probability of belonging to the cluster. Consequently, women living in the center of Amsterdam who prefer traffic education and the Stadshouderskade project, the only project located in their living area, belong to this cluster.

Cluster 5: Car and active mode safety (10%)

Table 59 Travel mode relatively a large share of the budget is allocated to by cluster 5

Modes	Budget allocated
Car	57
Active mode safety	51

The fifth cluster allocates the largest share of the budget towards car projects compared to the other clusters, as presented in Table 40. The remaining budget is allocated towards active mode safety projects, as presented in Table 49. The dominant living area of Table 44 shows predominantly individuals living in the northern areas A and B belong to this area, which are the areas Zaanstad and Purmerend. The expensive projects proposed in areas A and B are projects 1,3, and 12, which improve car and active mode safety. Individuals belonging to this cluster seem not to have a strong preference for cars and active modes but select the projects in or close to their living area.

Cluster 6: Active mode safety + cheap active mode and car projects (10%)

Table 60 Travel mode relatively a large share of the budget is allocated to by cluster 6

Modes	Budget allocated
Active mode safety	44

The sixth budget allocates the largest share of the budget towards active mode safety, as presented in Table 50. The sixth cluster seems to be more or less similar to the fourth cluster. Both clusters prefer active mode safety and predominantly live in area C. However, cluster 4 allocates the remaining budget to safety compliance, while individuals belonging to this cluster prefer to allocate the remaining budget to active modes and car improving projects, as presented in Table 40. The gender distribution of Table 43 shows men are more likely to belong to this cluster. These profiles suggest women in area C rather prefer traffic education, while men prefer to allocate the budget towards more car and bike projects.

Cluster 7: Public Transport (6%)

Table 61 Travel mode relatively a large share of the budget is allocated to by cluster 7

Modes	Budget allocated
Public transport	35
Shifted budget	18

The seventh cluster allocates the largest share of the budget towards PT projects, as presented in Table 51. The profile of the living area shows these individuals predominantly live in area F, Amsterdam Zuid Oost. Only two projects are located in area F, which both improve PT. The remaining budget is predominantly allocated towards safety compliance or shifted to the next year. The not significant profile of favorite travel mode in Appendix G shows that these individuals do not primarily have public transport as their favorite mode. These profiles suggest individuals living in area F prefer projects in their own living area, improving PT than projects in other living areas improving a travel mode they do use. The location of the project seems more important than the mode improved by the project.

5.3.5 Conclusion travel mode preference

At first, there seem to be clear clusters having a preference for a certain travel mode. However, the living area of individuals one-on-one overcomes with the expensive project proposed in the living area or close to the living area, except for traffic safety. Projects in the living area are frequently selected by individuals, even if the projects do not improve their preferred travel mode. Consequently, the clusters do not show clusters having a preference for a certain travel mode in the region, but clusters of individuals allocating the budget towards the travel modes of the proposed projects in their living area. Clusters that allocate a great extent of the budget towards a certain travel mode, predominantly live in the area an expensive project of this particular travel mode is proposed. One of the reasons is that expensive projects are predominantly selected by respondents living in the area the projects are located in. However, the clusters show a high percentage of individuals allocating a relatively high share of the budget towards safety compliance.

5.4 Insignificant covariates

Both favorite mode and political orientation are not significant covariates in any of the cluster models. However, these values do vary among the clusters, as presented in Appendix G. This result implies individuals do not base their choice on political orientation or favorite mode, but these characteristics are correlated with the living area.

Favorite mode

The results show individuals in areas A and B do predominantly have the car as their favorite travel mode, which are the northern parts of the region. Areas C, D, and E, the center of Amsterdam and Haarlemmermeer, have predominantly bike as their favorite mode. Furthermore, a relatively high percentage of areas C and D, the center of Amsterdam, have public transport as their favorite travel mode. Participants of area F, Amsterdam Zuid Oost, do not have a specific favorite travel mode.

The bivariate results of Chapter 4 presented car project numbers 1,3, and 5 were predominantly selected by car users, while car project 4 is not. Project 1 and 3 are relatively expensive projects located in area A and B. The cluster model shows these projects are predominantly selected by individuals living in Areas A and B. The insignificant covariates show favorite mode is related to living

area and individuals living in area A and B have the car as their favorite mode. More or less similar patterns are visible for other projects, and the mode improved.

Political orientation

The results show Social Democrats predominantly live in Areas A and B, which is the northern part of the region. Most liberal-oriented live in areas C, D, and E; the center of Amsterdam and Haarlemmermeer. Environmental-oriented individuals predominantly live in area C and E; Amsterdam West and Haarlemmermeer. A relatively high share of participants in area F is PVV/FvD oriented.

The bivariate results of Chapter 4 showed projects 14 located in area C, improving active mode safety was predominantly selected by environmental-oriented individuals. The insignificant covariates show political orientation is related to the living area. However, the cluster model showed the project is predominantly selected by individuals living in area C, who are environmental-oriented. More or less similar patterns are visible for other projects and political orientation.

5.5 Cross-table project choice and mode preference

A cross-table is constructed based on the posterior membership statistics, which is one of the outputs of the estimated model provided in Latent Gold. The posterior membership presents per participant the probability of belonging to this cluster. In the end, participants are assigned to the cluster that they have the highest probability to belong to. Table 52 provides an overview of the percentual distribution of participants. The total percentage per cluster is the cluster size. The table shows to which cluster the participants belonging to a certain cluster in the project cluster model are allocated in the travel mode cluster model and vice versa.

The horizontal columns present the clusters of the model, including project choices as indicators. The vertical rows present the clusters of the model, including travel mode preferences as indicators. Since the living area is the dominant covariate, the living area of individuals predominantly belonging to a certain cluster are presented as well. Just a slight overrepresentation is indicated with an asterisk icon.

The numbers between brackets show the percentual difference between the expected percentual distribution if there would be no relation between the two models and the revealed percentual distribution. If there were no relation, the participants would be distributed according to the cluster sizes. However, the deviations show a relation between the clusters. The clusters that seem to be related are marked in the Table 52.

One of the linked clusters is the ‘Traffic education and Stadshouderskade’ based on project choice cluster and ‘Safety compliance and active mode safety.’ Individuals selecting the projects traffic education and Stadshouderskade, which is expensive safety compliance and an expensive safety compliance project, belong predominantly towards the cluster ‘Safety compliance and Active mode safety.’ Consequently, these clusters are more or less the same. Therefore, it is logical a high number of respondents belongs that belong to this cluster in the project choice model belong to this cluster in the second model as well. A similar pattern is visible for the other linked clusters.

However, some clusters are presented by one model that is not presented by the other model. The 7th and smallest cluster of both models are not presented by the other model; the clusters ’accessibility of Purmerend’ and ‘Public Transport.’ However, both clusters are relatively small.

Furthermore, the third cluster of the cluster based on travel mode preference that relatively shifts a large share of the budget is not visible in the cluster model based on project selection. Eventually, individuals that shifted a relatively large share are not presented by project choice, which is reasonable since the shifted budget is not included as one of the indicators in the project choice cluster model.

In addition, the third cluster of the project choice model that selected as many projects as possible by selecting relatively cheap projects is not clearly visible in the travel mode preference model. However, most individuals belong to the first and second clusters based on mode preference. There seems to be a distinction among individuals selecting cheap projects improving all modes, improving active modes and active mode safety, and improving active mode safety and shift the remaining budget.

Lastly, cluster 1 based on mode preference is distributed over more or less all the clusters based on project choice. Cluster 1, based on mode preference, selects safety projects in combination with all kinds of modes. Almost all clusters based on project preference have some individuals belonging to this cluster. There seem to be individuals that select some projects in their living area, improving different kinds of modes in combination with (one of) the safety compliance projects.

Eventually, these results show that some estimated clusters of two models are linked to each other. However, both models do show some cluster characteristics that are not estimated by the other. The model based on mode preference does not clearly show individuals selecting many cheap projects or clusters in less densely populated areas selecting projects in their living area. However, the travel mode preference model is able to show clusters that have a strong preference for a certain travel mode. Consequently, the mode preference model shows the large cluster size for the cluster preferring safety compliance in some projects, improving different modes. The project choice model underestimates the size of this group has a preference for safety compliance. All living areas are represented within the cluster and a share of all clusters estimated by the model based on project choice belongs to this cluster. These individuals allocate half of the budget towards safety compliance and the remaining budget predominantly towards projects within their living area.

In conclusion, the cluster model based on project selection overestimates the share of individuals only selecting projects within their living area. The model based on mode preference shows a large share allocating budget towards safety compliance. Consequently, participants do not allocate the full budget to projects in their living area. However, individuals are intended to include projects in their project selection as well. Projects in or close to their living area are more attractive to most individuals than far-off located projects.

Table 62 Percentual distribution of participants allocation over the clusters and the percentual deviation if the participants would be equal distribution over the clusters according to cluster size

Projects \ Modes		Safety compliance + cheap car and active modes	Active mode safety + active modes	Active mode safety + cheap active mode projects and shift the remaining budget	Safety compliance and Active Mode safety	Active mode safety + car	Active mode safety + cheap active mode and car projects	Public Transport	**Total (cluster sizes)**
		E*	C,D	C,E	C	A,B	C	F	
Projects within Amsterdam	C, D	5 (-2)	9 (+2)	4 (+1)	2 (-1)	2 (-1)	2 (0)	3 (+1)	26
Traffic education & Stadshouders-kade	C	3 (-1)	3 (-1)	3 (+1)	6 (+4)	0 (-1)	0 (-1)	0 (0)	16
Many cheap projects scattered over the area	-	5 (+1)	8 (+4)	1 (-1)	0 (-2)	0 (-2)	2 (0)	1 (0)	16
Accessibility Zaanstad	A	1 (-2)	2 (-1)	1 (0)	2 (0)	6 (+4)	0 (-1)	1 (0)	13
Stadshouders-kade and cheap projects close to Amsterdam	C	0 (-3)	4 (+1)	1 (0)	0 (-1)	0 (-1)	6 (+4)	0 (0)	11
Safety compliance combined with cheap active mode projects	E	10 (+7)	0 (-2)	0 (-1)	0 (-1)	0 (-1)	0 (-1)	0 (-1)	10
Accessibility Purmerend	B	3 (0)	0 (-2)	1 (0)	1 (0)	2 (+1)	0 (-1)	0 (0)	8
Total (cluster sizes)		27	25	11	11	10	10	5	100

5.6 Cumulative project selection within the living area

The results of the cluster analysis show participants are intended to select projects within or close to their living area. Table 53 presents the percentage of participants that selected all projects or no projects within their living area. The statistics show in most participants select at least one project within their living area. In the areas where 3 projects are proposed, many participants did select at least 2 projects. However, the share that selected all projects within their portfolio is relatively small. In conclusion, most individuals do select projects in their living area but do not 'only' select projects within their living area.

Table 63 Distribution of individuals selecting all projects within their living area

proposed projects (#)	Area		All projects (%)	At least 2 projects (%)	At least 1 project (%)	No projects (%)
3	A	Zaanstad	16	81	92	8
	B	Purmerend	28	74	94	6
	E	Haarlemmermeer	24	58	88	12
2	D	Amsterdam Oost	26	-	80	20
	F	Amsterdam Zuid-Oost	8	-	63	37
1	C	Amsterdam West	60	-	-	40

5.7 Location-effect on municipality level

In the cluster analysis, the region is divided into 6 areas to reduce the additional parameters in the cluster model estimation. However, the project selection can be reviewed on a more detailed level of municipality, which divides the region into 17 areas, as presented in Appendix C. Table 54 and 55 show the distribution of project selection within the area, and in neighbor areas on the detailed level of municipalities for regions A (Zaanstad) and E (Haarlemmermeer). Projects located in the municipality within the area are marked dark green and projects located close to the municipality are marked light green. In some municipalities, almost 90 percent selected the project located within their municipality. The more far-off a project located from the municipality, the less frequently the project is selected. The location-effect is stronger visible on the municipality level. It should be noted, the response rate in some of the municipalities is relatively low. Therefore, the percentages are less accurate and representative. In contrast to area A, the projects in area E easily fits in the available budget combined with the safety compliance projects number 15 and 16. Both safety compliance projects 15 and 16 are included in the tables as well. The distribution shows the safety compliance projects are frequently selected by participants of area E (Haarlemmermeer), while not predominantly selected in area A. It is questionable if individuals living in area E have a higher preference for safety compliance projects than individuals in area A or this effect is caused by the fact that relative expensive projects are proposed in area A, while in area E, less expensive projects are proposed. Appendix H provides the percentages of projects selected in all municipalities and all projects.

Table 64 Distribution project selection in percentages within area A (Zaanstad)

Project number	1	2	7	11	12	15	16	Number of respondents
Project Costs	*50*	*3*	*5*	*4*	*40*	*50*	*20*	
Wormerland + Beemster	33	56	39	50	61	28	17	18
Zaanstad	41	41	60	37	51	25	22	111

Table 65 Distribution project selection in percentages within area E (Haarlemmermeer)

Project number	5	9	10	14	15	16	Number of respondents
Project costs	*10*	*8*	*6*	*40*	*50*	*20*	
Aalsmeer	90	80	50	30	20	90	10
Amstelveen	63	49	69	46	36	32	59
Haarlemmermeer	40	80	34	34	45	45	91
Uithoorn	87	60	73	13	47	33	15

5.8 Conclusion Clusters

The model presented clear clusters based on project selection and budget allocated to a certain travel mode. The clusters show predominantly projects' location affects project choices. However, projects having low costs are more frequently selected, either. Furthermore, a large group of individuals allocating a large share of the budget towards safety compliance is visible. The distribution of individuals' background characteristics showed a strong relation between the locations of the projects selected and individuals' living area; individuals are intended to select projects located in their living areas. In particular expensive projects are predominantly selected by individuals living in the area the project is located in. However, individuals do not only select projects in their living area or predominantly select all proposed projects in their living area. Other strategies are visible as well. Many participants allocate a large share of the budget towards safety compliance projects or select as many cheap projects as possible. Some groups of individuals apply a combination of strategies. However, no strategy for selecting projects improving a certain travel mode is shown. In addition, individuals' favorite travel mode is not related to individuals' project preferences. Consequently, the suggested relation, of car drivers that would only select projects that improve the car traffic network, does not occur. Also, political orientation is not significantly related to project preference. The results show both favorite travel mode and political orientation are related to the living area. Consequently, suggested relations between favorite travel mode and political orientation towards project preference are explained by the living area. Most individuals do allocate a subsequentially part of the budget to projects within their living area.

Furthermore, no clusters were visible based on quantitative project-attribute that showed quantified impacts in terms of safety, environmental, and travel time reductions due to the projects. These attributes seem to have no relation to project preference or are related to other project characteristics. It is not clear how participants took these attribute values into consideration, while deciding what projects to select.

In addition, demographic variables, being gender, age, education, car ownership, and expectations to move are significantly related to identified clusters. Women and individuals between the age of 20 and 40 are more likely to select safety compliance projects. High educated are more likely to select many low-cost projects, while lower educated are more likely to select projects within their living area. Car-ownership and expectation of moving did only differ among clusters having the center of Amsterdam as their living area. Therefore, more data is required to know the relation does occur in other areas as well.

In terms of disagreement, individuals do prefer different projects, since many individuals prefer to select at least one project in their living area. However, there are similarities in the strategies applied. Three main strategies of participants are visible, being 1) selecting projects in their living, 2) selecting as many as cheap projects and 3) allocating a large share of the budget to safety compliance.

The main founding of the quantitative cluster analysis is the strong relationship between the individuals' living area and the project location of projects selected. The visible location-effect has multiple implications. Firstly, projects in high populated areas are more frequently selected in total and have a higher probability of ending up in the optimal portfolio of projects. On the other side, expensive projects in less densely populated areas almost never end up in the optimal portfolio. Furthermore, the more individuals of a certain living area participate, the more likely the projects located in that living area are ending up in the optimal portfolio.

6. Experts' reflection on the results

The quantitative results of the cluster analysis showed three kinds of visible strategies among participants, being 1) selecting projects located in their living area, 2) preference for safety compliance and 3) selecting as many cheap projects as possible. However, the results showed many participants (60 to 94 percent per living area) were intended to include a project in their living area in their portfolio, which is called the location-effect. The qualitative results of this section present experts' reflections on the implications of the three strategies presented and, in particular, the strong location-effect. Scientific CBA and PVE experts review the theoretical implications for the evaluations of citizens' preferences, the advantages of PVE as an evaluation method for spatial-infrastructure projects and implications for policymakers, based on the results of the cluster analysis. Policymaking experts are asked to review the implications for policymaking in particular and how the information about citizens' preferences can support the decision-making process.

6.1 Interview setup

Dr. P.R. Koster of Vrije Universiteit Amsterdam Department of Spatial economics is approached as a PVE expert since he is one of the original developers of the PVE tool and one of the authors of the cited publications about PVE in Chapter 2. The interview was conducted in January 2020. The aim of the interview was to reflect on the implications of the various clusters distinguished in terms of 1) scientific evaluation of citizens' preferences for new spatial-infrastructure, 2) methodological implications for PVE as an alternative of CBA and 3) policy implications. In addition, the desirability of the patterns (such as individuals selecting projects within their living area, no pure clusters based on preference for a travel mode, such as a preference for cycle projects in the region) is reviewed.

Prof. dr. G. P. van Wee of Delft University of Technology Department of Technology, Policy, and Management is approached as a CBA expert since he is the author of multiple scientific key publications about CBA as an evaluation tool in transportation project appraisal. The interview was conducted in Delft in January 2020. The setup of the interview is equal to the setup of the interview with the PVE expert. However, the aim is to reflect on the results from another perspective than as a proponent of PVE in order to maintain the integrity of the implications for PVE and project evaluation in general.

Four policymakers working at the Vervoerregio Amsterdam were approached as decision-making experts. First, a meeting about citizen participation was conducted with senior project leader S. Talen of the department Knowledge and Research and senior advisor H. Luchtmeyer of the department Strategy, Management, and Communication. The interview was conducted in Amsterdam in December 2019. Both policymakers have expertise in regional project evaluation and setup of traveler panels to gather information about citizens' preferences for urban mobility, such as the Zaanstreek panel that was used to gather travelers' requirements for regional bus services, as discussed in Appendix I. A second interview was conducted with senior policy officers C. Winnips and J. van Os, who have expertise in the actual policy-making on a regional level and what information to consider in decision-making. The interview was conducted in Amsterdam in January 2020. The aim of the first interview was to discuss the level of citizen participation applied by Vervoerregio Amsterdam and their impression of the PVE tool to gather information about citizens' preferences. The aim of the second interview was to discuss how the distributed results of PVE should help decision-making and fit the best in the decision-making process.

6.1.1 Presentation to introduce interviews

For each of the interviews, one hour was available. The interviews were introduced with a short presentation of 5 minutes supported with a slide show. In the presentation, the main advantages of PVE and how it overcomes the problems with private WTP of CBA were explained as presented in Chapter 2. Subsequently, the case study was introduced by showing the online demo version of the tool of the experiment. The graph showing the average results of PVE was presented. It was stated that the average results do not provide accurate information and could even result in a distorted reflection of citizens' preferences. Consequently, the need for results that cover for distribution was motivated. Hypothetical relations of how individuals select projects were presented, which are the project-specific characteristics of the conceptual model. Furthermore, the hypothetical relations of background characteristics towards project preference were presented, being living area, political orientation, and favorite travel mode. The graph showing project selection by distance living area of Section 4.7.1 was presented to show a relation between the living area and project selection is suggested. The names of the seven identified clusters of the analysis based on project choice were presented. The first cluster was presented in a more detailed way to show that the combination of projects selected by individuals is strongly related to their living area. The clusters identified in the analysis based on the travel mode preference were presented as well to show that no strategy based on travel mode is visible, and individuals allocate a large share of the budget to projects in their living area, which do not improve their preferred travel mode. The distribution of the alternative strategies among participants, being selecting safety compliance projects and many projects having low costs, was also presented.

6.1.2 Setup semi-structured interview

A semi-structured list of questions was used for conducting the interviews. More or less, the same structure was used both for the interviews with the scientific experts and the policymaking experts. However, the focus of the interviews with scientific experts was to reflect the scientific implications of citizens' preference for spatial-infrastructure projects and PVE as an evaluation tool, whereas the focus of the interviews with policymaking experts was to discuss how to deal with the information provided as a policymaker and how the information could be applied in the decision-making process. The five themes are in accordance with the five sub-questions that try to answer the second research question. For each of the five themes, concrete questions are formulated to structure the interviews. The information provided by the interviews should answer these concrete questions.

1. Distribution of identified clusters

The results show participants are intended to select projects in their living area. The first implication of the location-effect is that projects located in highly populated areas receive more votes and have a higher probability of ending up in the optimal portfolio. Apart from that, the second complication is that the estimated welfare increase of projects that are located in overrepresented living areas in the sample is overestimated.

1.1 Would you have expected in advance citizens are intended to select projects in their living area?
1.2 *(to PVE and CBA expert)* If you would correct for the representativity of participants' living area, would this solve the problem of incorrect estimations for welfare increase due to a project?
1.3 To what extent is it desirable or problematic that respondents have the tendency to select projects within their living area?

1.4 To what extent is it problematic that projects in high populated areas relatively easily end up in the optimal portfolio, while relatively expensive projects in remote areas almost never end up in the optimal portfolio?

2. Geographical level of scale

One of the reasons individuals do not frequently select projects outside their living area could be that individuals do not have enough information about these projects. The scale of the experiments might be too large, causing individuals missing local knowledge about projects in other regions. Therefore, the scale of citizen participation experiments is reflected upon.

2.1 Citizen participation on a lower scale results in a more balanced distribution of local knowledge and experience of projects among participants, while citizen participation on a larger scale enables the opportunity to identify individuals' regional desires. Which insights are the most useful in a project evaluation?
2.2 Which geographical level of scale is the most desirable for the evaluation of regional transportation while knowing the identified clusters of this study?

3. PVE compared to CBA

This paper named the differences between PVE and CBA and how PVE possibly overcomes the problems with CBA. However, based on the results showing individuals are intended to select projects within their living area, the statements of how PVE overcomes the problems with CBA are reviewed.

3.1 *(to PVE and CBA expert)* To what extent are these results in line with the statement that individuals' priorities based on their private budgets do not reflect citizens' preferences for governmental spending for public infrastructure?
3.2 *(to PVE and CBA expert)* Knowing individuals' tendency to select projects within their living area, what is the advantage of PVE over CBA?

4. PVE Methodology

The intention of participants to select projects in their living area, the importance of less expensive projects, and safety compliance might be enlarged due to the design of the experiment. Information about these factors is presented in the project title overview, while project attributes are not. Furthermore, additional constraints in project selection could be added, or additional questions to gather more information about citizens' background characteristics could be included. Experts are asked to reflect on the way the PVE tool is designed.

4.1 What should be changed in the design of the PVE tool?
4.2 Which additional information of participants should be gathered in the PVE tool?

5. Policy implications

The aim of the distributed preference profiles is to present accurate information to policymakers about citizens' preferences for the allocation of a fixed public budget towards new spatial-infrastructure projects. Experts are asked to reflect on the implications of these distributed profiles for policymaking. In addition, policymaking experts are asked how the information of PVE could add value to the decision-making process.

5.1 To what extent does the insight that individuals select projects within their living area help policymaking in choosing projects?

5.2 *(to policymaking expert)* How should policymakers apply the information provided by PVE in policymaking?
5.3 *(to policymaking expert)* To what extent does the decision-making account for equal distribution of budget allocation?
5.4 *(to policymaking expert)* What are the main advantages of citizen participation in decision-making?

6.2 Interview results

The full interviews are presented in Appendix J. The main observations per topic are presented in this section. It should be noted that the aim of the interview is to present experts' reflections on the consequences in each of the 5 topics, as presented in Section 6.1.2. This section shows the empirical results of the interview. Chapter 7 further reflects on the results of the experts' views.

6.2.1 Experts' reflection of identified clusters and location-effect

Would you have expected in advance citizens are intended to select projects in their living area?

None of the interviewees did expect in advance the location-effect would dominate other effects. Both two scientific experts and the policymaking experts expected to see clusters having a specific preference for certain travel modes in the region. However, the fact that the results show a strong effect on location does not convince the interviewees that other aspects do not affect project preference. The interviewees are interested in how to decrease the location-effect and came up with multiple suggestions, such as excluding the project location in the title of the project.

If you would correct for the representativity of participants' living area, would this solve the problem of incorrect estimations for welfare increase due to a project? (to PVE and CBA expert)

Both two scientific experts (CBA and PVE) agree that the PVE analysis should correct for representativity of the living area since the living area is significantly related to project preference. In general, PVE should correct for representativity of all background characteristics that are significantly related to project preference.

To what extent is it desirable or problematic that respondents have the tendency to select projects within their living area?

The scientific PVE expert argues that participants should be allowed to select projects in their living area. The decision about what strategy to apply should be left to participants themselves, which is the aim of PVE. If participants prefer to allocate the budget to projects close to their living area, participants should be free to do so. In conclusion, the location-effect is not problematic in this experiment, according to the scientific PVE expert.

The scientific CBA expert argues that it is useful to know for scientific research in which the location-effect exists. However, when designing another experiment, it is not desirable to measure again a strong tendency of individuals selecting projects in their living area. For project evaluation, it is not desirable to measure that individuals select only projects in their living area, because such a research would not provide new insights compared to this study. The location-effect is quite strong. It is important to be aware of the location-effect. However, the strong effect does not rule out the existence of other effects. Especially since other strategies of selecting many low costs projects and a preference for safety compliance is visible as well. The CBA expert argues the location-effect should be controlled to better identify alternative effects. In addition, the CBA experts do not agree on excluding the location of projects in the entire experiment. However, the scientific CBA expert mentioned further research should investigate how to decrease the location-effect.

The policymaking experts argue, in case that participants first select the proposed projects in their living area and secondly allocate the remaining budget to other projects, it is not very useful for policymaking to know that projects are highly ranked by citizens. Alternative information about citizens' preference for a travel mode would be more useful. So, according to policymaking, it would be problematic if individuals would only select projects within their living area because they perceive that information would not be applicable in the decision-making process.

To what extent is it problematic that projects in high populated areas relatively easily end up in the optimal portfolio, while relatively expensive projects in remote areas almost never end up in the optimal portfolio?

The scientific PVE expert argues it is not a problem of PVE as an evaluation tool that projects in high populated areas are higher valued since it is not the aim of any project evaluation tool to democratically decide which projects are the fairest to realize. The purpose of PVE is to provide information about the projects preferred by citizens. It is up to decision-makers to take these results into consideration and to decide which projects should be realized.

Furthermore, the consequence that projects in high populated areas are more likely to end up in the optimal portfolio is not a problem itself, according to all experts. In highly populated areas, more individuals benefit from the new projects and the more people live in a certain area, the higher the number of people that pay taxes in that area. Consequently, it is fair that more budget is assigned to these areas and it is not problematic these projects relatively easy end up in the optimal portfolio. A similar reason is used for expensive projects located in more remote areas that almost never end up in the optimal portfolio. According to all experts, it is questionable whether to realize highly expensive projects in more remote areas. In general, the budget should be allocated proportionally towards the areas, according to the CBA expert. More budget to highly populated areas would be proportional, allocating the full budget to these high populated areas would not be proportional. The described consequence of projects in high populated areas that are more likely to end up in the optimal portfolio is in accordance with the proportional distribution.

The policymaking experts stated that indeed a large share of the total budget is allocated towards the city of Amsterdam, the high populated area within the region. They argue the benefits of projects in high populated areas are more likely to exceed the project costs; these projects have a higher cost-benefit ratio. Consequently, it should not be problematic that these projects are more likely to end up in the optimal portfolio, according to policymaking experts. However, the policymaking experts argue they cannot allocate all the budget to projects having the highest cost-benefit ratio since they are responsible for maintaining the regional network as a whole. Performance indicator requirements are set to ensure the performance of the network as a whole, such as maximum travel time from one place to another. If the required travel time is exceeded, network improvements are needed, even though it is a remote area. However, the travel time requirements are set per type of region according to the level of urbanization. The requirements for travel time from one place to another are more strict for highly populated areas. The establishment of requirements is explained in Appendix I.

Further remarks

Furthermore, both scientific experts agreed that the location-effect should be identified at a more detailed level in terms of the relation between individuals' value assigned to a project and the distance from the living location to the project location. These results show a negative correlation for participants between distance to projects and the project utility. The PVE expert stated that the

negative correlation with the distance should be included in one of the equations of the advanced MCDEV model that analyzes the welfare increase due to a new project.

6.2.2 Experts' reflection on the scale of citizen participation

Citizen participation on a lower scale results in more local knowledge and experience of participants, while citizen participation on a larger scale enables the opportunity to identify individuals' regional desires. Which insights are the most useful in a project evaluation?

According to the scientific PVE expert, the aim of PVE is that participants are free to decide what strategy to apply. Individuals might prefer to select projects in their living area. However, others prefer to select more projects with a lower budget over the area. The regional scale of the experiments allows both strategies. In other words, the scientific PVE expert agrees that PVE should be on a regional level to test regional desires. The scientific PVE expert does not reflect on whether it is a problem that participants have more local knowledge about projects within their living area.

The CBA expert mentioned, it is not one of the two insights being more useful than the other. Both insights are very useful on their own. However, it is important to define the aim of citizen participation on beforehand to define the best fitting scale. If the purpose of citizen participation is to retrieve local knowledge, a more local scale might be a better fit. If the purpose is to identify individuals' regional interests, the regional scale might be a better fit. Consequently, there is not one optimal scale for citizen participation, according to CBA expert.

However, the scientific CBA expert and policymaking experts argue that it is questionable to what extent individuals are able to unbiasedly compare projects within their living area to projects outside their living area. Therefore, they both argue that it might be useful to disallow participants to select projects within their living area to show regional desires.

Which geographical level of scale is the most desirable for the evaluation of regional transportation while knowing the identified clusters of this study?

The scientific PVE and CBA experts both agree to the regional level as applied in the case study is the best fit to identify citizens' regional desires. Policymaking experts of Vervoerregio Amsterdam also agree the regional scale is a good fit since it includes inhabitants living close to the location and travelers living in the region.

6.2.3 Experts' reflection on PVE as an evaluation tool compared to CBA

To what extent are these results in line with the statement that individuals' priorities based on their private budgets do not reflect citizens' preferences for governmental spending for public infrastructure? (PVE and CBA expert)

According to the scientific PVE expert, the setting of the tool creates the difference with the private WTP approach. Within the setting of PVE, it is not a problem if individuals make the same choices as they would do using their private budget. PVE does allow for participants to apply that approach as well. However, not *all* citizens' trade-offs using their private budget reflects their preferences for governmental spending. Some might select projects they are most intended to use, while others apply a more altruistic strategy. PVE allows both kinds of trade-offs, while private WTP experiments only reflect the user-potential.

According to the scientific CBA expert, the PVE experiment should not just measure individuals selecting projects in their living area since that would only reflect the user potential of projects. On the other hand, the CBA expert also mentions that the two alternative clusters that are shown by this study, being 1) selecting as many cheap projects and 2) prioritizing safety compliance, imply

participants do not only select projects they are more intended to use. However, the identified location-effect is quite strong. According to the CBA expert, it should be tested how the location-effect could be decreased by the design of the PVE tool since the location-effect might dominate other effects. If these tests show other project characteristics than safety are alternatively evaluated either, which is explained by the individuals making other trade-offs with their private than public budget, the concept becomes more interesting. The CBA expert mentions projects explicitly focusing on the reductions of carbon or noise pollution as a suggestion. Further research should identify the extent of differences between PVE and a more or less similar experiment from a private WTP.

Knowing individuals' tendency to select projects within their living area, what is the advantage of PVE over CBA? (PVE and CBA expert)

According to the scientific PVE expert, it is about the setting of PVE that differs from the approach in CBA, which creates the advantage of PVE over CBA. Individuals have the option to select projects in their living area or, in contrast, select projects located far-off their living area. The projects preferred by citizens could be the projects they are most likely to use but do not have to be. According to the PVE expert, that is a better reflection of how citizens evaluate projects than the private WTP approach of CBA. Therefore PVE should replace CBA according to the scientific PVE expert.

According to the scientific CBA expert, the PVE tool should measure more than just participants preferring projects close to their living area since less complex experiments could be used to measure that effect. However, the scientific CBA expert does believe other aspects do affect project choice, which is implicated by clusters preferring safety compliance or low costs projects. Consequently, the CBA expert believes PVE could be used to present an alternative perspective of project evaluation, which concept is interesting. The CBA expert does not state that one method should replace the other.

6.2.4 Experts' reflection on PVE methodology and design

What should be changed in the design of the PVE tool?

First, the information provided in the project titles might be one of the causes of the location-effect, according to the CBA expert. Individuals might make a preselection of projects purely based on the location of the projects. Consequently, the location-effect might be decreased by not naming it in the project title or not naming it at all. Policymaking experts agree that the project title might influence participants' choice. They propose to test the effect of naming alternative characteristics in the project title as well. For example, the number of trees cut. The policymaking experts are interested if these attributes would still have no effect in that case.

Furthermore, according to policymaking experts, multiple projects improving alternative travel modes should be proposed per living area. This is in contrary to the applied case study, in which only Public Transport projects were proposed in region F (Amsterdam Zuid-Oost). The policymaking experts argue all participants should have the option to choose different projects, improving different travel modes within their living area. Furthermore, the total costs of the projects proposed should be equal per living area according to policymaking experts. These changes would reflect a more similar trade-off among participants in selecting projects within their living area or outside their living area.

Which additional information of participants should be gathered in the PVE tool?

The scientific PVE expert suggested that information about the sequence of project preferred could be derived if participants first have to rank all the projects. More information about first choice projects or budget filling projects would be provided.

In addition, the scientific PVE expert suggests including an additional constraint to projects selection, which disallows participants to allocate the full budget to their living area. A minimum constraint could be set, which forces participants to allocate a minimum budget to each of the regions. A maximum budget could be set to restrict the budget allocated to participants' living area.

Furthermore, additional information about travel behavior would be useful information, according to all experts, for instance, information about individuals' work locations. Travel behavior might show individuals select a project that improves the infrastructure where they frequently have to travel.

6.2.5 Policy implications

How should policymakers apply the information provided by PVE in policymaking?

According to the scientific CBA and PVE expert, an evaluation method like PVE should provide accurate information about citizens' preferences to policymakers. However, it is up to policymakers what decisions to make and to what extent to consider these preferences of citizens. Consequently, the scientific CBA and PVE experts do not concretely answer how the insights should help policymakers.

However, the CBA expert does mention some insights that could help policymakers. For instance, the results show clusters of participants selecting many low costs projects. This indicates participants prefer to distribute the budget over multiple projects rather than one expensive project. Policymakers could apply this strategy.

Policymaking experts argue that citizen participation provides useful information about what kind of projects are preferred by citizens. They mention citizens' preferences could provide useful information about societal interest for specific projects. However, they explicitly note policymakers would never directly apply the results of citizens' preferences but will take the information into consideration for their final decision. Policymakers have to determine if citizens' preferences shown by an experiment like PVE are desirable for the region and result in the best infrastructure for people. The policymakers do not mention concrete or explicit examples of how information about citizens' preferences should enrich the decision-making process and to what extent the preferences are taken into consideration.

In what step of decision-making does an evaluation tool like PVE or general citizen participation add the most value? (policymaking expert)

As described in Appendix I, all project initiatives have to be in line with the established strategic and tactical vision of the region. When there is a new initiative for a project, the project has to follow a specified phasing process. Appendix I describes the whole phasing process in more detail. The level of specification in terms of budget, scope, and design of the project increases with the phases. From the moment a project initiative starts the phasing process, the project is placed on the operational investment program and the estimated project costs are reserved within the available yearly budget for infrastructure projects, which is a bit more than 100 million euros per year. Policymaking experts suggest three sub-processes where alternative citizen participation would create additional value. The first two sub-processes are part of the phasing process per project. The third process is a separate process evaluating projects regarding each other on a higher level.

1. Initiative phase

In the initiative phase, the problem definition is established. Citizen participation could help policy-makers in the solution directions that are in line with citizens' needs. Themes of mobility preferred rather than specific project preferred are better applicable in this phase since no concrete projects are defined in the initiative phase. However, policymaking experts argue a regional scale would be the best fit in this phase to approach both inhabitants and travelers on a regional level.

2. Examination phase

In the examination phase, the project (alternatives) are evaluated. Citizen participation could help decision-makers to choose the preferred solution for a specific problem. For example, citizens could choose between a bridge, a tunnel, or a detour as a solution for a missing link. The evaluation of concrete project variants is the most valuable in this phase. However, a smaller scale would preferable to make use of local knowledge. Due to local knowledge, citizen participation could create insights on what important to take into consideration. Policymaking experts do not name concrete examples. In addition, a citizen participation experiment in which individuals choose between different solution variants would be useful for decision-makers to know which alternative has more support among citizens, who should be the users the infrastructure in the end.

3. Project prioritization

Project prioritization is used to determine which projects have more priority with reference to other projects. In reality, many project ideas are ongoing, one being more concrete than the other. Next to the phasing process, these ideas are bundled, and these projects are prioritized, for instance, due to budget or time constraints. Citizens' preference for specific projects might be useful for the prioritization of projects. However, the type of projects preferred by citizens' could be used for prioritizing in more situations than these set of proposed projects. The preferred impacts of projects could help the Vervoerregio what kind of projects to devote money to. Especially in the future, the prioritizing of projects is expected to be more crucial due to more budget constraints. The policymakers do specify how these projects are prioritized and what the precise consequences are.

To what extent does the decision-making account for equal distribution of budget allocation? (policymaking expert)

The decision-making process is project-based, which implies projects are evaluated based on performance indicators, whether it fits in the available budget and is in accordance with the established vision of the Vervoerregio Amsterdam, as described in Appendix I. Once a project initiative is accepted, the project is included in the agenda of investment and the budget is reserved.

In the past, 100 million euros were divided over the modalities in different fixed budgets (12% cycling, 61% public transport, 7% traffic safety and 20% road traffic according to public information on the website (Vervoerregio Amsterdam, 2019b)) as described in Appendix I. However, the Vervoerregio Amsterdam has reviewed this distribution and changed the budget to a more flexible distribution. The policymakers stated that the more flexible approach is more in line with the responsibility of the network as a whole, instead of review each network per modality separate.

In addition, policymakers are asked how they consider the spatial distribution of the budget. The policymaking experts explain that there are no strict guidelines for the spatial distribution of the budget. However, the investment agendas are reviewed twice a year by the Region Council, in which representatives of all 15 municipalities are part of. According to the policymaking expert, the Region Council that controls the budget allocation would not approve an agenda of investment in which the budget is disproportionately allocated over the region. Consequently, the proportional spatial distribution is indirectly taken into account.

What are the main advantages of citizen participation in decision-making? (policymaking expert)

Policymakers stated that it is their ambition to increase citizen participation in their decision-making process. There are three main pillars of why the region (Vervoerregio Amsterdam) has the ambition to include more citizen participation in the decision-making process.

1. The information can be used to realize the infrastructure that is more in line with citizens' needs.
2. It is relatively easy to consider citizens' preference in the project phase compared to changing the design after the project is realized.
3. Local experience and local knowledge are useful for better infrastructure designs.

The policymakers explicitly noted that policymakers do not directly apply citizens' preferences. The information is very useful for policymakers. However, not all preferences of citizens result in the optimal infrastructure. Citizens' preferences are one of the many inputs that should be taken into consideration. The policymakers do agree that just implementing citizens' preferences is not an option and would make policymakers redundant.

7. Reflection on experts' views

Section 6 showed the empirical results of experts' reviews. This section reflects on the experts' views and suggestions, whether these are legitimate according to the findings of this study, the described concept of PVE, and the described decision-making process. The comments and suggestions are discussed according to the similar 5 themes of Section 6.2, being 1) theoretical implications of the location-effects, 2) scale of citizen participation, 3) PVE compared to CBA, 4) PVE design and 5) policy implications. The first three themes are more theoretical perspectives, the fourth more methodological, and the last one policy implications.

7.1 Reflection on the location-effect

7.1.1 Desirability implications location-effect

One of the main findings of this study is that individuals are intended to select projects within their living area, which is called the location-effect. The two main implications are 1) welfare increase of projects located in living areas that are overrepresented in the sample are overestimated and 2) projects in high populated areas are more likely to end up in the optimal portfolio, while expensive projects in remote areas end up in the bottom of the ranking of projects.

According to the scientific CBA expert and the scientific PVE expert, the first implication is problematic. Therefore, the optimal portfolio analysis should correct for the representative's living area, according to experts. Correcting for representativity of significant background characteristics does result in a better reflection of what projects are on average, ranked the highest by citizens. However, the optimal portfolio that corrects for the representative area does still not provide any information about the distribution of citizens' preferences. The aggregated portfolio loses information about strategies applied by citizens and the distribution of views what is the best infrastructure. So the analysis of the optimal portfolio should correct for the representative's living area to properly reflect average views, but it is still questionable whether the average view is the most valuable information.

Furthermore, all experts stated the second implication is not a problem of a project evaluation tool itself. If the assumption is that the more people benefit, the higher the welfare increase due to a project. The evaluation tool correctly shows the welfare increase of a project located in a high populated area results in a higher welfare increase than a project in a low populated area. The scientific experts agree that the allocation of budget in practice should be proportional to populations of areas. For instance, allocating the full budget to Amsterdam would be out of proportion. The results show the latter is not the case in this study. However, according to the experts, it is not the aim of an evaluation tool to correct for fair democratic results. In conclusion, it is not a problem that projects in high populated areas are more likely to end up in the optimal portfolio. However, if only projects in high populated areas end up in the optimal portfolio, it is not a problem of the evaluation tool but up to policymakers to correct for the proportional distribution.

7.1.2 Desirability participants select projects in their living area

The experts reviewed to what extent it is desirable individuals select projects in their living area. The PVE expert argues participants should be allowed to select projects in their living area. In contrast, the CBA expert argues it is not desirable to just measure that citizens prefer projects in their living area, and policymakers argue that the information about citizens preferring projects in their living area over projects in other areas is not useful for policymaking. This paragraph shows both sides can be argued, depending on the aim of the study.

The study shows that only 16 to 28 percent select all (2 or 3 projects) in their living area. The results of the cluster analysis also showed individuals frequently select low-cost projects in other areas, where no living area was explicitly related to. A reason could be individuals believe not all budgets should be allocated to their living area, which reflects a preference for spatial-equality. The other way around, the expensive projects in very high populated city centers are also selected by individuals not living in that area. For example, individuals living in Haarlemmermeer frequently selected the project in the city of Amsterdam. One of the reasons could be that these individuals know the traffic situation because they frequently travel to these areas. Furthermore, the results showed a preference for projects improving safety compliance and projects having low costs, which are not related to the location of the project. The three strategies are shown by this study imply an entanglement of interests coming together in PVE; social interests (e.g., safety compliance), ethical interests (e.g., spatial equity), and economic interests (e.g., projects in own living area or improving infrastructure they frequently make use of). Individuals selecting projects in their living area is one of the multiple interests expressed by participants in PVE. As a result, the PVE does not *'only'* measure individuals' preferred projects in their living area, which is suggested by policymaking experts. The location-effect is one of the aspects to reflect the mix of spatial-infrastructure projects preferred by citizens. The results reflect on what extent individuals prefer projects in their living area or attach value to spatial equality. Consequently, the location-effect is not problematic if one wants to identify citizens' preference for spatial-infrastructure projects over the region.

However, experts expected to see clusters having a preference for a certain travel mode and select projects improving this particular travel mode over the region. For example, participants who prefer to stimulate cycling, selecting a portfolio of predominantly cycling projects, whereas the results of the cluster analysis did not show these kinds of clusters. The results implicate citizens do not have a particular travel mode preference in the evaluation of the project but assign more value to other characteristics such as project location. Apart from their expectations, the policymaking experts mentioned it would be more useful if there were clusters based on travel mode preference, while on the other hand, they mention that within the Vervoerregio Amsterdam, projects are evaluated per individual project. Their past approach of fixed total budgets per travel mode is abandoned. Therefore, it seems to be contradictory that information about citizens' travel mode preference would be more useful.

Besides, as the scientific CBA expert mentioned, for the scientific evaluation of citizens' preferences, the occurrence of the location-effect was not identified yet. Consequently, the identified location-effect is an important finding. Further scientific research should be aware of it. However, the dominant location-effect does not imply other effects like travel mode preference do not occur at all. It could be that travel mode improved is an additional reason to select a project. For example, individuals could prefer cycling, but rather have a public transport project in their living area they can make use of than an alternative cycling project on the other side of the region they never visit. However, in an alternative experiment where the individuals could choose between a cycling project or a public transport project in their living area, the individuals who prefer cycling would maybe choose the cycling project in their living area. If one wants to explore the effect of characteristics that are probably dominated by the location, such as travel mode improved by the project, the location-effect dominating these effects would be problematic. Consequently, in such an experiment, the location-effect might be better decreased or excluded.

In conclusion, to what extent the location-effect is problematic depends on the relation one wants to evaluate. If the aim is to identify individuals' preference for a combination of projects in the region, the location is one of the characteristics of the projects. The information about the location of projects

enables participants to express their preference for the spatial distribution of the budget. In contrast, if the aim of the experiment is to evaluate citizens' value for concrete effects of projects like noise decreasing measures, the location-effect dominating all effects might be undesirable.

7.2 Reflection on the applied regional scale

The experts reflected on the fit of the regional scale of citizen participation, as applied in the experiment. All experts agreed that the regional scale is the best scale to explore citizens' desires on the regional level.

However, the scientific CBA expert and the policymaking experts argue participants might be unable to objectively compare projects in their living area to projects in other regions. To overcome this problem, they suggest to not allow individuals selecting projects in their living area.

In contrast, the scientific PVE expert noted that the aim is to allow participants to decide on the strategy they prefer to apply. Participants are allowed to allocate the full budget to their living area. On the other side, individuals have the choice to equally distribute the budget over the region, either. The regional level enables to evaluate citizens' preferences for projects outside the region. Consequently, disallowing individuals to select projects within their living area would not accurately reflect individuals' preferences, because forcing participants who prefer to allocate the budget to their living area to select other projects does not reflect the preference of that participant.

However, one of the risks of an experiment on a regional scale is that participants have more local knowledge about projects in their living area. Whereas it could be the case, participants have never visited the location of the far-off located projects. Consequently, the participants' knowledge about the current traffic situation of the proposed projects might be unbalanced, which risks participants selecting projects in their living area because they know these projects. The experts did not provide suggestions to solve the unbalanced knowledge about projects.

Eventually, if the aim of the project is to retrieve local knowledge of citizens instead of their preferred regional strategy, a lower scale might be a better fit to ensure all participants have a more or less equal amount of local knowledge, as the CBA expert suggested.

In conclusion, there is no one optimal fit for citizen participation. The best scale for projects depends on the purpose of the study. If the focus is to gather local knowledge, a lower scale might be a better fit, while a regional scale seems a better fit for identifying citizens' strategy of project selection. However, a limitation of an experiment on regional fit is the unbalanced knowledge about projects.

7.3 Reflection on PVE as an evaluation tool compared to CBA

The main difference between the approach of PVE and the private WTP approach is the setting of PVE. PVE allows participants to apply any strategy they prefer, while CBA only shows the user potential, according to the PVE expert. Consequently, individuals selecting projects in their living area does not contradict the concept of PVE.

However, if the results of this study would show individuals would only select projects in their living area, the results would not reflect a significant difference from the private WTP approach, according to the CBA expert. Indeed less complex methods could be applied to measure that effect. However, the results show individuals do not just select projects in their living area. Participants select among else low costs projects over the region and assign a high value to safety compliance, which the WTP approach of CBA is not able to show. Consequently, the results are not reflecting a similar trade-off as the private WTP approach would show.

Furthermore, the PVE expert mentions the PVE better reflects citizens' preference for projects and should replace CBA. However, the CBA expert argues both methods show an alternative perspective, where the PVE perspective could also be interesting. The PVE tool might better show individuals' budget preference and their preferred strategy for a combination of projects. However, projects are mainly valued based on location, costs, and improvements to safety compliance. CBA shows a systematic comparison of projects attribute values, which participants of PVE seem to not predominantly do.

7.4 Reflection design PVE tool

The experts made multiple suggestions for changing the information provided, adding more constraints, and adding more questions about individuals' background characteristics. The suggestions are reflected in the concept of PVE in this section.

Each of the experts argued that the way information is presented to participants affects their choices. The policymaking experts mentioned that it could be that project attributes significantly affect project choice when attribute values are presented in the project title. The information needed for the three strategies visible is all presented in the project title, being the project location, project costs, and safety compliance effects. Therefore, the information presented in the project title should be reconsidered. For example, if the location-effect is perceived as problematic, not naming the location of the project in the title could be considered.

Furthermore, a ranking of the selected portfolio is proposed by the PVE expert. The ranking would provide more information about first choice projects and projects that are selected to fill the available budget. In addition, the ranking could provide more information about the preference for safety compliance. The current results provide no more information than many participants, including safety compliance projects in their portfolio. A ranking could identify if a participant prefers safety compliance over new infrastructure projects in their living area or not. However, ranking all projects would require many efforts of participants. It is more useful to know if individuals, for example, first select the project in their living area and secondly safety compliance than knowing if a project is individuals 15^{th} or 16^{th} choice. Consequently, ranking the projects included in the participants' portfolio should be a better compromise.

Experts suggested individuals' travel behavior should be identified to see if individuals select projects that improve the infrastructure they frequently make use of. In addition, the travel behavior might also explain why, in the case study, individuals living in the northern part of the region selected projects in both northern regions, while individuals living in the southwest area Haarlemmermeer did not even frequently select low costs projects on the other side of their living area. In conclusion, the information about travel behavior is useful to identify the (different) preferences of travelers who make frequent use of the current infrastructure and inhabitants living close to the current infrastructure. Furthermore, information about participants' travel behavior might also explain choice behavior. For example, to what extent individuals select projects improving the infrastructure they frequently make use of.

Lastly, the policymaking expert state the project selection should be balanced in terms of multiple travel modes projects per region and a balanced total cost of the projects per area. For the project evaluation, the balance should be a better reflection. In particular, how individuals value safety compliance. The results show individuals living in areas where less expensive projects are proposed, more frequently select safety compliance projects. It is questionable if these individuals have a more definite preference for safety compliance. However, it is complex to compose a selection of projects from which individuals can choose, being a similar kind of trade-off for all participants. However, in

area A, three projects are proposed, which together costs 95 million, while in area E, three projects having costs from 8 to 15 million are proposed. Furthermore, only PT projects are proposed in area F. Further experiments could avoid such extremely unbalanced distributions of projects.

7.5 Reflection on policy implications

Both scientific experts claim the aim of an evaluation tool in policymaking is to provide accurate information to policymakers. It is up to policymakers what to do with the information. Consequently, policymakers, instead of the evaluation tool, are responsible for fair distribution. However, the average portfolio does not provide any information about the distribution of citizens' preferences. It should be noted that the average results lose valuable information. For instance, the insight of individuals selecting many less expensive projects instead of one expensive project is not visible by presenting no more than the optimal portfolio.

In addition, the average results do not provide a well-founded reason to claim the top 5 projects are valued the highest by citizens. Whereas the distribution shows, individuals prefer projects within their living area, low-cost projects spread location in the region and safety compliance projects. The distribution of preferences does provide a reason to claim an expensive project in high populated areas, combined with low costs projects spread located over the area and safety compliance projects are valued the highest by citizens. These strategies are not just applied by citizens living in Amsterdam, the highest populated area in the region, having a large share of the votes. Individuals all over the region belong to the cluster selecting low costs projects over the region and safety compliance. In addition, projects in high populated areas are not just selected by individuals living there. Consequently, the distributed results are more in line with the statement of the scientific experts that an evaluation tool should provide accurate information to policymakers.

The policymaking experts pinpoint three alternative sub-processes of decision-making in which citizen participation could be useful, being 1) initiative phase of project phasing, 2) plan examination phase of project phasing and 3) prioritizing projects in general. However, the best scale of the projects and the optimal level of detail of the projects proposed depends on the phase. The PVE experiment applied for this study seems to fit the best in the prioritization of projects due to the scale and the specific concrete projects that are proposed.

The policymaking experts did not provide concrete alternatives on how to integrate PVE in these processes. However, as described in Appendix I, projects are evaluated on travel-time reductions, project costs, and safety implications. In addition, a level of priority is assigned to a project. The level of priority depends on the current performance of the infrastructure. There are 3 levels of priority. Infrastructure corridor that highly exceeds the norms for travel time or the number of traffic injuries gets more priority. How the indicators are weighted to determine the level of priority is not defined. However, the societal interests, presented by PVE, could be an additional indicator to determine project priority. Projects like traffic education, highly valued in PVE, could get more priority based on societal interest presented by PVE.

Furthermore, the policymaking experts stated that in the past, the budget was fixed allocated per modality. However, according to the strategies shown in PVE, participants do not explicitly allocate budget over travel mode. Project-specific characteristics such as project location have more influence on what kinds of projects individuals select. In addition, the policymaking expert mentions there are no strict guidelines about the distribution of budget over the region. However, the results show citizens' assign value to the spatial-equality of budget allocation. Besides the Region Council controlling the agenda of investment and indirectly controlling spatial distribution of budget, policymakers should check the spatial-equality directly by evaluating projects.

The main advantage of citizen participation like PVE in policymaking seems to be the new insights about strategies applied by citizens. The main advantage of the optimal portfolio for policymaking is the information about what projects are, on average, highly valued among citizens. However, the main advantage of PVE on a regional scale is not to retrieve local knowledge or change the design of the proposed projects. It should be noted that both could be retrieved from individuals' motivations for a project.

Eventually, the main advantage of the distributed results is that citizens' strategy for budget allocation can be shown. Furthermore, better reasons why individuals are ranked high are shown by the distributed results, which could be used by policymakers in the evaluation or prioritization of ongoing projects.

8. Conclusion

The conclusion answers the three main research questions.

Which distributed profiles of preferences can be identified among citizens *using the Participatory Value Evaluation (PVE)* for public budget allocation to spatial-infrastructure projects?

Different profiles of project selection are identified. The profiles showed the location of the project highly affects project preference. In addition, project costs do affect project preference and a large group of individuals attach much value to safety compliance. The background characteristics show these distributed profiles are mainly related to individuals' living area. Individuals are intended to include (some) projects close to their living area in their portfolio. However, other strategies are visible as well. Some individuals select as many projects over the region having low costs and many individuals allocate a large share of the budget towards safety compliance. Most individuals apply a combination of these strategies. However, most individuals do select at least one project in their living area. In particular, expensive projects are predominantly selected among individuals living in the area the project is located.

In contrast, no profiles based on quantitative attributes that quantified safety implications, environmental implications or reduced travel time were visible. The profiles seemed to be related to alternative project characteristics and it is not clear to what extent individuals take these attribute values into consideration while deciding what projects to select.

Remarkably, no profiles based on travel mode improved by the project were visible either. There were no profiles selecting a combination of projects that improved a certain travel mode spread over the area. The preference for allocating budget towards a certain travel mode appeared to be strongly related to individuals living areas. Individuals that selected the expensive projects proposed for a travel mode, predominantly lived in the area the project was located, even if the project did not improve their preferred travel mode. Consequently, the location of the project seems to have more effect than the travel mode improved by the project.

The identified background characteristics showed living area is the most important variable explaining heterogeneity among the clusters, while political orientation and favorite traveling mode are not. Consequently, instead of individuals being motivated by their political orientation or select projects that improve their favorite travel modes, individuals are motivated by project location, in particular, project locations within their living area.

The founded location-effect seems to be even stronger on the lower scale of municipalities within living areas. Projects are relatively the most selected among citizens living in the municipality within the living area the project is located in. These statistics imply that the closer participants live to the project, the more intended individuals are to select the project.

In addition, the study showed demographic variables such as gender, age, and education significantly affect project preference. Women and individuals between the age of 20 and 40 are more likely to select safety compliance projects. Higher educated are more likely to select low costs projects spread over the whole region, while lower educated are more likely to select projects within their living area. Individuals' income, having a driving license and having a PT commutation had no significant effect.

In terms of disagreement, individuals do disagree about the project preference since most individuals do prefer at least one project within their living area. However, similarities in strategies applied by

participants are presented either. Most individuals do select at least one project within their living area. However, only a small group of individuals selects only projects or all projects within their living area. Most individuals do reserve at least some budget for low costs projects in other areas than their living area or safety compliance in the whole region.

How do experts review the implications of the identified distributed profiles of preferences among citizens for public budget allocation to spatial-infrastructure projects?

None of the experts had expected the location-effect would strongly dominate other effects. However, experts agree it is an important finding, which further research should consider. The scientific CBA expert and policymaking argue the location-effect is problematic and further studies have to control the location-effect, while the scientific PVE expert argues participants selecting projects in their living area correctly reflects their preference for a portfolio of spatial-infrastructure projects.

However, the scientific CBA expert and the scientific PVE expert agree that the PVE analysis should correct for the representative's living area to correctly show the portfolio of projects preferred by the majority. The fact that projects located in highly populated areas are more likely to end up in this portfolio, is not a problem, according to all experts. Policymaking experts mention that in practice, a large share of their budget is allocated to highly populated areas.

All experts agree the regional scale is the best fit for an experiment to measure regional desired strategies. The PVE expert argues a regional scale allows individuals to express their altruistic preferences for far-off located projects, whereas, allocating the full budget to their living area is allowed as well. The scientific CBA expert and the policymaking experts stated participants should not be allowed to select projects in their living area since citizens have more knowledge about these projects and advantage by these projects.

According to the PVE expert, the setting of PVE creates the difference with the private WTP approach. The advantage of PVE is to allow for any strategy preferred by participants. Consequently, the identified location-effect is in line with the idea of PVE. PVE allows all kinds of trade-offs, while private WTP experiments only reflect the user-potential. Therefore, PVE should replace CBA according to the scientific PVE expert. The scientific CBA expert argues PVE should not just measure individuals' selection of projects in their living area because that would not differ from private WTP, and alternative methods, which are less complex, are available to measure that individuals' prefer projects in their living area over projects in other areas. However, if more than the location-effect is measured, the CBA expert argues that PVE could show an interesting alternative perspective of project evaluation.

The scientific CBA expert and policymaking experts argue the location in the project title might increase the location-effect. The CBA expert stated the information presented in the project title should be reconsidered. Furthermore, policymaking experts argue multiple projects improving different travel modes per region should be proposed. The scientific PVE expert mentioned a ranking of projects as an additional question and a minimum/maximum constraint of the budget allocated per region. The latter would avoid individuals allocating the full budget to their living area. The scientific CBA expert and policymaking experts argue participants are not able to unbiasedly compare projects in their living area to projects outside their living area. Consequently, these projects should be evaluated separately. For regional desires, individuals should not be allowed to select projects in their living area, according to the CBA expert and policymaking experts.

According to the scientific CBA and PVE expert, an evaluation method like PVE should provide accurate information about citizens' preferences to policymakers. Both argue it is up to policymakers how to account for citizens' preferences in policymaking. Policymakers do not mention concrete ideas to implement these results in policymakers either. However, the policymaking experts do state the preferences of citizens are very useful for policymaking. They mention that 1) citizens' preferences enables project realization more in line with citizens' needs, 2) it is relatively easy to consider citizens' preferences in the decision-making process per project compared to changing the design after the project is realized and 3) local experience and local knowledge are useful for better infrastructure designs. However, policymaking experts argue they would never directly implement the projects preferred by citizens. The policymakers agree that just implementing citizens' preferences would make policymakers redundant.

Apart from that, policymaking experts do mention three sub-processes of decision-making where citizens' preferences could be useful, being 1) initiative phase, 2) project examination phase and 3) prioritization of projects. However, the policymaking experts mention less concrete projects than this experiment would be more useful for the initiative phase. In addition, a more local scale that proposes project alternatives would be more useful for the plan examination phase. Consequently, the scope of the experiments fits the best in the prioritization of projects, where one project gets more priority than the other. The policymaking experts do not mention concretely how these results could complement in determining what projects get priority.

The results show individuals prefer projects in their living area. The policymaking experts argue that the Region Council would not approve an agenda of investments in which the geographical distribution of budget is out of proportion, for example, if no budget is allocated to one of the living areas. However, there are no strict guidelines about the distribution of the region.

On the reflection of experts' view, what are the implications of the identified distributed profiles of preferences among citizens for public budget allocation to spatial-infrastructure projects?

For scientific research, the location-effect was not identified yet. According to the experts, it is important to be aware of the effect of project evaluation. The experts do not agree whether the location-effect is desirable. However, the desirability of the location-effect in an experiment depends on the purpose of it. If the purpose is to identify citizens' preference for regional spatial-infrastructure, the preference of citizens for projects in their living area is one of their interests. Individuals, including among else a project in their living area, reflect their preference for the optimal portfolio. This study clearly shows individuals do not only select projects in their living area. For the evaluation of citizens' strategic preferences about the mix of regional spatial-infrastructure projects realized, the location-effect is not a problem, like the scientific PVE expert argues. However, some effects might be dominated by the location effect. For example, the travel mode improved by the project. If the aim of the experiment is to identify individuals' preference for a travel mode, this effect is probably dominated by the location-effect. For such research, the location-effect is problematic, as the CBA expert and policymaking expert argue. Consequently, the desirability of the location-effect should be defined before setting up the experiment.

A problematic implication of the location-effect is that the preference for projects, located in living areas that are overrepresented in the sample, is overestimated. Therefore, the experts agree the analysis determining the optimal portfolio of projects should correct for representativity of the living area. By correcting for the representativity of the living area, the optimal portfolio better reflects the projects preferred by the majority of citizens living in the region.

However, the implication that projects in high populated areas are higher ranked is not a problem itself, since more individuals living there benefit from these projects either. Furthermore, the aim of an evaluation tool like PVE is to provide accurate information. Consequently, it is not problematic when PVE shows projects in high populated areas are the more frequently selected projects. It is up to policymakers what to do with the provided information and whether to correct for spatial-equality.

Regarding the geographical level of scale, the experts agree the regional scale is the best scale to identify citizens' preferences for infrastructure projects on a regional level. Experiments on a regional level allow citizens to make a trade-off between projects in their living area, projects in other areas, or more safety compliance in the whole region. However, it is more likely that individuals who have more local knowledge of the traffic situation of projects in their living area compared to projects located far-off located projects. Consequently, one of the risks is that participants' knowledge about projects is unbalanced between projects located within and far-off their living area. As a result, individuals might select projects in their living area because they better understand the need for the improvement of the traffic situation.

Regarding PVE as an evaluation method, the result that individuals are intended to select projects within their living area does not contradict the concept of PVE. PVE allows participants to apply any strategy they prefer, while CBA only shows the user potential. Eventually , individuals do not only select projects in their living area. Participants select among else low-cost projects over the region and assign a high value to safety compliance, which the WTP approach of CBA is not able to show. Consequently, PVE might better reflect what projects are preferred by citizens. However, CBA shows a systematic comparison of project attributes values, which participants of PVE not predominantly seem to do. CBA might better show the cost-efficiency based on a systematic evaluation of effects, whereas PVE might better reflect the projects preferred by citizens, including individuals' normative views. Therefore, both methodologies show an alternative perspective on project evaluation.

About the design of the PVE tool, experts agree the information that is shown in the project title in the experiment, probably affects individuals' project choice, which is confirmed by the results showing costs, location, and improvement of safety compliance is shown in the project title. Therefore, the information presented in the project title should be reconsidered in future PVE experiments depending to what extent it is problematic these strategies dominate.

Furthermore, a ranking of the portfolio would provide valuable information about individuals' preference for one project over another. For example, whether individuals prior safety compliance over expensive projects in their living area, while current information just show both projects are included in the portfolio. A minimum per living area or a maximum for individuals' own living area would avoid that individuals allocate the full budget to their living area. However, a minimum or maximum constraint would force individuals to select projects outside their living area, which does not directly reflect their real preference. Consequently, a minimum or maximum would restrict participants' choice behavior, which does not provide a solution for cases where the location-effect is problematic.

Apart from that, information about individuals' travel behavior would be useful to show how many of the individuals making frequent use of the current infrastructure of a project, selected the project. The information about travel behavior could also explain individuals' project choice. For example, to what extent individuals select project improving the traffic situation they make frequent use of.

In terms of PVE in policymaking, experts agree the aim of an evaluation method like PVE is to provide accurate information to policymakers. It is up to policymakers what to do with this information.

However, this study showed, distributed preferences provide more accurate information about different projects preferred. In addition, more information about strategies for budget allocation preferred by citizens.

Within the decision-making process, the PVE using concrete projects on a regional level seems to fit the best in the prioritization of projects, where ongoing projects are compared to each other, and the level of priority for specific projects is determined. In addition, the PVE could be used to determine the societal interest for projects as well. Projects are evaluated based on performance indicators, such as a reduction in travel time over costs. One of the additional indicators could be the societal interest, estimated by the PVE methodology.

9. Discussion

The research investigated the distribution of individuals' preference for spatial-infrastructure projects and reflected the results by experts. This chapter describes the most important implications that are derived from the results and whether these are in line with previous studies. Finally, the limitations of the study, recommendations, and suggestions for further research are discussed.

9.1 Major implications

The implications from the data and findings of this study are divided into implications for the theoretical evaluation of citizens' preferences for the allocation of the public budget towards spatial-infrastructure projects, methodological implications for PVE or CBA as evaluation tools for welfare increase estimations, and policy implications. The aim of this section is to show the implications of this study for a higher level of theory and practice of policymaking.

9.1.2 Implications for theoretical evaluation citizens preferences

The main finding of this study is the location effect, which implicates participants' intend to select those projects that are close to the location where they live. As discussed, to what extent the location-effect is problematic depends on the relation one wants to evaluate. If the aim is to identify individuals' preference for the combination of projects in the region, the location is one of the characteristics of the projects. The information about the location of projects enables participants to express their preference for the spatial distribution of the budget. In contrast, if the aim of the experiment is to evaluate citizens' value for concrete effects of projects, the location-effect dominating all effects might be undesirable. In such a case, not naming the location of the project in the PVE experiment should be considered. Consequently, an important implication for scientific research is to define to what extent the location-effect is desirable before setting up the experiment. However, whether the research controls for the location-effect or not, researchers have to be aware the location-effect strongly exists.

In addition to this, the location-effect increases with the geographical size of the scale of the experiment. The results show that individuals are strongly inclined to select projects located in the municipality within their living area; almost 70 to 90 percent of individuals favor projects that are located in their municipality. Individuals intend to select projects in other municipalities within their living area, which is a higher level of aggregation; most projects are selected by 50 to 70 percent of individuals living in the living area the project is located in. Only 5 to 20 percent of living areas select expensive projects in far-off located living areas. However, the far-off located projects are still within individuals' region. Consequently, an experiment on a national level is expected to show an even stronger location-effect, where individuals are expected not to select projects in provinces far away from their living area. The results show the longer the distance between the living location and project location, the less intended individuals are to select the project. Consequently, projects in high populated areas are more likely to end up in the optimal portfolio. Since individuals frequently include low-cost projects independent of the location in their portfolio as well, expensive projects in the more remote areas end at the bottom of the ranking.

Furthermore, the results show clusters selecting low-cost projects spread located over the region, while other clusters predominantly select projects close to their living area. The first seems to indicate a preference for spatial-equality. The profiles of demographic background characteristics show high educated are more likely to apply this first strategy, while low educated are more likely to apply the second strategy. Consequently, higher educated seem to have more preference for spatial-equality.

On the other hand, It could be the case lower educated have more difficulties in processing information due to the complexity of the PVE tool. However, Mouter et al. (2017a) found precisely the same relation between the level of education and preference for spatial equality using a discrete stated choice model, which experiment was less complex than the PVE design of this study. The comparison of this study confirms the level of education is related to preference for spatial equality rather than having difficulties with the complexity of the design.

The results show individuals predominantly select projects in their living area, low cost-projects, and safety compliance projects. These results indicate individuals select projects based on the *location*, *costs,* and improvement of *safety compliance*. In contrast, the results showed project selection was not based on attribute values, or travel mode improved. It is questionable to what extent individuals consider quantitative attributes since the study of Mouter et al. (2018) showed insignificant parameters of quantitative attribute values but highly significant project constant values. In addition, the study of Kahneman (2011) stated human beings are not able to systematically compare quantitative attribute values. The theory also stated that humans are bound to simple heuristics, such as focusing only on a few aspects (Kahneman, 2011). These statements are in line with the finding of this study that individuals predominantly base their choice on alternative project attributes and not the quantitative attribute values. Consequently, it is questionable whether an experiment like PVE should ask individuals to compare attribute values of, in this experiment, 16 projects. Furthermore, it is questionable whether societal interest for the project should be evaluated based on linear relations with quantitative attributes of the project, which is discussed in Section 9.1.2.

No clusters of individuals selecting a combination of projects improving a similar travel mode were visible. However, the experts interviewed did not expect to see no clusters based on travel mode improved. Furthermore, the study of Mouter et al. (2020) using the same experiment stated cycling projects are higher valued by participants compared to car projects in PVE because individuals prefer to stimulate cycling. However, the line of reasoning is not in line with the findings of this study. This study showed individuals do not evaluate projects based on the travel mode improved by the projects. Alternative project characteristics such as project location and project costs dominate project preference. Based on the findings of this study, the main reason why cycling projects are higher ranked is the lower costs of these cycle projects. The cycling projects proposed are less expensive than car projects. However, this study did not include individuals' motivations, which the study of Mouter et al. (2020) did. Motivations showed individuals motivated to select cycling projects among else because they prefer to stimulate cycling. However, according to the theory of Kahneman (2011), individuals reach decisions very rapidly based on instinct or subconscious analogy. Then we tend to look for evidence and arguments which support the decision (Mackie et al., 2014). Consequently, promoting cycling appears to be an additional reason to include, among else, a cycling project in the portfolio. No significant cluster of individuals selects only cycling projects, which implies the reason to stimulate cycling is not their dominant motivation for participants to select a portfolio only including cycling projects.

Furthermore, the results showed individuals allocate a large share of the budget to a project in their living area, improving an alternative travel mode than their favorite travel mode. Project location seems to be more important than travel mode improved. Consequently, it could be questioned whether individuals' preference for a specific project reflects their preference for general infrastructure in terms of modality. Therefore, concrete projects, including project location, should not be used to measure individuals' preference for new infrastructure regarding modalities. However, in such an experiment controlling for the location-effect, the researches should be aware of a location-effect dominating the travel mode improved exists.

9.1.2 Theoretical implications for PVE and CBA as an evaluation methodology

Location-effect

This study showed individuals' living area is significantly related to project preference. Individuals are intended to select projects in their living area. A problematic implication, where expert agrees on, is that the welfare increase of projects in the overrepresented living area is overestimated. Therefore, the optimal portfolio analysis should correct for representative living areas to reflect average results.

Furthermore, this study showed that the closer a project is located to their living location, the more likely individuals select the project. These results indicate individuals assign more value to a project, the closer it is located to their living location. In cases the location-effect exists, the PVE welfare computation should include an estimated parameter for this distance. The estimated distance parameter should probably be included in the individuals' utility function of the MCDEV model described by Dekker et al. (2019), which describes the welfare increase for individual citizens due to a project. It is expected, according to the findings of this study, the distance parameter would be negative for spatial-infrastructure projects. Further research should identify how the model should exactly cover for the location-effect.

However, in cases a strong location effect occurs, CBA should correct for distance from living location to project location as well. The study of Mackenzie (2012) showed the CBA methodology can correct for the location-effect.

Attribute values insignificant

The computation of welfare increase due to projects of both the CBA and PVE methodology is based on the valuation for quantitative project attributes, such as the number of travel time reduced, reduction of traffic injuries, and the fewer numbers of trees cut. However, the results of this study showed citizens do not necessarily compose their portfolio based on project attributes. It is even questionable to what extent individuals consider these attribute values. Furthermore, the theory of Kahneman (2011), as discussed in Section 2.1 and Section 9.1.2, stated that human beings are not able to systematically trade-off quantitative project attributes. Consequently, it is questionable if welfare increase due to a project can be accurately established using quantitative attribute values. In other words, the analysis might miss something. This does not implicate that project attributes like travel time reduced should be excluded from the model nor that these project characteristics should not be presented to participants in the tool. Participants might evaluate them in a different way than the linear relation the welfare computation analysis does. However, the way attribute values are presented in the design of the tool could also be the reason participants do not necessarily consider them. The attribute values are not presented in the project titles. Participants have to select the 'compare bottom' to compare quantitative attribute values or have to look into the more elaborate project descriptions. It is unknown how individuals consider attribute values in their decision-making. Further research should be conducted in this line.

Safety compliance highly ranked in PVE experiment

This study shows individuals attach much value to safety compliance projects within the setting of PVE. According to the motivations analyzed by Mouter et al. (2019b), individuals do not only select these projects because of safety implications. Individuals probably select these projects because of their normative beliefs. However, the welfare increase due to these projects is underestimated by CBA. The CBA methodology should assign more value to safety compliance projects for an accurate reflection of welfare increase due to these projects.

Portfolio analysis

The results show many individuals prefer the combination of low-cost projects spread located over the region, which implies 1) individuals prefer several low-costs projects over one expensive project, and 2) individuals prefer spatial equality of budget allocation over the region. According to the results of this study, a combination of projects that accounts for these preferences results in additional welfare increase, which is underestimated by summing up the welfare increase due to each project separately.

It is too complex within the CBA methodology to account for additional welfare increase due to the combination of projects. In contrast to the PVE tool, where individuals are asked to compute a portfolio in their favor. The PVE methodology computes an optimal portfolio. Therefore it is possible to account for additional welfare increase due to specific combinations of projects within the PVE methodology. Since individuals are asked to compute their portfolio in PVE, the model can account for the welfare increase due to a combination of projects. Further research should establish the mathematical model to account for additional welfare increase due to combinations of projects that account for low-cost projects or spatial-equality, which is beyond the scope of this study.

Low-cost projects

First, a higher welfare increase should be assigned to a portfolio, including a higher number of projects with the same total budget, while controlling for all other effects. For example, two portfolios A and B, which both are 100 million euros in total, are compared. Portfolio A includes 4 projects, each 25 million euros. Portfolio B includes 1 project of 100 million euros. The summed total effects of both projects are equal. In that case, portfolio A should result in a higher welfare increase according to the results of this study since more projects are realized with the same budget. The current welfare computation of PVE or CBA underestimates the welfare increase due to the higher number of projects realized with the same budget. Consequently, the total welfare increase computation of a portfolio should correct for the number of projects the portfolio includes.

Spatial-equality

Secondly, a higher welfare increase should be assigned to a portfolio that covers spatial distribution. For example, two portfolios C and D, which are both 100 million euros in total, including both 4 projects, are compared. Portfolio C includes 4 projects located in the same living area close to each other, while portfolio D includes 4 projects that are spread located over the region in different living areas. The welfare increase due to the project combination of portfolio D is higher according to the results of this study since these better cover for spatial equality. The current welfare computation of PVE or CBA underestimates the welfare increase due to the combination of projects that cover spatial equality. Consequently, the total welfare increase of a portfolio should correct for the distance between projects of a portfolio.

Information presented in the design of the experiment

The results show that project selection is predominantly based on project *location,* project *costs,* and improvement of *safety compliance.* These results indicate individuals do predominantly base their choice on the information provided in the titles of the projects. Consequently, the information presented in the project title does affect what projects individuals selected. Future experiments should carefully consider the information presented in the project title. For example, if one would decrease the location-effect, not naming the location in the project title can be considered. On the other hand, attribute values like the number of trees cut could have more impact on participants' decision-making process by naming it in the project title.

Furthermore, the results of this study show the regional scale enables participants to decide to choose projects in their living area or in other areas. However, individuals have more local knowledge about the current traffic situation of projects close to their living area than projects located far from their living area. Consequently, the information participants have about projects is unbalanced. An implication is that individuals might select projects in their living area because they know these projects and better understand the urgency of the project. Therefore, it is important for experiments to be aware individuals have less knowledge about projects far away from their living location. The larger the geographical scale of the experiment, the more unbalanced participants' knowledge about traffic situations among projects is. Consequently, in particular, for experiments on a regional scale or larger, the information presented should carefully be constructed to clearly present the benefits of the project. If it is difficult to describe the urgency of projects in project descriptions, it could be considered to provide the option to participants to retrieve more information, for example, by providing a video of the situation.

9.1.3 Policy implications

Application of PVE in policymaking

The aim of PVE in policymaking is to provide accurate information to policymakers. This study shows the distributed results provide more accurate information about the strategies applied by participants, which the aggregated results are not able to show. According to the theory of Nyborg (2012), the distributed results show the reasons one needs. This study show individuals prefer projects close to their living area, low-cost projects (spread over the region), and safety compliance. These insights provide a reason to allocate *more* budget to the high populated areas than low populated areas and allocate budget to safety compliance. Furthermore, these insights provide a reason to include low cost-projects, which are spread located over the region, to the agenda of investments.

This study stated PVE better reflect individuals' expectations from the governmental spending for spatial-infrastructure projects. However, that does not imply CBA is useless for policymakers. CBA is able to structurally and clearly weigh all project effects. CBA might be a better indicator to weigh the factual project implications over investment costs to show the cost-efficiency of a project. Whereas, PVE probably shows a better reflection of citizens' preferences and the societal interest for a new spatial-infrastructure project, which is predominantly based on *project location*, *project costs* and improvement of *safety compliance,* based on the current design of PVE. Consequently, CBA and PVE show both an alternative perspective of project evaluation, which both show useful information to policymakers. Policymakers name cost-efficiency as one of the criteria of newly proposed projects, societal interest presented by PVE could be an additional indicator. The societal interest presented by PVE can result in more safety compliance projects in the investment programs since those are highly ranked in PVE.

Furthermore, this study showed one of the strategies is that individuals are selecting many less expensive projects instead of one prestigious project. The current incentives for politicians seem to be more in the direction of getting visible credits for a prestigious project. Politicians could be more inclined to dedicate themselves to prestigious projects for their reputation, while a small project might result in similar effects. Consequently, the future incentives for politicians should be in the direction of getting credits for realizing several low-cost projects, which is more in accordance with citizens' preferences.

Implications for transport planning

In terms of transport planning implications, this study showed individuals do not allocate budget according to their travel mode preference. Alternative project-specific characteristics, such as project

location, are more important to citizens than the travel mode improved by the project. Consequently, it would be contradictory to divide the available budget of the region in fixed budgets per modality, only a minimum budget for safety compliance projects would be reasonable, according to the findings of this study. A flexible budget distribution over the travel modes is more in accordance with citizens' preferences. Vervoerregio Amsterdam did already change this approach to a flexible distribution, which other regional governments could consider as well.

Furthermore, the initiatives for projects are evaluated separately in the current regional decision-making. If each project initiative is evaluated separately, the observed strategies that are preferred by citizens are difficult to apply. Information provided by an evaluation tool like PVE enables to evaluate the bunch of projects on the agenda of investment as a whole. The total agenda of yearly projects could be evaluated for the three strategies identified in this study, being 1) spatial distribution of budget as a derivative of individuals preferring new projects in their living area, 2) rather more low costs projects than one expensive projects and 3) allocate a substantial part of the budget to safety compliance. Investment agendas that are in line with those strategies should be more in accordance with citizens' preferences.

9.2 Limitations and recommendations

The main recommendations and possible limitations are discussed in this section.

No information about participants' travel behavior was available. This information could be used to explain individuals' choices for particular projects. For instance, participants might select projects improving the infrastructure they have to make frequent use of. An additional question could ask participants' work location since that is probably the location individuals most frequently travel to.

In addition, the distribution of projects over the area was quite unbalanced in terms of project costs of the projects and travel modes of projects proposed per living area. Further studies should consider proposing both expensive and less expensive projects and different travel modes per living area. This would better reflect whether individuals consider spatial-equality. No low-cost project in Amsterdam Zuid Oost was proposed in this experiment. Consequently, individuals selecting as many less expensive projects did not have the option to select a low-cost project in that area. Furthermore, the results showed safety compliance was more frequently selected by individuals living in areas where only less expensive projects were proposed (Haarlemmermeer). However, it is questionable whether these individuals have a higher preference for safety compliance than individuals living in other areas where highly expensive projects were proposed, such as Zaanstad in the experiment. A balance of total costs of projects per area should better reflect the trade-off between safety compliance and new infrastructure.

Furthermore, the dataset contains only information if projects are in the optimal portfolio or not. One of the limitations is that no information was available whether projects are individuals' first choice or selected as a 'budget-filler.' An expert suggested that participants should rank the proposed projects. If participants have to rank the projects included in their portfolio, valuable information would be gathered. For example, if individuals prefer safety compliance projects over other projects in their living area.

To identify how citizens' living area is related to projects selected, the region is divided into sub-areas that reflect individuals' living area. The number of subregions is restricted to 6 categories to limit the additional parameters of the cluster model. However, the 6 living areas are defined arbitrarily based on municipalities and project locations. It is not reflected what geographical area individuals consider as 'their living area.' Individuals living at the border of a living area live as close to a project in their

neighbor area as a project within their living area. However, determining the precise effect of the distance is beyond the scope of this research. Further research should reflect the optimal number and definition of living areas.

An online panel was used for data collection to gather many responses. Furthermore, individuals received monetary compensation for filling in the questionnaire, which risks the participation of individuals just to receive monetary compensation. Consequently, some individuals could have spent the limited time to process information such as quantitative attribute values, which risks the lower quality of the data. However, the consequentiality of participants' choices is noted in the tool, which should overcome problems with a stated preference. Consequently, despite the limitation of individuals participating to receive monetary compensation, the choices should accurately reflect individuals' preferences.

Finally, the experiment applied the fixed budget assumption, which implies the presented budget is undoubtedly allocated to infrastructure projects. Due to the fixed budget, individuals might select additional cheap projects as 'budget fillers.' It is not sure whether such a choice reflects the welfare increase for citizens. An alternative could be to apply a flexible budget. Using a flexible budget implies individuals are allowed to change the available budget, which results in an increase or decrease of taxes paid by citizens. However, a flexible budget increases the complexity even more. Further research should identify whether a flexible budget results in different strategies than a fixed budget of participants.

9.3 Further research

Three suggestions for further research are suggested in this section; two suggestions for research about the location-effect and one for the welfare increase caused by combinations of projects.

Location-effect in more detail

This study shows the location of the project strongly affects individuals' choices for projects. Further research should identify the location-effect in more detail and how the location-effect is related to the design of the tool.

Firstly, this study shows a negative relation between the distance from individuals' living areas to project location and project selection. Further research could identify the extent of the relationship more precisely by using individuals living location and the distance to the project location. This research could show in what distance range (in kilometers) projects are popular, and the distance range projects become significantly less popular. The insights can be used to better determine the dimensions and the optimal number of distinct living areas in the region. In the next step, the determined parameter for distance from individuals living location to project location could be used in the MCDEV model to more accurately determine societal welfare increase due to a project.

Secondly, the location-effect could probably be decreased by the way information is presented in the design of the PVE tool. The location-effect might be decreased by only naming the location in the more elaborate project description instead of naming the location in the project title. The effect of excluding the name in the project title could be identified by a PVE experiment, including two versions A and B. In the experiment, version A includes the project location in the project title, whereas version B only names the location in the more elaborate project description. It could be the case that in experiment A, individuals make a pre-selection of projects based on the location named in the title and do not even read other project descriptions, while in experiment B, individuals have to look at the elaborate description to know the location. A third version C could be included where the project location is not

named at all, which would definitely decrease the location-effect. Version C could be applied to identify the effect of not providing the location of projects at all.

Portfolio analysis

This study showed citizens prefer to allocate the budget towards more low-cost projects that are spread located over the region. A portfolio of a fixed budget, including more projects (due to lower costs per project) and including projects that are more spread located over the region, results in an additional welfare increase. Summing up, the welfare increase of each project separately underestimates the total welfare increase due to the portfolio of projects. First, further research should identify to what extent participants select many low costs projects because citizens prefer the government realizes as many projects using a fixed budget or because citizens prefer the budget is equally distributed over the region. As a next step, further research should investigate how the welfare computation of the PVE model should account for the additional welfare increase due to this combination of projects.

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Appendix A: Additional limitations CBA

CBA

The impacts of projects are based on the input of multiple studies. Each input parameter of the CBA is generally estimated by a separate study. This atomistic approach risks the internal consistency of the parameters. Parameter values might differ when these are based on one study, which might affect the outcome of the analysis.

Furthermore, the poor consideration of broader goals of transport planning is problematic, according to Handy (2018), which may lead planners and policymakers away from those goals either. Broader goals like the quality of life and the long-run sustainability of solutions are impeded. Transportation planning is even at a crisis point, neglecting these broader goals, according to Banister (2008).

Another strongly related critique towards the CBA is the corroding of the forward-looking nature of the project planning. The implicit assumption of the CBA is that individuals' past choices reflect their beliefs concerning the future transportation system (Mouter et al., 2019). However, the central role of transport planning is defining the desired future and policies that help to move towards that future (Handy, 2008).

The last critique towards the CBA is the general use of standardized transport models to establish the impacts of a certain transport project. These impacts are monetized using generic price tags like the value of a statistical life. It is questionable whether these generic numbers lead to a correct and accurate estimation in specific contexts (Mouter et al., 2013a).

PVE

PVE captures citizens' preference towards broader goals of planning. The motivations for selecting a certain project are related to broader goals. For instance, respondents of the PVE experiment of Mouter et al. (2019a) preferring a cycling highway, motivations can be attributed to broader goals such as promoting cycling, trying to decrease car use, and create a healthier environment.

PVE captures ethical considerations and normative views (Mouter et al., 2019a). PVE enables participants to motivate their forward-looking preferences in the evaluation of projects. PVE captures for normative ideas regarding the preferred future transportation system.

Both CBA as PVE uses standardized transportation models to establish impacts of transport projects. However, the evaluation of impacts in PVE is based on the judgments of local citizens. Participants can decide for themselves to what extent they base their selection on the standardized values, which they explicit information they receive in PVE (Mouter et al., 2019a). Especially for safety aspects in PVE, of which PVE presents the decrease in traffic injuries due to the new project. Participants might argue their judgment in personal experiences of which policymakers were unaware of (Mouter et al., 2019a).

Appendix B: Screenshots experiment

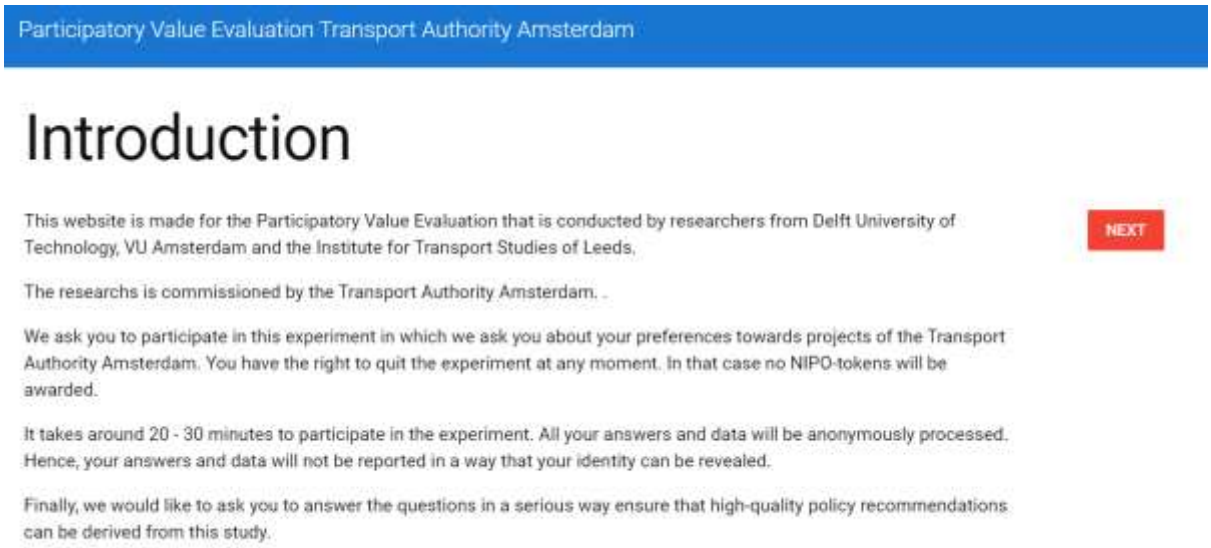

Figure 20 Screenshot Introduction online participatory value experiment

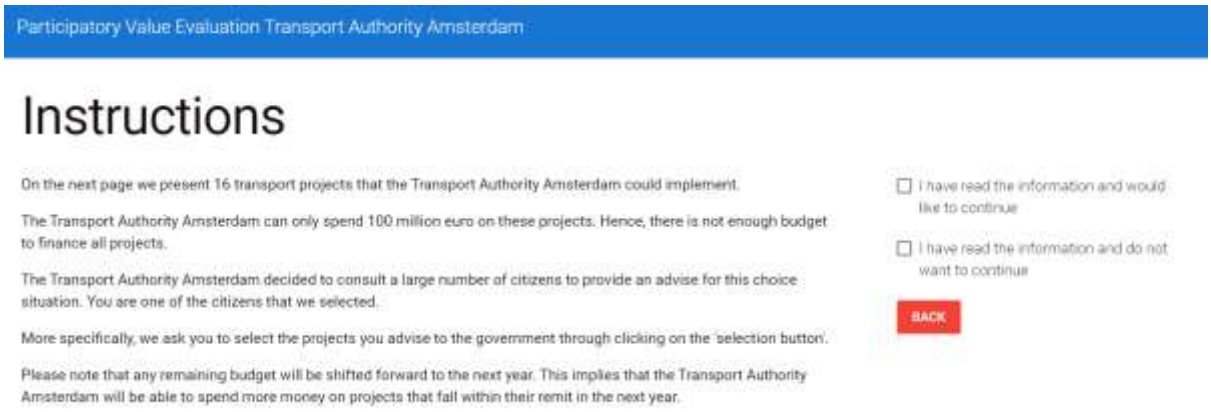

Figure 21 Screenshot instructions online participatory value experiment

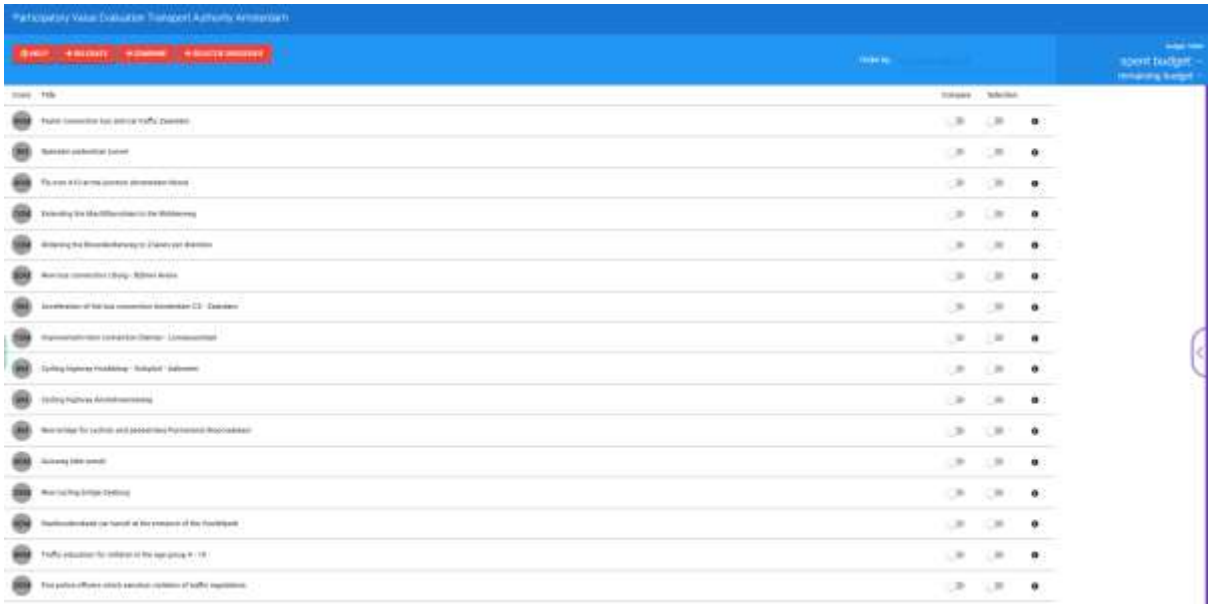

Figure 22 Screenshot of the online survey with an overview of the projects

Participatory Value Evaluation Transport Authority Amsterdam

Compare

	Faster connection bus and car traffic Zaandam	Ijpendam pedestrian tunnel	Fly-over A10 at the junction Amsterdam Noord	Extending the MacGillavrylaan to the Middenweg	Widening the Bovenkerkerweg to 2 lanes per direction	New bus connection IJburg - Bijlmer Arena	Acceleration of the bus connection Amsterdam CS -
Type	type	type	type	type	type	type	type
Costs	50M	3M	40M	10M	10M	50M	5M
Number of travelers	60000	20000	70000	35000	32500	4500	5000
Minutes of travel time savings	3	1	3	4	4	7	1
Additional traffic deaths	0	0	0	0	0	0	0
Additional traffic injuries	0	-1	0	0	1	0	0
Additional households affected by noise pollution	60	0	125	-100	10	0	0
Chopped trees	0	0	120	0	30	0	0

Figure 23 Screenshot of comparison selected projects

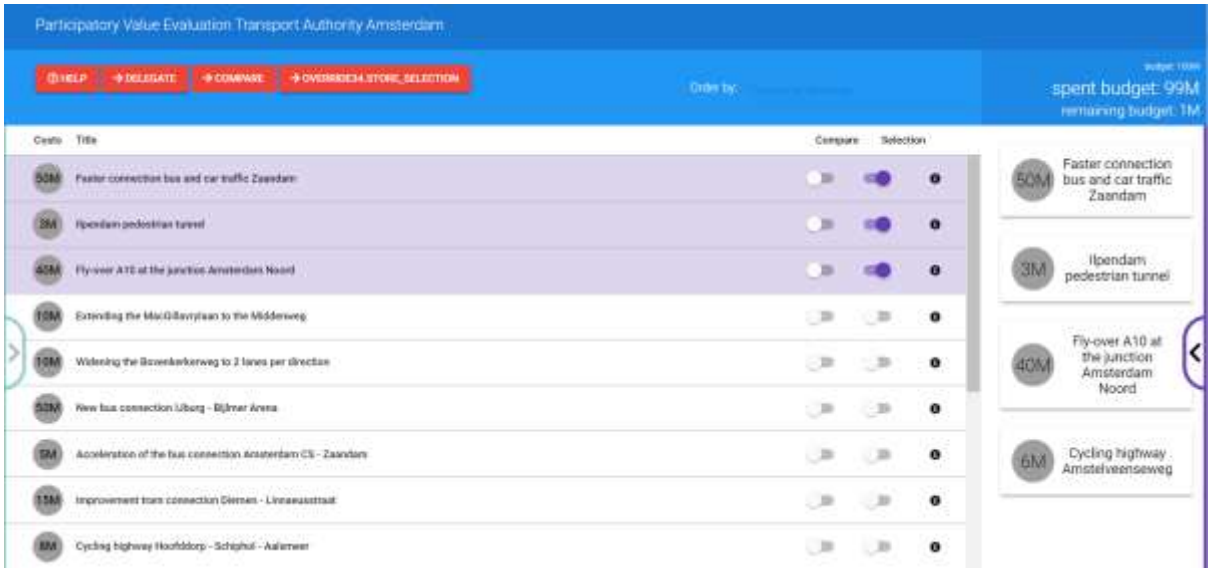

Figure 24 Screenshot selected projects, spent budget and remaining budget

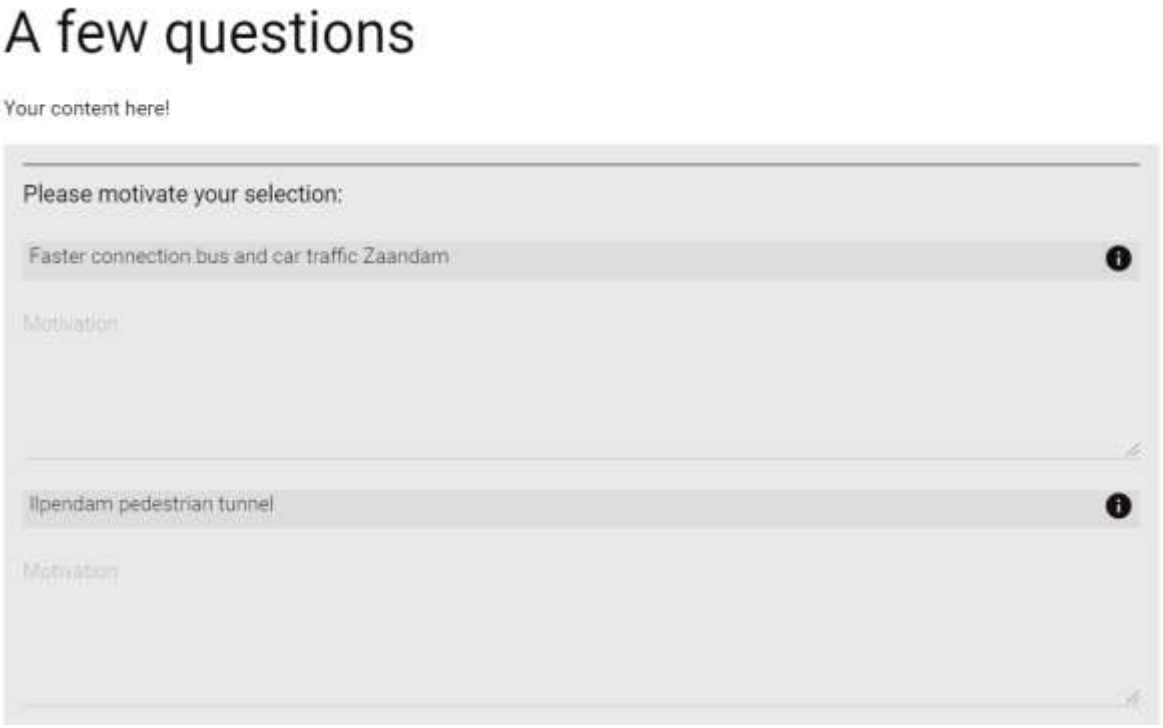

Figure 25 Screenshot of motivations selected projects

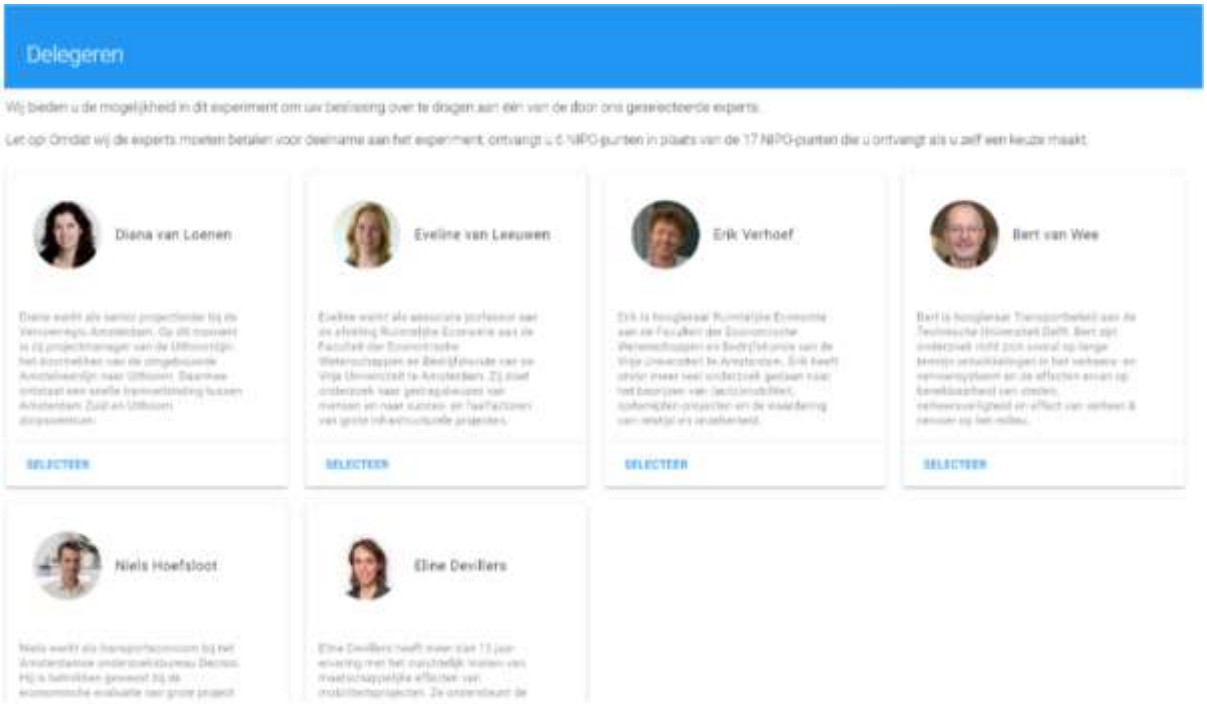

Figure 26 Screenshot of Delegation options

Appendix C: Location classification

Living neighborhood according to local municipalities, which are presented in Figure 25. These municipalities are part of Vervoerregio Amsterdam.

Figure 27 Municipalities of Vervoerregio Amsterdam (Vervoerregio Amsterdam, 2017b)

An additional distinction between the areas of Amsterdam according to the distinction of Figure 26. The figure presents the division in accordance with Gemeente Amsterdam.

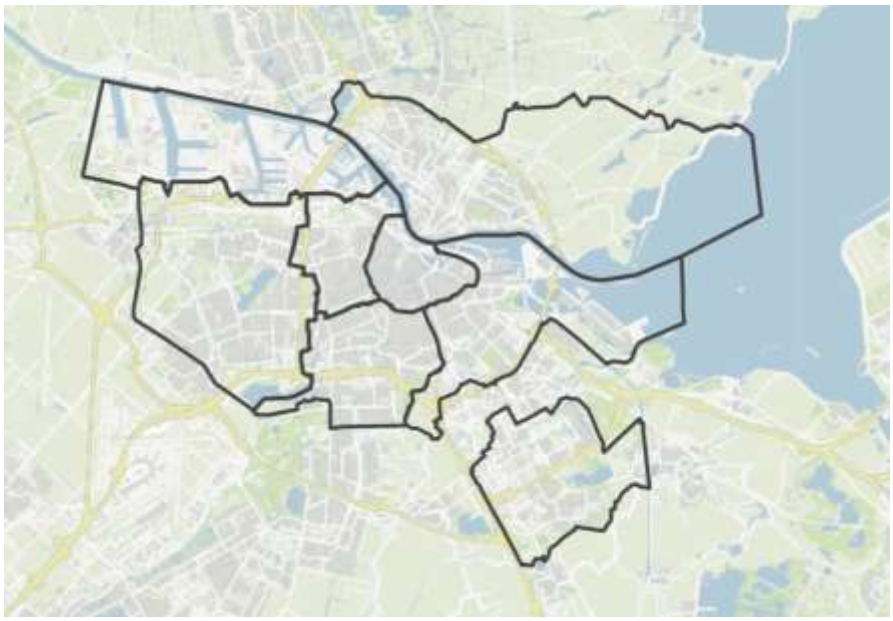

Figure 28 The division of Gemeente Amsterdam (Gemeente Amsterdam, n.d.)

Appendix D: Distribution Project Selection

Travel mode

Table 66 Percentage of votes from each group of having a similar favorite mode

Project Nr	Costs	Car	PT	Bike	Other	Total votes
2	3	34.72	18.58	39.61	7.09	409
14	40	29.82	21.85	41.65	6.68	389
4	10	35.14	18.11	41.08	5.68	370
16	4	33.88	19.28	41.60	5.23	363
11	20	34.84	18.41	41.36	5.38	353
9	8	31.59	17.68	45.22	5.51	345
7	5	35.78	22.29	34.90	7.04	341
10	6	31.93	19.28	43.37	5.42	332
15	50	34.38	17.98	41.32	6.31	317
5	10	41.26	16.36	36.80	5.58	269
8	35	27.46	27.46	40.16	4.92	244
13	15	24.07	19.50	51.87	4.56	241
3	40	50.75	17.91	25.87	5.47	201
12	40	39.66	16.09	36.21	8.05	174
1	50	48.57	21.90	22.86	6.67	105
6	50	29.17	30.21	35.42	5.21	96
Total respondents		341	199	382	59	

Table 67 Deviation of the expected distribution according to the percentage of total respondents per travel mode. If the percentage of individuals selected per travel mode is equal to the distribution of the respondents per travel mode, the deviation is 0.

Project Nr	Costs	Car	PT	Bike	Other	Total votes
2	3	-0.04	-1.70	0.67	1.08	409
14	40	-4.94	1.57	2.71	0.67	389
4	10	0.37	-2.18	2.14	-0.34	370
16	4	-0.88	-1.00	2.66	-0.78	363
11	20	0.08	-1.87	2.42	-0.63	353
9	8	-3.17	-2.60	6.28	-0.51	345
7	5	1.02	2.00	-4.04	1.02	341
10	6	-2.83	-1.01	4.43	-0.59	332
15	50	-0.38	-2.30	2.39	0.29	317
5	10	6.50	-3.93	-2.14	-0.44	269
8	35	-7.30	7.17	1.22	-1.10	244
13	15	-10.69	-0.78	12.93	-1.45	241
3	40	15.99	-2.37	-13.07	-0.54	201
12	40	4.89	-4.19	-2.73	2.03	174
1	50	13.81	1.62	-16.08	0.65	105
6	50	-5.59	9.92	-3.52	-0.81	96
Total respondents		341	199	382	59	

Political orientation

Table 68 Percentage of votes from each group of having a similar political orientation

Project nr.	Costs	Christen Democrats	Social democrats	Liberalism	Environ-mentalism	Populism	Other parties	Not voted	Total votes
2	3	10.66	20.56	29.19	22.34	6.85	1.52	8.88	394
14	40	6.01	23.22	31.15	25.68	6.56	1.09	6.28	366
4	10	8.15	23.31	30.34	19.94	8.15	2.53	7.58	356
16	4	8.09	23.41	32.66	17.63	8.38	2.60	7.23	346
11	20	10.56	20.82	29.62	22.87	6.16	2.35	7.62	341
9	8	9.73	21.88	28.88	20.67	6.99	1.52	10.33	329
7	5	8.84	24.09	27.44	19.82	8.23	1.52	10.06	328
10	6	7.62	19.05	33.97	21.27	6.35	1.27	10.48	315
15	50	9.43	23.23	30.64	19.87	5.39	3.03	8.42	297
5	10	11.45	19.85	33.97	12.60	8.78	3.05	10.31	262
8	35	9.21	19.67	29.71	22.59	6.69	2.93	9.21	239
13	15	5.49	24.05	32.91	24.47	6.33	0.42	6.33	237
3	40	8.02	22.46	29.41	14.97	11.76	1.60	11.76	187
12	40	13.94	26.67	26.06	15.76	6.67	0.61	10.30	165
1	50	7.00	25.00	37.00	8.00	5.00	0.00	18.00	100
6	50	10.53	20.00	25.26	23.16	5.26	4.21	11.58	95
Total respondents		79	210	288	188	66	19	87	

Table 69 Deviation of the expected distribution according to the percentage of total respondents per political orientation. If the percentage of individuals selected per political orientation is equal to the distribution of the respondents per political orientation, the deviation is 0.

Project nr.	Costs	Christen Democrats	Social democrats	Liberalism	Environ-mentalism	Populism	Other parties	Not voted	Total votes
2	3	2.23	-1.85	-1.55	2.27	-0.19	-0.50	-0.40	394
14	40	-2.42	0.81	0.41	5.62	-0.49	-0.93	-3.00	366
4	10	-0.29	0.90	-0.40	-0.12	1.10	0.50	-1.70	356
16	4	-0.34	1.00	1.92	-2.43	1.34	0.57	-2.06	346
11	20	2.13	-1.59	-1.12	2.81	-0.89	0.32	-1.66	341
9	8	1.30	-0.53	-1.86	0.60	-0.05	-0.51	1.05	329
7	5	0.41	1.67	-3.30	-0.25	1.19	-0.50	0.78	328
10	6	-0.81	-3.36	3.23	1.21	-0.69	-0.76	1.19	315
15	50	1.00	0.82	-0.10	-0.20	-1.66	1.00	-0.87	297
5	10	3.02	-2.56	3.23	-7.47	1.73	1.03	1.02	262
8	35	0.77	-2.75	-1.03	2.53	-0.35	0.90	-0.08	239
13	15	-2.95	1.64	2.17	4.41	-0.71	-1.61	-2.96	237
3	40	-0.41	0.05	-1.32	-5.09	4.72	-0.42	2.48	187
12	40	5.51	4.25	-4.68	-4.31	-0.38	-1.42	1.02	165
1	50	-1.43	2.59	6.26	-12.06	-2.04	-2.03	8.72	100
6	50	2.10	-2.41	-5.47	3.09	-1.78	2.18	2.29	95
Total respondents		79	210	288	188	66	19	87	

Living area

Table 70 Percentage of votes from each group of having a similar living area

Project nr	Costs	A	B	C	D	E	F	Total votes
2	3	15.82	16.38	27.12	11.58	20.34	8.76	354
14	40	5.85	4.97	46.78	14.04	18.42	9.94	342
4	10	8.84	8.54	35.67	18.29	16.46	12.20	328
11	4	16.23	19.16	30.52	8.77	17.86	7.47	308
16	20	8.85	9.84	31.80	12.13	24.26	13.11	305
9	8	7.33	5.33	32.33	9.00	38.33	7.67	300
7	5	25.00	8.78	29.39	10.81	17.91	8.11	296
10	6	10.24	6.48	34.13	8.53	30.03	10.58	293
15	50	12.13	12.13	29.78	11.03	26.10	8.82	272
5	10	8.40	6.72	27.31	5.88	39.92	11.76	238
13	35	6.79	3.17	39.82	26.70	15.84	7.69	221
8	15	5.29	5.29	38.94	16.83	14.42	19.23	208
3	40	20.00	25.14	17.14	14.86	14.86	8.00	175
12	40	47.22	9.03	18.06	9.03	14.58	2.08	144
1	50	57.30	8.99	17.98	2.25	10.11	3.37	89
6	50	1.15	2.30	41.38	16.09	16.09	22.99	87
Total respondents		129	82	272	112	175	84	

Table 71 Deviation of the expected distribution according to the percentage of total respondents per living area. If the percentage of individuals selected per living area is equal to the distribution of the respondents per living area, the deviation is 0.

Project nr	Costs	A	B	C	D	E	F	Total votes
2	3	0.71	6.78	-4.73	-1.53	-0.15	-1.08	354
14	40	-9.26	-4.63	14.93	0.92	-2.07	0.11	342
4	10	-6.26	-1.07	3.82	5.18	-4.03	2.36	328
11	4	1.13	9.55	-1.33	-4.35	-2.63	-2.37	308
16	20	-6.25	0.23	-0.05	-0.98	3.77	3.28	305
9	8	-7.77	-4.27	0.48	-4.11	17.84	-2.17	300
7	5	9.89	-0.82	-2.46	-2.30	-2.59	-1.73	296
10	6	-4.87	-3.12	2.28	-4.58	9.54	0.74	293
15	50	-2.97	2.53	-2.07	-2.09	5.61	-1.01	272
5	10	-6.70	-2.88	-4.54	-7.23	19.42	1.93	238
13	35	-8.32	-6.43	7.97	13.58	-4.65	-2.14	221
8	15	-9.82	-4.31	7.09	3.71	-6.07	9.39	208
3	40	4.89	15.54	-14.71	1.74	-5.63	-1.84	175
12	40	32.12	-0.57	-13.79	-4.09	-5.91	-7.75	144
1	50	42.20	-0.61	-13.87	-10.87	-10.38	-6.47	89
6	50	-13.96	-7.30	9.53	2.98	-4.40	13.15	87
Total respondents		129	82	272	112	175	84	

Appendix E: LCCA Project choice indicators

Profiles

Table 72 Cluster profiles of all covariates of the project choice model

	Cluster1	Cluster2	Cluster3	Cluster4	Cluster5	Cluster6	Cluster7	p-value
Political orientation								
N/A	0.10	0.07	0.03	0.13	0.07	0.13	0.11	0.15
Christan Democrats	0.03	0.11	0.13	0.09	0.04	0.10	0.08	
Social democrats	0.23	0.16	0.20	0.24	0.23	0.17	0.15	
Liberalism	0.27	0.33	0.29	0.23	0.33	0.26	0.21	
Environ-mentalism	0.20	0.21	0.19	0.06	0.23	0.10	0.31	
PVV/FvD	0.07	0.04	0.05	0.09	0.08	0.08	0.05	
Others	0.02	0.00	0.01	0.02	0.01	0.07	0.01	
Not voted	0.09	0.07	0.10	0.14	0.02	0.08	0.07	
Living area								
N/A	0.15	0.10	0.15	0.29	0.21	0.21	0.10	0.00
A	0.01	0.03	0.10	0.60	0.01	0.08	0.19	
B	0.01	0.00	0.08	0.00	0.01	0.08	0.69	
C	0.38	0.37	0.26	0.05	0.39	0.15	0.02	
D	0.30	0.00	0.09	0.05	0.04	0.06	0.00	
E	0.00	0.47	0.23	0.01	0.24	0.31	0.00	
F	0.15	0.03	0.09	0.01	0.10	0.12	0.00	
Favorite Travel mode								
N/A	0.07	0.00	0.04	0.09	0.03	0.04	0.03	0.29
Car	0.24	0.35	0.31	0.45	0.26	0.32	0.56	
PT	0.24	0.18	0.21	0.15	0.16	0.14	0.20	
Bike	0.39	0.40	0.38	0.24	0.49	0.45	0.18	
Other	0.06	0.07	0.05	0.07	0.06	0.05	0.04	
Education								
Elementary	0.09	0.03	0.05	0.14	0.03	0.08	0.13	0.00
MAVO/MBO	0.08	0.13	0.06	0.09	0.05	0.11	0.10	
HAVO/VWO	0.19	0.31	0.27	0.47	0.21	0.36	0.31	
HBO/WO	0.41	0.31	0.33	0.22	0.33	0.31	0.37	
WO master	0.22	0.22	0.29	0.08	0.38	0.14	0.07	
N/A	0.01	0.01	0.01	0.00	0.00	0.00	0.02	
Age								
18 - 19	0.29	0.26	0.14	0.13	0.21	0.12	0.11	0.00
20 - 31	0.16	0.22	0.15	0.18	0.25	0.25	0.17	
32 - 41	0.20	0.19	0.26	0.22	0.15	0.26	0.23	
42 - 50	0.17	0.17	0.26	0.25	0.21	0.18	0.23	
51 - 70	0.17	0.16	0.19	0.23	0.18	0.18	0.27	
Mean	49.26	49.51	54.76	55.10	51.29	53.67	56.72	

Income								
01 - 03	0.22	0.20	0.17	0.18	0.16	0.22	0.26	0.10
04 - 14	0.30	0.25	0.20	0.24	0.23	0.19	0.20	
15 - 15	0.08	0.08	0.07	0.14	0.12	0.10	0.11	
16 - 17	0.22	0.23	0.28	0.28	0.25	0.26	0.30	
18 - 27	0.18	0.24	0.28	0.16	0.23	0.22	0.13	
Mean	41620.63	46113.60	56520.80	45923.76	49970.02	47905.93	39072.57	
Gender								
Men	0.52	0.46	0.59	0.58	0.69	0.55	0.50	0.01
Women	0.48	0.54	0.41	0.42	0.31	0.45	0.50	
Move								
N/A	0.08	0.02	0.03	0.09	0.02	0.08	0.03	0.01
No	0.83	0.93	0.90	0.85	0.89	0.86	0.93	
Yes	0.09	0.05	0.07	0.06	0.09	0.06	0.05	
Car owner								
N/A	0.04	0.04	0.19	0.09	0.15	0.16	0.04	0.00
No	0.49	0.24	0.21	0.08	0.27	0.16	0.05	
Yes	0.47	0.72	0.59	0.83	0.58	0.68	0.92	
Driving License								
N/A	0.05	0.03	0.14	0.10	0.05	0.09	0.03	0.09
No	0.24	0.10	0.10	0.03	0.09	0.08	0.05	
Yes	0.71	0.87	0.76	0.87	0.86	0.83	0.93	
Public Transport commutation								
N/A	0.04	0.02	0.08	0.07	0.03	0.09	0.01	0.19
No	0.39	0.60	0.49	0.57	0.55	0.60	0.68	
Yes	0.57	0.38	0.43	0.36	0.42	0.31	0.31	

Model parameters

Table 73 Model parameters project choice model

	Cluster1	Cluster2	Cluster3	Cluster4	Cluster5	Cluster6	Cluster7	Wald	p-value	R^2
1	0.28	0.76	0.60	2.05	-2.39	-2.37	1.07	101.14	0.00	0.28
2	-0.59	-0.89	0.60	-0.41	0.36	0.46	0.48	181.26	0.00	0.26
3	0.67	0.63	0.99	1.12	-2.36	-2.59	1.53	51.91	0.00	0.13
4	0.44	-0.81	0.63	-0.98	0.79	0.26	-0.12	103.93	0.00	0.21
5	-0.63	-0.63	0.07	0.80	-0.74	0.54	0.58	147.51	0.00	0.23
6	2.05	1.07	1.84	0.43	-1.85	-1.81	-1.73	-0.62	0.00	0.12
7	-0.35	-1.05	0.45	0.44	0.38	0.28	-0.15	103.85	0.00	0.16
8	0.36	-0.83	0.76	-0.66	0.90	0.15	-0.67	104.35	0.00	0.18
9	-0.54	0.29	0.90	-1.14	0.55	0.77	-0.84	164.34	0.00	0.30
10	-0.49	-0.06	0.53	-0.60	0.74	0.38	-0.49	141.98	0.00	0.19
11	-0.53	-0.95	0.61	-0.28	0.27	0.36	0.52	150.76	0.00	0.22
12	-0.19	0.18	0.85	1.49	-0.19	-2.74	0.60	116.48	0.00	0.25
13	1.06	0.24	0.93	-0.07	0.39	-2.01	-0.53	79.99	0.00	0.17
14	0.57	0.73	-1.45	-0.71	3.77	-3.08	0.16	66.34	0.00	0.43

15	0.17	0.88	-2.94	0.06	-2.98	4.18	0.64	50.29	0.00	0.40
16	-0.17	-0.47	0.21	-0.59	0.50	0.92	-0.40	119.71	0.00	0.17

Intercepts

Table 74 Intercepts project choice model

Intercepts	Overall	Wald	p-value
Choice1			
0	2.02	6.00	0.01
1	-2.02		
Choice2			
0	0.08	4.06	0.04
1	-0.08		
Choice3			
0	1.46	6.01	0.01
1	-1.46		
Choice4			
0	0.37	47.55	0.00
1	-0.37		
Choice5			
0	0.58	129.27	0.00
1	-0.58		
Choice6			
0	2.61	6.22	0.01
1	-2.61		
Choice7			
0	0.33	56.05	0.00
1	-0.33		
Choice8			
0	0.81	146.38	0.00
1	-0.81		
Choice9			
0	0.44	51.83	0.00
1	-0.44		
Choice10			
0	0.35	69.13	0.00
1	-0.35		
Choice11			
0	0.23	30.09	0.00
1	-0.23		
Choice12			
0	1.28	7.93	0.00
1	-1.28		
Choice13			
0	1.11	8.26	0.00

1	-1.11		
Choice14			
0	0.49	4.51	0.05
1	-0.49		
Choice15			
0	0.74	4.94	0.05
1	-0.74		
Choice16			
0	0.25	35.73	0.00
1	-0.25		

Model for clusters

Table 75 Intercepts covariates project choice model

Intercept	Cluster1	Cluster2	Cluster3	Cluster4	Cluster5	Cluster6	Cluster7	Wald	p-value
	-0.65	8.53	13.73	-0.92	6.66	9.44	-36.79	11.03	0.09
Political orientation									
	Cluster1	Cluster2	Cluster3	Cluster4	Cluster5	Cluster6	Cluster7	Wald	p-value
N/A	5.70	6.27	-39.01	5.31	5.25	5.77	10.71	51.31	0.15
Christan Democrats	-1.22	1.26	6.92	0.46	-0.50	-0.01	-6.91		
Social democrats	-0.63	-0.15	5.66	-0.79	-0.23	-1.01	-2.84		
Liberalism	-0.53	0.44	5.92	-0.93	0.05	-0.75	-4.19		
Environ-mentalism	-6.74	-4.81	0.32	-6.72	-5.61	-6.52	30.09		
PVV/FvD	1.31	1.32	7.28	1.41	1.95	0.58	-13.85		
Others	2.11	-4.81	6.10	1.33	0.31	2.07	-7.10		
Not voted	0.02	0.50	6.81	-0.06	-1.22	-0.14	-5.90		
Living area									
	Cluster1	Cluster2	Cluster3	Cluster4	Cluster5	Cluster6	Cluster7	Wald	p-value
N/A	2.96	0.89	-0.75	2.16	0.41	-0.59	-5.08	137.01	0.00
A	-5.09	-2.30	-2.90	1.52	-4.42	-3.13	16.31		
B	-4.86	-10.63	-5.66	-10.37	-7.56	-5.80	44.88		
C	3.84	1.57	-0.94	0.18	-0.04	-1.23	-3.38		
D	9.38	-0.16	3.55	5.54	3.18	3.22	-24.69		
E	-13.21	7.85	5.00	-0.84	5.77	5.28	-9.84		
F	6.98	2.79	1.70	1.81	2.66	2.25	-18.19		
Favorite mode									
	Cluster1	Cluster2	Cluster3	Cluster4	Cluster5	Cluster6	Cluster7	Wald	p-value
N/A	29.46	-30.73	14.71	22.03	-15.67	-27.91	8.11	27.31	0.29
Car	-7.04	7.60	-3.71	-5.25	3.80	6.91	-2.31		
PT	-8.74	6.55	-4.64	-6.56	2.71	5.93	4.75		
Bike	-6.57	8.59	-2.82	-4.41	5.10	8.20	-8.10		
Other	-7.11	7.98	-3.54	-5.80	4.06	6.86	-2.46		
education									

	Cluster1	Cluster2	Cluster3	Cluster4	Cluster5	Cluster6	Cluster7	Wald	p-value
Elementary	1.19	-0.54	-0.22	1.36	0.18	1.18	-3.14	61.70	0.00
MAVO/MBO	-0.81	-0.20	-1.24	0.51	-0.26	0.52	1.47		
HAVO/VWO	1.17	1.33	1.13	2.88	2.12	2.48	-11.10		
HBO/WO	0.78	0.10	0.45	0.87	1.77	1.48	-5.45		
WO master	1.54	1.37	2.07	1.77	3.45	2.30	-12.50		
N/A	-3.87	-2.05	-2.19	-7.39	-7.26	-7.96	30.72		
Age									
	Cluster1	Cluster2	Cluster3	Cluster4	Cluster5	Cluster6	Cluster7	Wald	p-value
	-0.07	-0.08	-0.04	-0.05	-0.06	-0.05	0.36	27.18	0.00
Income									
	Cluster1	Cluster2	Cluster3	Cluster4	Cluster5	Cluster6	Cluster7	Wald	p-value
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.67	0.10
Gender									
	Cluster1	Cluster2	Cluster3	Cluster4	Cluster5	Cluster6	Cluster7	Wald	p-value
Men	0.19	0.04	0.27	0.39	0.58	0.15	-1.63	16.48	0.01
Women	-0.19	-0.04	-0.27	-0.39	-0.58	-0.15	1.63		
Expecting to move out									
	Cluster1	Cluster2	Cluster3	Cluster4	Cluster5	Cluster6	Cluster7	Wald	p-value
N/A	1.81	0.94	-1.61	0.31	-3.06	0.66	0.96	25.61	0.01
No	0.80	1.48	2.42	0.99	3.18	1.24	-10.11		
Yes	-2.61	-2.42	-0.82	-1.30	-0.12	-1.89	9.15		
Car owner									
	Cluster1	Cluster2	Cluster3	Cluster4	Cluster5	Cluster6	Cluster7	Wald	p-value
N/A	-10.54	1.74	2.79	-0.26	3.08	2.74	0.45	34.56	0.00
No	7.18	0.29	0.03	1.08	-0.13	-0.10	-8.34		
Yes	3.36	-2.03	-2.82	-0.82	-2.95	-2.63	7.90		
Driving license									
	Cluster1	Cluster2	Cluster3	Cluster4	Cluster5	Cluster6	Cluster7	Wald	p-value
N/A	2.41	-0.51	-0.12	3.12	-1.37	-1.01	-2.51	19.02	0.09
No	-0.38	0.83	0.58	-1.43	1.07	0.96	-1.63		
Yes	-2.03	-0.31	-0.46	-1.69	0.30	0.05	4.14		
Public transport communication									
	Cluster1	Cluster2	Cluster3	Cluster4	Cluster5	Cluster6	Cluster7	Wald	p-value
N/A	-24.61	13.56	13.81	-27.59	7.76	14.28	2.80	15.98	0.19
No	11.88	-6.95	-7.20	13.35	-4.10	-7.22	0.24		
Yes	12.73	-6.61	-6.60	14.24	-3.66	-7.06	-3.04		

Appendix F: Quantitative attributes as indicators

A cluster model is estimated, including all total project attribute values per individual as indicators, which are all added as continuous variables. The model contains 6 indicators in total. Table 66 presents the BIC values to determine the optimal number of clusters. The BIC value keeps decreasing, even with more than 11 clusters. However, the BVR value and number of significant BVR's does not decrease a lot after 4 clusters. Therefore, the model with 4 clusters is selected.

Table 76 BIC and BVR values as criteria to determine the optimal number of clusters

Number of clusters	BIC	#BVRS>3.84	Max BVR
1	47028	13	446
2	44028	13	196
3	42236	10	132
4	40872	10	83
5	40351	11	70
6	39654	11	57
7	39326	11	47
8	38867	9	31
9	38543	8	27
10	38422	9	23
11	38123	8	21

Clusters based on project attributes

Table 67 presents the cluster sizes and profiles. The statistical Wald test shows all indicators are significant, which means the indicator values differ significantly among the clusters.

Table 77 Cluster profiles model including quantitative attributes as indicators

	Cluster1	Cluster2	Cluster3	Cluster4	Wald	p-value
Cluster Size	0.40	0.24	0.22	0.14		
Attributes						
Travellers	15,878.52	10,750.13	23,997.94	30,098.24	523.35	0.00
Time Savings	2.70	2.35	3.42	2.37	160.12	0.00
Deaths	-0.20	-0.32	0.00	-0.17	160.93	0.00
Injuries	-1.95	-3.30	-0.26	-1.74	122.73	0.00
Noise	-5.04	0.00	9.97	25.96	511.65	0.00
Trees	8.36	0.00	18.00	31.52	107.41	0.00

Table 78 Cluster description of 4 clusters based on quantitative attributes

Cluster nr.	Description
1	No specific preference
2	Safety and trees preferred over travel time savings
3	Time savings
4	Travelers affected

Table 68 presents an overview of the cluster interpretation. The first cluster and largest cluster seems not to have a specific preference for one of the attributes, which is the largest cluster. Probably, these individuals base their choice on alternative project-specific characteristics despite comparing project values. The second clusters select project that decrease the number of traffic injuries and traffic deaths. Probably these individuals select safety compliance projects or slow mode safety projects since these projects result in a decrease in traffic injuries and deaths. The third cluster mainly selects the project with the highest impacts in terms of travel time savings. The projects with most minutes of time savings per travelers are car, cycle, or public transport projects in spite of safety compliance or active mode safety projects.

Figure 29 Projects having the highest travel time savings

Cluster 4 mainly selects projects that have a high number of travelers, which are all the car projects and the frequently selected Stadshouderskade project.

Figure 30 Projects having the highest number of travelers

Appendix G: Modes as indicators

Table 79 Cluster profiles of all covariates of the mode preference model

Education level							
	Cluster1	Cluster2	Cluster3	Cluster4	Cluster5	Cluster6	Cluster7
Elementary	0.09	0.06	0.12	0.05	0.14	0.04	0.02
MAVO/MBO	0.10	0.06	0.11	0.14	0.07	0.07	0.09
HAVO/VWO	0.30	0.23	0.29	0.25	0.35	0.28	0.41
HBO/WO	0.35	0.36	0.32	0.33	0.34	0.30	0.27
WO master	0.17	0.28	0.15	0.22	0.10	0.30	0.20
N/A	0.00	0.00	0.02	0.02	0.00	0.00	0.02
Favorite mode							
N/A	0.03	0.05	0.07	0.02	0.07	0.04	0.07
Car	0.33	0.29	0.33	0.33	0.50	0.25	0.39
PT	0.18	0.25	0.15	0.16	0.16	0.23	0.18
Bike	0.42	0.36	0.40	0.39	0.21	0.42	0.33
Other	0.04	0.06	0.05	0.11	0.07	0.06	0.02
Neighborhood							
N/A	0.19	0.14	0.16	0.18	0.22	0.18	0.13
A	0.09	0.09	0.10	0.11	0.40	0.09	0.10
B	0.12	0.04	0.11	0.06	0.14	0.02	0.05
C	0.18	0.32	0.27	0.38	0.12	0.37	0.24
D	0.11	0.16	0.14	0.08	0.05	0.07	0.08
E	0.23	0.17	0.20	0.15	0.01	0.18	0.15
F	0.08	0.09	0.03	0.03	0.07	0.09	0.26
Orientation							
N/A	0.09	0.09	0.11	0.09	0.12	0.05	0.03
Christan Democrats	0.08	0.07	0.04	0.05	0.08	0.08	0.18
Social democrats	0.20	0.18	0.15	0.22	0.27	0.23	0.25
Liberalism	0.28	0.28	0.33	0.31	0.21	0.32	0.18
Environ-mentalism	0.17	0.19	0.25	0.22	0.11	0.20	0.10
PVV/FvD	0.06	0.07	0.07	0.03	0.07	0.07	0.12
Others	0.03	0.02	0.00	0.00	0.01	0.01	0.07
Not voted	0.09	0.10	0.05	0.08	0.14	0.05	0.07
Income							
01 - 03	0.23	0.16	0.20	0.22	0.20	0.20	0.19
04 - 14	0.22	0.25	0.26	0.28	0.20	0.22	0.29
15 - 15	0.09	0.11	0.05	0.10	0.11	0.08	0.18
16 - 17	0.24	0.24	0.30	0.22	0.28	0.30	0.22
18 - 27	0.22	0.23	0.18	0.18	0.21	0.21	0.13
Mean	46825.70	49873.27	45502.27	41092.60	46316.30	49744.75	38709.39
Age							

08 - 19	0.18	0.23	0.21	0.23	0.19	0.15	0.22
20 - 31	0.20	0.19	0.14	0.25	0.16	0.22	0.16
32 - 41	0.25	0.20	0.22	0.16	0.27	0.18	0.16
42 - 50	0.21	0.19	0.19	0.18	0.21	0.29	0.19
51 - 70	0.16	0.20	0.25	0.17	0.18	0.16	0.27
Mean	52.03	51.49	53.36	50.21	52.58	53.91	53.65
Gender							
Male	0.52	0.54	0.49	0.46	0.61	0.70	0.61
Female	0.48	0.46	0.51	0.54	0.39	0.30	0.39
Move							
N/A	0.05	0.07	0.10	0.03	0.06	0.02	0.04
No	0.89	0.86	0.81	0.90	0.88	0.93	0.91
Yes	0.06	0.08	0.09	0.08	0.07	0.06	0.05
Car ownership							
N/A	0.11	0.11	0.12	0.03	0.06	0.11	0.05
No	0.22	0.34	0.24	0.30	0.10	0.30	0.25
Yes	0.66	0.55	0.64	0.67	0.84	0.59	0.69
PT commutation							
N/A	0.06	0.06	0.07	0.01	0.05	0.03	0.02
No	0.56	0.41	0.53	0.57	0.60	0.58	0.52
Yes	0.38	0.53	0.39	0.42	0.35	0.39	0.46
Driving License							
N/A	0.09	0.08	0.10	0.02	0.05	0.04	0.05
No	0.10	0.18	0.12	0.08	0.07	0.14	0.13
Yes	0.82	0.74	0.78	0.90	0.89	0.82	0.82

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
No Answer	12	43	18	35	26	9	36	24	34	31	40	22	20	36	31	42
Amsterdam Centrum	4	40	5	42	15	11	27	40	35	31	38	7	56	53	27	33
Amsterdam Noord	3	41	36	46	17	5	36	24	15	15	22	14	42	42	31	37
Amsterdam Oost	0	32	9	62	8	21	21	40	34	30	26	9	64	43	23	28
Amsterdam West	7	35	10	51	25	10	29	29	35	44	35	4	28	66	25	50
Amsterdam Zuid	10	40	8	46	25	19	37	27	38	37	42	10	27	58	35	21
Amsterdam Nieuw-West	4	30	16	36	28	13	34	26	35	35	28	14	25	58	32	35
Aalsmeer	0	30	20	60	90	10	40	20	80	50	30	20	10	30	20	90
Amstelveen	5	36	10	25	63	12	27	17	49	69	22	10	22	46	36	32
Bijlmermeer	2	42	17	46	31	29	35	44	33	42	35	2	23	50	25	48
Diemen	9	26	26	57	26	13	9	61	0	22	4	0	26	35	17	52
Edam- Volendam	8	50	50	33	8	0	33	8	33	33	67	8	17	25	42	50
Haarlemmermeer	5	44	16	31	40	7	29	15	76	34	40	13	21	34	45	45
Ouder-Amstel	0	38	0	38	54	23	38	38	54	46	38	15	0	15	62	38
Purmerend + Landsmeer + Waterland	10	74	54	34	21	3	31	14	17	21	73	17	7	20	40	34
Uithoorn	7	53	20	33	87	0	47	27	60	73	20	7	13	13	47	33
Wormerland + Beemster	33	56	39	33	6	0	39	11	11	22	50	61	6	17	28	17
Zaanstad	41	41	25	21	17	1	60	8	18	23	37	51	13	15	25	22

Figure 31 Project slection per municipality (percentages)

Appendix I: Decision-making process Vervoerregio Amsterdam

To answer the second research question of how to fit the results into the phases of the decision-making process, the practical decision-making process is described. The decision-making process of Vervoerregio Amsterdam is described in accordance with the case, which is representative of regional decision-making in the Netherlands. The decision-making process is described from a strategic mobility vision to the more operational investment programs. Subsequently, the project phasing is described, which is a process parallel to the investment programs. Table 70 presents the hierarchical process. The time horizon is more an indicator. It could be the case that due to the complexity, size of the project, or political circumstances, project realization processes take more than 10 years. The information is derived from the public information provided by Vervoerregio Amsterdam.

Table 80 Three stages of policy (own work based on Metropoolregio Amsterdam (2016), Vervoerregio (2017) and Vervoerregio (2019a))

	Strategic Mobility Vision	**Mobility Policy Framework**	**Investment Programs**	**Project Phasing**
Output	Strategic tasks	Mobility per area	Project initiatives	Infrastructure realizations and maintenance
Level	Strategic	Tactical	Tactical/Operational	Operational
Time horizon	10-50 years	5-10 years	1-5 years	1-5 years

Strategy mobility vision

In the regional vision, the ambitions and strategies of the Vervoerregio are presented. The strategy ambitions are defined based on trends over the years, such as population growth and economic- and technology development. Strategic tasks for mobility within and towards the region are defined to achieve these ambitions. In total, five strategy tasks are defined. The strategic vision provides a basis for a more concrete mobility policy framework (Metropoolregio Amsterdam, 2016).

1. From modality to mobility
2. Towards a carbon-neutral mobility system
3. Safely and pleasantly from door to door
4. Mobility and the environment go side by side
5. The proximity of daily activities

Mobility Policy Framework

The Vervoerregio distinguishes 5 different levels of urbanization. The space availability, mobility pressure, and travel purpose differ per level of urbanization. Therefore, the mobility tasks are specified per level (Vervoerregio Amsterdam, 2017a). Figure 30 shows the geographic distribution of the levels of urbanization over the region. The region is divided into the same areas as applied for the analysis in the case study to compare the level of urbanization with the results in the next chapter.

The modes available depends on the type of areas. Area C is the densely populated city of Amsterdam, having a high degree of urbanization. Common modes within and towards these central urban areas are active modes and public transportation, of which high connected networks are available. These areas have less space available for car infrastructure. The Vervoerregio prefers to stimulate active modes and PT within and towards these areas. The car traffic network gets less priority. Most trips are

business purposes or tourism. Extremely high numbers of travelers make use of the infrastructure, but there is not a lot of space for the infrastructure in these areas.

Area B is a more rural area, less densely populated, and has more space for recreation. It is less cost-effective to realize high connected PT and active mode networks compared to city center areas since fewer travelers make use of the infrastructure. The car is the dominant travel mode within and towards these areas, especially for longer distances. PT functionates as a frequent connection between main junctions. Inhabitants should quickly reach the place of their daily activities (work, school, etc.). There is more space in these areas. However, the number of travelers is relatively low.

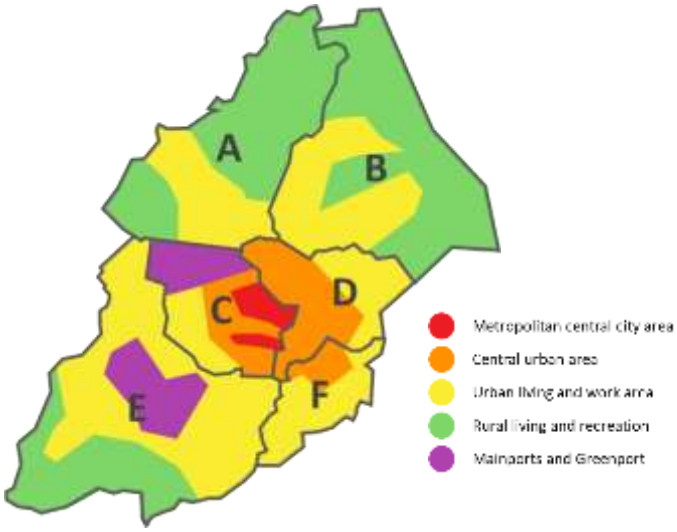

Figure 32 Levels of urbanization (own work, based on Metropoolregio Amsterdam (2016))

The ambition of the Vervoerregio is to realize these projects as cost-efficient as possible. However, the network as a whole should be served, whereof less densely populated areas belong to as well. Therefore, key performance indicators for the network are established by Vervoerregio Amsterdam, such as minimum travel time from door to door and the number of serious road traffic casualties (Vervoerregio Amsterdam, 2017a).

Investment programs

Budget distribution over the modes

An initiative of a project has to be included in one of the investment programs. The investments are presents the planning of selected and prioritized projects. Projects are prioritized based on the established key performance indicators, which present the need for a project. Four different investment programs based on modalities are distinguished (Vervoerregio Amsterdam, 2019b). The percentages of the budget contribution of the Vervoerregio Amsterdam to each of the modalities is presented as well. Each year, around 100 million euros are reserved for regional infrastructure projects in Vervoerregio Amsterdam. New infrastructure projects are partly financed by the Vervoerregio, partly by the road owner (the municipality or the country council).

1. Cycling (12%)
2. Public transport (61%)
3. Traffic safety (7%)
4. Road traffic (20%)

In the past, these fixed budgets were allocated to each mode. The budget per mode is becoming more flexible over the years. However, investment agendas are still separately presented.

Budget distribution over the areas

The investment agendas are reviewed twice a year by the Region Council, in which representatives of all 15 municipalities are part of. The plan of approach should be cost-effective and cost-efficient (Vervoerregio Amsterdam, 2017a). Projects within high populated areas have more travelers and inhabitants who benefit from a new infrastructure project. Consequently, the cost-benefit ratio is more likely to be positive compared to less densely populated areas. However, it is not fair to realize out of the proportional part of the projects within high populated areas. Consequently, while in advance, no strict guidelines are set for the geographical distribution or distribution over the modes, these distributions are reflected and supervised by the Region Council. The distributions are indirectly taken into account by policymakers in prioritizing projects, as described in the interview in Appendix J.

Project phasing

The aim of project phasing is to smoothen the process in an effective and cost-efficient way. The phasing approach in project planning is a regular approach. Consequently, the phasing of Vervoerregio Amsterdam is comparable to other municipal, regional, or national governments. All projects should follow the project phasing. However, relatively small projects can leave out some phases. The required process details, organization, and decision information level increases with the progress in phases. Therefore, the feasible role of citizen participation differs per phase of the process. The following paragraphs present the formal project phasing according to the public information provided by Vervoerregio Amsterdam (Vervoerregio Amsterdam, n.d.). It could be less straight forward in practice, which is beyond the scope of this research.

The idea of project phasing and citizen participation

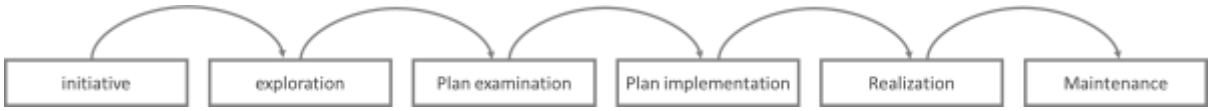

Figure 33 Project Phasing Vervoerregio Amsterdam (own work, based on Vervoerregio (n.d.))

1. Initiative

In the initiative-phase, the problem definition is defined. A global solution direction and purpose are determined, which have to be in line with the general mobility framework and mobility tasks defined. The project initiative is incorporated in the investment program, including a rough budget as an indicator. The geographical scope and time horizon of the project have to be approximately determined.

Citizen participation could help decision-makers in the solution directions that are in line with citizens' needs. Themes of mobility preferred rather than specific project preferred are better applicable in this phase since no concrete projects are defined in the initiative phase. An example of a problem could be the target of travel time between the area 'a' and 'b' is exceeded. Citizen panels could help to identify the demand for modalities or traffic junctions that should be improved.

1. Exploration

In the exploration phase, the plan of the project is elaborated. Solution directions are worked out into more detail. Guidelines or preconditions for the desired effects, costs, and implications are established. The required budget is less rough specified and reserved in the program of investment.

However, the exact budget is not established yet, which allows reviewing multiple alternatives in the plan examination phase.

2. Plan examination

In the plan examination phase, the project (alternatives) are evaluated. A preferred solution is established in this phase, which is a concrete project. The planning, costs, and financiers of the project are established. The preferred alternative is determined based on the effects of the alternatives towards the defined mobility tasks, the interest of involved parties, and the costs of the project. Concrete variants of projects are compared to each other.

Citizen participation could help decision-makers to choose the preferred solution. For example, citizens could choose between a bridge, a tunnel, or a detour as a solution for a missing link. Concrete projects could be proposed. However, a smaller scale would preferable to make use of local knowledge. A citizen participation experiment in which individuals choose between different solution variants would be useful for decision-makers to know which alternative has more support among citizens, which should use the infrastructure in the end. Secondly, individuals' local knowledge can be used for the optimal design. Thirdly, accounting citizens' input selecting a solution variant is relatively easy compared to changing the design when it is already realized.

3. Plan implementation

The final solution is selected, and the last details are elaborated. The scope, effects, and planning are reviewed if they are in line with the initiative agreements. Decision-makers have to take definitive agreements, which can take a long time. Subsequently, the planning procedures are completed in this phase to start the tender and realization of the project. The budget is definitively allocated. From this phase, citizen participation is not applicable anymore since the phases focused on contracts and infrastructure realization.

4. Realization & maintenance

The practical realization of the project. The Vervoerregio has to keep informed about the developments in planning, scope, costs since they are still accountable. After realization, the infrastructure operator is responsible for the time period that is agreed upon beforehand.

Three opportunities citizen participation

In conclusion, citizen involvement could be useful for the Vervoerregio in the initiative or the plan examination phase of projects. However, in the initiative-phase, projects are not concrete specified like the PVE. In the plan examination phase, the scale of participation is smaller than PVE. Design as the PVE experiment in the case study is specifically applicable in the described phasing.

However, apart from the phasing of projects, participation might be applied for prioritizing projects in the agenda of investment, where projects are prioritized based on key performance indicators, where citizens' support might be one of the indicators. In reality, many project ideas are ongoing, one more concrete than the other. Next to the phasing process, these ideas are bundled, and these projects are prioritized, for instance, due to budget or time constraints. Citizens' preference for specific projects might be useful for prior projects. However, the type of projects preferred by citizens' could be used for prioritizing in more situations than these set of proposed projects. The preferred impacts of projects could help the Vervoerregio what kind of projects to devote. Especially in the future, the prioritizing of projects is expected to be more crucial.

Ambition to increase citizen participation in the decision-making process

Citizen participation is a high topic on both the national level as on a regional level. The Vervoerregio Amsterdam tries to setup citizen panels and aspires to include interests of citizens more into the decision-making process. Therefore, it is important to have an inclusive stakeholder representation instead of only extreme opinions. Consequentiality and providing feedback towards citizens is an important aspect to show citizens their opinion counts. The Vervoerregio did already set up multiple panels and had a positive experience with these panels (Vervoerregio Amsterdam, 2019a).

The Vervoerregio Amsterdam is setting up panels in sub-areas of the Vervoerregio, proposing projects in one modality, like the experiment in Zaanstreek-Waterland, which is area A (Zaanstad) and B (Purmerend) of the case study together. Proposed projects are Public Transportation concession on a lower scale. The following paragraph describes the proposed projects and the results.

> *- Citizen panel Zaanstreek-Waterland (Vervoerregio Amsterdam, 2019c).*
>
> *The Vervoerregio is setting up a citizen panel in Zaanstreek Waterland. The citizens of the area had the opportunity to participate in the so-called serious gaming experiment. Participants show their preference for Public Transportation projects within the area. Participants could choose among projects such as higher frequency of busses, extended night network of busses, Zero Emission busses, fewer transfers, higher frequencies during peak hours, or additional staff in busses. The first three alternatives were the most popular, especially after including a budget constraint. The Vervoerregio distinguished participants that live in the area and travelers through the area living in near located regions.*

As a result of the serious-gaming methodology, the regions formulated ‘wishes’ for new concessions. Providers that could fulfill one or more of these concessions have more chance of winning the concession for Public Transportation in these areas (Vervoerregio Amsterdam, 2019c).

Appendix J: Interviews

Interview 1 Vervoerregio Amsterdam (Stefan Talen & Hedy Luchtmeyer)

18th December 2019

General impression citizen participation like PVE

The preferences of citizens for infrastructure are very interesting. Citizen participation in policymaking is a national theme. The preferences of alternative stakeholders are very important in policymaking. Therefore it is not a requirement to have a representative sample in such an experiment. It is important to identify the different opinions of the stakeholders in the field. Citizen participation is getting more important in the future, where there are more strict budget constraints.

In such an experiment, it is useful to know what type of projects are preferred by citizens. The projects proposed in the experiment are too concrete, according to to the policymakers. However, policymakers are really positive about providing feedback to citizens on how their preferences are considered in policymaking. Therefore it is important to show citizens the results of the experiment. Consequently, citizens are able to experience the consequences.

Projects in the experiment

More fictive projects could be used in experiments to test what type of projects are prioritized by citizens. For instance, what modality do citizens prefer, or what missing link has high societal interest?

It is not useful if individuals select all projects in their living area. If individuals select all projects in their living area, their priority is not clearly reflected.

Background PVE

It would be useful if participants could vote against a certain project to show what projects have high interest and what projects individuals do not prefer. This information would show what people disadvantage due to a certain project.

Furthermore, information about citizens' travel behavior could provide useful information. This would allow making a separation between individuals living close to the project and travelers making frequent use of the infrastructure. The information could identify interesting dilemmas where travels prefer a short travel time, but inhabitants prefer to minimize noise pollution.

Clusters:

Policymakers argue they are not interested in the average results, the preference of certain interest groups within the Vervoerregio would be more useful. The average results would show another distribution than looking per neighborhood.

Vervoerregio does experiment with serious gaming. The game tests what decision citizens would make. However, these experiments are on a very local level (Zaanstreek) about very specific alternatives.

Local knowledge: citizen has local experience about projects in their living neighborhood. Citizens have more knowledge about what kind of projects are urgent since they know the project situation. However, the risk of such experiments is that citizens choose projects that improve the traffic situation they frequently have to make use of.

Regional interest: Individuals make choices about projects in the region without considering their personal interests. However, such experiments risk individuals who do not have enough knowledge about these projects to make such decisions.

Geographical level of scale:

Interesting scale. In a neighborhood or residential area, the findings are less useful since that scale only includes inhabitants, not the travelers. The future users of the infrastructure are not per definition the individuals living close to the project location. Therefore it is interesting what their preferences are on a larger scale and what they not prefer.

Policymaking

The tool fits the best within the project phasing of projects. However, information about project phasing is available on our website.

Interview 2 Vervoerregio Amsterdam Constance Winnips & Joost van Os

16th January 2020

How is the budget allocated to a travel mode determined?

The exact numbers are not fixed per year (anymore). The Vervoer Regio assigns the budget towards projects and distinguished four different modes indeed. In the past, there was a certain amount of budget allocated towards, e.g., Public Transport. However, that approach is changed; the budget per travel mode is flexible.

In general, relatively more Public Transport and active modes are realized in the urban areas of Amsterdam. In the outskirts, more remote areas, relatively more car infrastructure projects are realized in combination with the accessibility of major hubs and transfer location (P&R locations). Citizen involvement could play an important role in getting insights about the type of infrastructure preferred by the citizen, which should be used in prioritizing projects.

To what extent is it problematic individuals select projects in their living area? How do you deal with this behavior as a decision-maker?

The Vervoerregio honestly regrets to see this behavior. The knowledge of individuals preferring projects in their living area is not very useful and applicable to policymakers. However, it is really useful to know this kind of behavior could occur, also for other alternative panels. Other trade-offs, such as preferred travel mode, are more interesting to know. However, it is unknown why individuals are inclined to predominantly select the proposed projects within their living area. It could be individuals kind of selfish prefer to allocate the budget in their neighborhood over projects located far-off. However, it could also be the case individuals know these project locations.

The Vervoerregio is interested in trade-offs within a sub-region of the Vervoerregio. The trade-off among projects within a sub-region provides more information than individuals just selecting all these projects. The trade-off among regional projects outside their region could be an interesting alternative as well. Both approaches avoid individuals just selecting all the proposed projects within their living area. By avoiding such behavior, PVE would be a very useful tool for citizen involvement in project evaluation.

Projects in areas having a high number of inhabitants, like the city of Amsterdam, get more votes in PVE and more benefits in CBA evaluation. Consequently, projects in these areas are more likely to end up in the optimal portfolio of projects. To what extent is this problematic?

A relatively larger share of the total budget of the Vervoerregio is allocated to the city of Amsterdam. However, the proportional number living in Amsterdam is much higher than in other areas of the Vervoerregio. In Amsterdam, a number of individuals benefit from new infrastructure projects. Consequently, more budget is allocated to this area. However, there are more so-called cores of the region. Another core is Schiphol, passed by an extremely high number of travelers every single day. The costs are more likely to outweigh the benefits at these locations compared to remote locations. Apart from this, a location like Schiphol as a network junction is even more interesting, since travelers that benefit are not individuals living in the neighborhood in particular. If individuals just select projects in their living area, Schiphol would be an interesting case to compare. The Vervoerregio is interested in how a project like this will score in a tool like PVE.

To what extent is it problematic relative expensive projects in remote areas 'never' end up in the optimal portfolio?

An infrastructure project has to be efficient. If a project does not have enough support or travelers that benefit, the project does not get priority over other projects. There should include a certain amount of travelers that benefit from realizing a new project at a certain location. However, there are minimum set values for the accessibility of remote areas in the Vervoerregio. The network of the Vervoerregio should reach the whole region. If those set values are violated for remote areas, the infrastructure should be improved.

To what extent does the account for equal distribution of the budget over the region?

There are no guidelines about the minimum budget per subregion established. However, if the distribution of budget over the areas is remarkable out of proportion, the Region Council would have a question about these. Representatives for each municipality are part of the Region Council, who will control an equal distribution. In conclusion, while there are no strict guidelines, the equal distribution is checked.

In general, the budget is allocated to locations where the projects are needed the most, has the most potential and is the most cost-efficient, which is more likely in an area where more people live or make use of the infrastructure. However, the Vervoerregio strives for an accessible network entry for the whole region.

How are the citizens' preferences considered in the decision-making process? Which phase of the decision-making, how, and what are important requirements?

Firstly, citizen participation could be applied to the prioritizing of projects. Citizen involvement can be used to verify the demand for projects. Urgent projects need to get priority.

Secondly, citizen participation could be applied during the decision-making process. The decision-making process is divided into multiple phases. The extent of project specification increases in the phasing process. The level of detail of possible citizen involvement differs per level.

There are two suitable phases for citizen involvement; the exploration phase and the plan implementation phase. The first phase would be effective on a regional level, including quite an abstract level of detail. Understanding important themes such as better accessibility of PT in a certain region would be useful in this phase.

In the plan implementation phase, more concrete alternatives for a certain problem in a specified area are specified. Citizen participation would be more useful on a more local level making use of citizens local knowledge and user expertise.

In both phases, PVE could function as a tool to understand citizens' preferences. However, the scope of PVE, proposed projects, and level of detail of presented information should be adapted towards the purpose of the citizen involvement. On beforehand, designers of PVE should determine what level of citizen participation is needed.

What if citizen preferences directly oppose the policy of the Vervoerregio?

Would be strange if citizen prefers the opposite of the vision drawn up by the Region Council since the members of the regional council are indirectly elected by citizens. Consequently, the Region Council should be representative of citizens. If citizens would prefer the opposite of the policy of the Vervoerregio, the structure of the decision-making process should be reconsidered. However, the ambition of citizen participation is not to test the vision or strategy of the Vervoerregio but rather to involve the citizen in the direction of solutions. For instance, how we should realize a carbon-neutral transportation project.

Furthermore, a citizen could have their desires. However, directly implementing citizen desires does not always result in optimal policies. For instance, a door to door accessibility for vehicles within the city of Amsterdam could be a desire but is not achievable because of the limited space.

Eventually, just applying citizens' needs would make decision-makers reductant. It is useful to understand citizens' needs, apply their local knowledge and create infrastructure in accordance with their needs. However, it is up to the decision-maker what to do with this information. The decision-maker should evaluate himself what the best for the network and (all) its users is.

Interview CBA expert Bert van Wee

6th January 2020

To what extent is it desirable/problematic respondents select projects within their own neighborhood?

In the first place, I want to mention, it is very important to do research about this relationship. We did already know there is a difference in how individuals prioritize needs using their private budget compared to using a fixed public budget. However, we did not know the reason why yet. There are some possible explanations. This research shows one clear relationship.

However, it is kind of disappointed to see this relationship. It would be more interesting if participants would select certain types of projects based on their ideological considerations or social motives, which would be more interesting. However, if you found such a relation as a scientific researcher, you have to accept it.

Knowing this effect occurs, the effect can be investigated in more detail. For example, further research could be designed in a way the location-effect is eliminated, for instance, by ranking projects within the same area. What we don't know is if the location of the project overrules other project characteristics or project locations, the only project characteristic is that counts. If it is the only characteristic that counts, the concept of PVE is not very useful for spatial infrastructure projects. The same occurs in a (CBA) choice experiment when you ask individuals whether they would use a new cycling track; individuals would rather use a cycling track close to their living area. Consequently, if the location-effect is the only effect, CBA choice experiments would show a more or less similar outcome with easier methodologies.

So the research shows location overrules other aspects included in the research, such as mode improved. What we do not know, the other effects do not exist.

The same happens in health science, where smoking, exercising, and drinking affects human health to a large extent. However, that does not mean other factors have no impact on human health. Other factors could be overruled by these dominant factors. So you should perform the research again while controlling for smoking, exercising, and drinking to observe the impact of other factors. So the results raise questions for further research. However, that is how it works with scientific research.

If location is the only factor in determining project selection, we should wonder about the relevance of the concept of PVE. While if other factors affect project selection, which is explained by the fact individuals make other trade-offs with their private than the public budget, the concept keeps interesting.

However, these results suggest there exist clusters applying an alternative strategy. For instance, one cluster selecting as many as cheap projects. Another cluster is preferring safety projects. These results imply the location-effect is not the only effect that exists. Therefore it would be interesting to test a design that decreases the location-effect.

Because these results show, other strategies exist, suggest there are interesting alternative approaches to evaluate projects than a CBA approach using private budget evaluation. Therefore the PVE concept keeps interesting. It could take many years to crystallize the concept. However, that is not a problem. It took many years before the guidelines of CBA were established. Probably, the concept has to be iterated in the coming years, and over the years, we understand the pattern of behavior among respondents.

In conclusion, the concept is interesting and should not be dismissed due to these results. However, the location-effect is stronger than expected. More eccentric frames like preferring PT, safety, or environment were expected.

If you would correct for the representative living area, would this solve the problem (projects within the city of Amsterdam would have more votes)

You should correct for all patterns of which you do not want to affect your results. In this case, individuals select projects within their living area. Consequently, you should definitely correct for representativity. Otherwise, you measure where individuals are living, not the overall preference for projects.

However, the fact that projects in Amsterdam get more votes because more persons live in Amsterdam, it is not a problem itself. More individuals live in Amsterdam, more individuals that pay taxes are in Amsterdam. Consequently, more individuals have an advantage through new infrastructure projects in Amsterdam. It would be a problem if not a proportionally part of the budget is allocated towards a region. For instance, if 50 percent of the region lives in Amsterdam and 90 percent of the budget is allocated to Amsterdam, it would raise disadvantaged feelings by other regions that pay taxes as well. In CBA, the effect is even stronger, because of more benefits in high populated areas, all projects in these areas have a higher cost-benefit ratio.

This dilemma is a justice principle of territorial equity, which are different things than the OPOV principle and fixed public budget setting. It is difficult to distinguish these entanglements of ethics and economic interests.

In addition, there are various ways of reasons to select a project. Individuals might select spatial-infra, they intend to use themselves in the future, improve the accessibility of their neighborhood or prefer any project close to their living area more than projects on the other side of the region. However, individuals might think one step ahead as well. For instance, individuals always using the car, selecting PT projects, so more individuals use PT instead of a car, which improves the car traffic flow and the individuals' travel time.

In conclusion, there are many points of discussion and implications for further research by these results!

Consider regional and the individual/neighborhood interest separate, would that be a better alternative for the evaluation of infrastructure needs?

Local knowledge vs. regional desires. Which one is the most useful in a project evaluation?

Which scale level is the most desirable for regional transportation? (Knowing individuals select projects within their own region)

If you ask individuals, 'would you prefer new infrastructure projects close to your living area, which you can easily use or an alternative road 100 km further away,' individuals probably all choose the first option. You might prefer to test the principle in general. For instance, let people choose between more budget towards roads improving accessibility of local areas or more budget towards highways in the region. It is more interesting what individuals think about the principle in general, such as more budget towards PT or cycle infrastructure, better local roads, better highways, etc.

Local more specific projects, regional more about themes of transportation projects improved. Interesting is how individuals think about types of projects, does it differ using their private budget

compared to a fixed public budget. Scientific research did already show individuals care more about traffic safety using the fixed public budget, in which research the location component was excluded.

However, if you want to investigate local problems and bottlenecks in the infrastructure, you are forced to include the location component. However, asking local people would be more interesting in that case. However, there are more travelers passing this area. Therefore it is difficult to reach all these affected people. Carrying out the analysis on a regional level provides the opportunity to select these individuals out of the sample. However, the purpose of these studies differ.

In conclusion, it is not the question which interest or way of thinking is more interesting, it is all about the purpose of the study. 1) Identify problems/bottlenecks in the area, 2) brainstorm about solutions for problems in the area in the area, 3) evaluate disparate projects form a collective interest.

It is useful to evaluate projects from another perspective than the private WTP of CBA. Many people vote in the elections, not in their own economic interest, but decide what they perceive as the best in societal interest. It is interesting to know what their social preferences are how to allocate the public budget.

To what extent is it problematic that (expensive) projects in remote areas never end up in the top portfolio?

Other interesting trade-offs than travel time vs. traffic safety

The triangle of Safety, Environment and Travel time. Those are interesting trade-offs. Within the environment: Carbon emission, noise pollution, and air pollution. These might all be different in private situations compared to collective expectations from the government. Trade-offs who experience positive/negative effects? Young vs. elderly or high vs. low incomes, geographical distribution (remote vs. urban areas, periphery, or economic core areas). Equity types: Nicolas Thomopoulos (2009) about 10 equity principles, which might all differ from the private budget perspective than a fixed public budget.

If all individuals select projects within their own neighborhood, what is the advantage of PVE over

CBA?

The setting is different and could result in a different perspective of project evaluation. However, the current design and results of the experiments do not show these differences very clearly, which is probably due to the strong location-effect in this experiment. These results do not form a piece of strong evidence in advantage to PVE, and supporters of CBA might take these against PVE. However, I think that it is too easy to say. This research might not be an argument to stop with the concept of PVE. However, it might be a warning to carefully design the PVE tool and avoid a too strong location-effect. The fact that the location-effect is very strong does not imply other effects do not exist. However, it is important to adapt the design and decrease the location-effect. You do not want to measure individuals who prefer projects in their living area over projects in the rest of the area. However, CBA has these concerns as well if projects are evaluated from their private budget. Therefore it is not per definition a problem of PVE.

Ber van Wee: It might be interesting to know how individuals think about complete other regions.

For instance, someone not living in the region asking about their preferences to exclude personal interests. However, local knowledge is excluded in that way. However, it might be an interesting alternative to split the local knowledge and regional interest whose might be intercorrelated. To

include local knowledge and make use of it, an experiment could ask to evaluate projects that are all located in an individual's neighborhood.

What is important to adapt to other PVE experiments?

Exclude the location-effect, for instance, by proposing more projects close to individuals living area. If the purpose is to get more information about local knowledge, another methodology should be applied than comparing unequal projects. It is important to avoid perceptions. For instance, individuals perceive an intersection as dangerous while it is not. Therefore, it is extremely important to minimize different perceptions among participants. One way could be by presenting numbers, which is included in the PVE design. However, it is questionable whether individuals compare these numbers precisely and unbiased. Alternative measures could avoid these misinterpretations, which is another point of further research.

Expectations of strategies

Individuals might prefer multiple, less expensive projects compared to one prestigious project. The current incentives for politicians are more in the direction of getting visible credits for a prestigious project. Public choice theory shows politicians are more inclined to dedicate themselves to prestigious projects for their reputation., while a small project might result in similar effects. Asking individuals would probably prefer to realize the small projects having similar impacts and save some budget. These results could be shown by PVE.

Interview PVE expert Paul Koster

9th January 2020

To what extent is it desirable/problematic respondents select projects within their own neighborhood?

Participants should at least have the option to select projects in their living area. It's about the strategy they prefer to apply. Participants could also prefer to use an alternative strategy, such as distribute the budget over as many projects. The strategy participants should be openly left to themselves.

If the location-effect is significant and strong, this effect should be included in the utility function of the MCDEV model applied by PVE to determine the optimal portfolio of projects. A negative coefficient for project distance from the individuals' living area, projects close to an individuals' living area would retrieve a higher utility for this particular individual. Its logical infrastructure projects close to the individuals' living area get a higher utility because the individual probably is more likely to make use of it.

If you would correct for the representative living area, would this solve the problem (projects within the city of Amsterdam would have more votes)

It is indeed essential to know if certain areas are under or over-represented if the living area significantly prefers project preference. However, one should correct for all background characteristics that significantly affect project preference. It is possible to check representativity and correct for under and over-representation. Otherwise, the OPOV principle would result in a utility overestimation of projects preferred by overrepresented groups. The utility of projects preferred by underrepresented groups would be an underestimation. In conclusion, one should correct for representativity of significant background characteristics.

Secondly, if participants predominantly select projects in their living area, projects in Amsterdam would have more votes and get a higher total utility. However, if more individuals live in the city of Amsterdam, more individuals benefit as well. Consequently, it is not a problem projects in Amsterdam end up high in the ranking of projects.

From another perspective, it's an ethical question for policymakers when building an expensive road connection in a remote area. Not many inhabitants are expected to use the new road, so why allocate a large share of the budget towards this project in substitution of the expensive project a high number of citizen benefits of.

However, PVE is an informative tool, where participants could decide what strategy to apply. Participants could decide to geographical equally distribute the budget as well. The purpose of PVE is more to replace the traditional CBA than creating a democratic tool. How to apply the information provided by PVE is another question.

Consider regional and the individual/neighborhood interest separate, would that be a better alternative for the evaluation of infrastructure needs?

Including citizens, travel patterns would be a useful addition in the analysis. However, considering the regional and neighborhood interest, citizens should have a say how their living area. In CBA analysis, the interest of travelers gets too much priority. For instance, when realizing a new high-way in citizens backyard, CBA considers travelers' travel time the most and includes compensation for individuals

ending up with the high-way in their backyard. In PVE, these individuals have a clear vote, which is fairer.

Local knowledge vs. regional desires. Which one is the most useful in a project evaluation?

PVE is not about local knowledge or regional interest. It is about a personal preferred strategy. The current design is quite bureaucratic. The design of the PVE tool should be constructed in the way it stimulates the desired interests of participants. Consequently, the purpose should be specified in advance, considered by designing PVE.

In the current design, a combination of local knowledge and regional interest are visible. The personal preferred strategy could be egoistic or altruistic, both show the regional interest of the individual, which is a normative view. In the evaluation of projects for the design of policies, the regional perspective should be traced. Whenever the regional interest is egoistic or altruistic, it is an outcome of the evaluation. This is just information provided by PVE as an evaluation tool. It is up to policymakers how to use the information.

Which scale level is the most desirable for regional transportation? (Knowing individuals select projects within their own region)

This is the correct scale. PVE should show what one the one side individuals living near the projects, on the other side, its users. The projects should be evaluated on a regional level to include approximately all users of the infrastructure. Furthermore, the region is the scale the budget is intended for, all inhabitants of the region belong to the region.

To what extent is it problematic that (expensive) projects in remote areas never end up in the top portfolio?

That is not a problem with the method itself. The purpose is not to design a democratic tool. PVE has to present that information. It is up to policymakers what to do with the information.

If all individuals select projects within their own neighborhood, what is the advantage of PVE over CBA?

It is not about the results. It is about the setting PVE provides. It is not about a choice set like CBA. It is about public budget constraints, what citizens prefer in that scenario. Another aspect of PVE is how to deal as a participant with budget constraints. Individuals have to make trade-offs since not all projects fit in the budget. Within the trade-off, PVE allows all kinds of strategies. This experiment shows a strong project location-effect. However, that is just a result. It is not sure whether, with a similar experiment, it shows the same results.

What is important to adapt to other PVE experiments?

1. As mentioned before, including individuals' travel patterns.
2. A ranking of selected projects could provide more information about participants' trade-offs.
3. A minimum and maximum budget allocated per area could be considered as an additional constraint. By introducing a minimum and maximum budget allocated to a region, the results show more insights about the preferred distribution of budget over the region. One would allocate more to one region. Others would allocate more to another region. This is a better representation of how it practically works in policymaker. The budget has to be divided over different budget boxes.
4. It is important to define the living location of participants. For instance, individuals living in the northern part of Haarlemmermeer live more close to Amsterdam compared to

individuals living in the south of Haarlemmermeer. Therefore, the (arbitrary) definition of sub-areas should be a well-founded choice.

5. The location-effect should be tested in more detail. For example, a new experiment providing two variants, one showing the location in the short title, one without showing the project location in the project title.