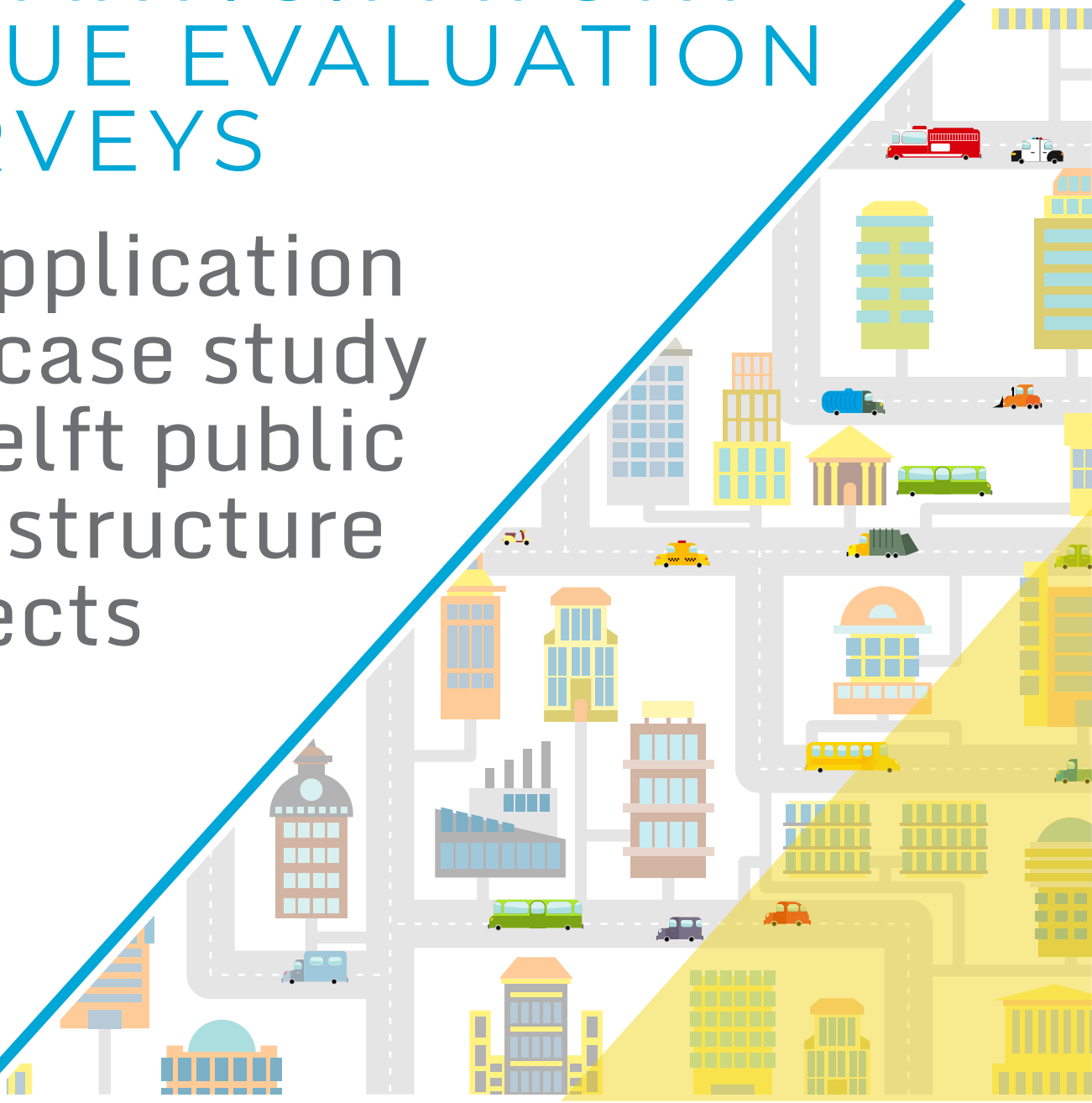
STUDYING PARTICIPANT DECISION-MAKING PROCESSES IN PARTICIPATORY VALUE EVALUATION SURVEYS

By application to a case study of Delft public infrastructure projects



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Studying participant decision-making processes in Participatory Value Evaluation

By application to a case study of Delft public infrastructure projects

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Preface

I remember distinctly the lecture in which Niek Mouter introduced the Participatory Value Evaluation methodology. The idea of involving ordinary citizens in public policy-making was intriguing to me. So when the time came to search for a subject for my Master's thesis I quickly thought of PVE. One year after an initial Skype-session between Barcelona and Delft I am very happy to have had the opportunity to work with the method and design my very own PVE survey. I found it a pleasure to construct a survey with projects in my immediate surroundings and I was even more thrilled to distribute my survey amongst fellow students and residents of Delft. Not many students in Delft have the option to showcase their research directly amongst their friends and neighbours. To all who took the time and made the effort to participate in my PVE survey, thank you!

I would like to take the opportunity to express my gratitude to the members of my graduation committee Niek, Gerdien and Eric for their guidance and feedback in this project. To José Ignacio: muchas gracias por tu ayuda en este proyecto! Also a shout-out to Perry for making my research possible by adjusting the online tool to suit my wishes, thank you very much.

And, last but not least, I want to say thank you to all my friends who have made the years that I spent in Delft absolutely fantastic.

Tomas Ben Peeters
Delft, March 17th 2020

Summary

Valuation of public projects using Participatory Value Evaluation

Participatory Value Evaluation (PVE) is an innovative methodology that supports public policy-making by estimating the societal value of public policies or projects through citizen participation. In PVE a survey is composed that presents its participants a portfolio-construction task: participants are presented a range of possible projects with associated impact attributes and they are asked to construct their ideal portfolio of projects. This PVE survey is distributed amongst a large group of citizens and its outcomes are their selected portfolios and qualitative motivations for the selected projects.

Analysis of the project selections is done through choice modelling in which project specific parameters and taste parameters associated with the levels of the impact attributes. The applied choice modelling assumes that participants make their decisions in a perfectly rationality and utility maximising manner.

Issues with underlying assumptions

This theory of perfect rationality and utility maximisation relies on five assumptions relating to the decision-maker and the decision-making process that he/she applies, namely that he/she: (1) has complete knowledge of the choice task and its project alternatives, (2) has preferences using which to evaluate the project alternatives and attributes, (3) is able to optimise, (4) is indifferent to theoretically equivalent information, and (5) takes all project alternatives into consideration. It is currently not known whether these assumptions are valid for participants of PVE surveys.

Research questions

This research tested these assumptions by applying both a process approach and a structural approach to participant decision-making in PVE surveys. The main research question and sub-questions are formulated as follows: *To what extent do participants of a Participatory Value Evaluation survey make their decision in a rational and utility maximising manner?*

1. To what extent do participants take all information that is provided in a PVE survey into consideration while making their decision?
2. To what extent do participants evaluate the full choice set of project alternatives in a PVE survey?
3. What decision-making processes are applied by participants while making their decision?
4. Are participants indifferent to whether attribute levels are presented as a set of numbers with separate attribute titles, or as a set of short sentences that include the attribute titles?

Research methodology

Research preparation: based on a review of previous PVE applications a PVE survey was established for the purposes of this research. In this specific context fixed budget PVE survey participants could construct a portfolio of six infrastructural projects that are currently considered in the municipality of Delft. The impacts of the six projects were indicated by five impact attributes. Relative to earlier PVE applications this PVE survey was of medium complexity[1].

Process tracing study: to address the first three sub-questions a process tracing methodology was applied in which ten participants were asked to verbalise their thoughts while performing the choice task of the constructed PVE survey. The output of this study consisted of audio and screen recordings. The audio recordings were transcribed into a verbal protocol which was analysed using coding of statements. The screen recordings were used to construct an action log.

[1]The PVE survey applied in the process tracing study is accessible through this link: `http://pve.splicedgene.com/process-tracing-experiment`. The two variants applied in the variation experiments are accessible through these links: `http://pve.splicedgene.com/tomas-variation-experiment` and `http://pve.splicedgene.com/tomas-variation-experiment-quantitative`, respectively.

The outcomes were interpreted using decision-making processes taken from decision-making literature based on the behavioural economics paradigm. These related to strategies and tendencies, as well as effort-reducing methods related to heuristics. The participants were recruited from the researcher's personal network. This study also served as a test run for the PVE survey and based on the experiences the survey was improved for the subsequent variation experiment.

Variation experiment: to address the fourth sub-question two surveys were constructed in which the presentation of the attribute values was varied. These were presented either as a set of numbers with separate attribute titles (quantitative), or as a set of short sentences that include the attribute titles (narrative). The output of this experiment consisted of quantitative data on project selection, qualitative data on project motivations, and descriptive data with responses to questions on socio-demographic characteristics, project specific questions, and Likert-scale statements. The quantitative data on the portfolios were used to determine the project counts and to estimate a simple MNL choice model with project specific parameters and taste parameters related to the attribute levels.

Findings of process tracing study

Information considered: the results showed that that in the medium complex environment of the applied PVE survey all participants tried to access and consult all available information. However, half of the participants were only considering part of the available information.

Project titles were consulted and considered by all participants. Descriptions were consulted once by most participants. Whether the attributes were taken into consideration to a large extent differed greatly between participants. Cost and budget were considered by all participant. The design of the online tool was found to be important as one participant missed the project specific pages and another missed the comparison option.

Full choice set considered: the process tracing study showed that seven out of ten participants made an evaluation of the full choice set of project alternatives. The three other participants quickly discarded projects, seemingly based on instinct and not on the provided information. This shows that information on preferences of participants is not captured in the current PVE methodology.

Identified decision-making processes: the results showed that participants who complete a PVE survey tend to either focus on the attribute levels or on other aspects of project alternatives. The former is associated with (weighted) additive/linear strategies, while the latter is associated with elimination-by-aspect strategies. Participants were observed applying a strategy twice or combining strategies while performing the choice task.

Participants were observed applying effort-reducing methods by not taking into account specific attributes, ignoring part of the provided information, or swiftly reducing the choice set by discarding projects. Additionally, an effort-reducing method was identified that was specific to the portfolio-construction task presented in PVE surveys in which participants chose to make a sequential choice instead of a simultaneous choice for the full portfolio. Not all participants were observed to apply effort-reducing methods.

Findings of variation experiment

The variation experiment was live over a period of almost four weeks and in total 169 valid responses were recorded. The narrative variant was completed by 85 participants and the quantitative variant by 84. The samples captured in the two variants were highly similar and it was concluded that any difference in outcomes would most likely be attributable to the applied variation. The trends in project selections for both variants were similar, but one project was selected considerably less in the narrative variant and instead participants selected a range of other projects. Chi-square tests showed that at a 90% confidence level it could be concluded that there was a relation between the variation and the selection count of that project, while for the other projects no relation was found.

The follow-up questions included a statement that tested the perception of the participants with respect to the manipulation, for which participants could indicate the level to which they used the attribute levels while making their decision. For the narrative variant participants indicated more often that they did, compared to the quantitative variant. However, for the quantitative variant the MNL choice model

estimation resulted in a better model fit and a higher number of significant taste parameters than for the narrative variant. This indicates that participants who were presented the attribute levels in a set of numbers made their decision based on the attribute values to a greater extent than the participants who were presented the attributes in a narrative.

This is contradictory and it is theorised that participants for the narrative variant perceived the attribute levels as being more important after completing the survey, but that while performing the choice task the direct comparison of attribute levels was easier with the quantitative variant. The overall impact of the manipulation on the outcomes was found to be limited.

Conclusion

The research tested the assumptions of perfect rationality and utility maximisation for a specific context PVE survey of medium complexity that asks participants to complete a portfolio-construction task. The assumption that participants have complete knowledge of the choice task and the project alternatives was determined to be valid for most participants. Whether participants are able to optimise using clear preferences is valid to a limited extent. The assumption that participants are indifferent to theoretically equivalent information in the case of the attribute levels was determined to be valid to a limited extent. In this case it is theorised that this is due to the complexity of the environment and considerations of broader aspects by participants, which reduces the impact of variations in presentation. The assumption that participants take all project alternative into consideration is found to be valid to a limited extent as the majority of participants considered the full choice set, but several participants were found to quickly dismiss projects on first instinct.

All in all, this research showed that the assumptions underlying the choice modelling done in PVE are for the most part valid in the case of PVE surveys of medium complexity. Below the recommendations following from the findings are listed.

Recommendations

The results show that not all preferences of participants are captured in a PVE survey because part of the participants reduce the choice set quickly. Such a specific dislike for a project that is not based on attribute levels or a full consideration of the project is not captured in the current PVE methodology. It is recommended to include the option for participants to vote-down projects.

Also, some participants were found to ignore specific attribute levels, attributes in general, or other parts of the provided information. Currently, there is an incentive to disregard projects because participants have to actively include projects in a comparison. Therefore, it is recommended to include all projects in the comparison by default instead of none of the projects as is the current standard.

Knowing what you intend to measure and presenting the PVE survey accordingly seems to be important. The choice task instruction seemed to be a cause for confusion. If a public policy-maker wants to measure how citizens would perform a Cost-Benefit Analysis the participant should be instructed to do so, but if the aim is to capture broader preferences the PVE survey should be designed accordingly.

Contents

List of Figures

List of Tables

Nomenclature

CBA	Cost-Benefit Analysis
CoSEM	Complex Systems Engineering & Management
CSV	Comma-Separated Values
MNL	Multinomial Logit
MRDH	Rotterdam-The Hague Metropolitan Region
PB	Participatory Budgeting
PSC	Project Specific Constant
PVE	Participatory Value Evaluation
PWE	Participatieve Waarde-Evaluatie [Dutch]
SDC	Socio-Demographic Characteristic
SP	Stated Preference
SWF	Social Welfare Function
TAA	Transport Authority of the municipality of Amsterdam
TTS	Travel Time Savings
USWM	Urban Storm Water Management
WTP	Willingness To Pay

1 Introduction

1.1. Research background

Public policy-making is supported by public project appraisals that establish the societal value of projects. Such projects could be investments in river flood protection and prevention, as well as transport infrastructure. Public project appraisals are generally executed using cost-benefit analysis (CBA), which is the standard in many western countries (Mackie, Worsley & Eliasson, 2014).[1]

However, during the last few years there have been calls for a higher degree and new ways of citizen participation in public policy-making processes across different levels of government. At a Dutch local level the Association of Dutch Municipalities (VNG) proposes to find new ways of enabling citizen participation in public policy-making processes (VNG, 2017). Also, at the level of the European Union a study by the European Parliamentary Research Service (EPRS, 2018) on the prospects for e-democracy in Europe specifically recommends, among others, to conduct experiments in order to improve e-participation. CBA does not incorporate citizen participation and therefore there is a search for alternative or additional public appraisal methods that do incorporate citizen participation. The next sections describe the CBA and Public Budgeting (PB) practices and, subsequently, the methodology of Participatory Value Evaluation (PVE), which is the focus of this research.

Cost benefit analysis

CBA is currently incorporated to a high degree within public policy-making processes in western countries (Mackie et al., 2014). CBA determines the societal desirability and economic efficiency of a proposed policy or project.This is done by expressing the benefits and costs of a policy or project in monetary terms (van Wee, 2012). Then, to decide whether to execute the policy or project the benefits and costs are weighed against each other. If the benefits outweigh the costs the policy or project is considered beneficial to society. In the case that multiple projects are considered the projects' net benefits to society can help public policy-makers in ranking the projects.

In the CBA appraisal process estimations of consumers' private Willingness To Pay (WTP) are applied. This approach is criticised because people might make different decisions when allocating public budget versus spending their own money, such as argued by Sunstein (2005) in the area of environmental policy. In addition, as noted earlier, CBA does not incorporate public participation. As a result of this and other concerns with CBA its outcomes might be disputed and public acceptance limited.

Participatory budgeting

One such alternative public policy-making process is the practice of Participatory Budgeting (PB). Sintomer, Herzberg & Röcke (2008) defined PB as a procedure which lets non-elected citizens participate in constructing the budget for public finances. In general, PB procedures are set up such that the citizens are invited to public meetings. Here the citizens discuss amongst each other to establish a budget proposal and subsequently the political representatives react to it (Aragonès & Sánchez-Pagés, 2009).

[1] The first part of this introduction was adopted from the original research proposal of this project

With that, PB facilitates public participation in the valuation of public policies and projects. However, PB has drawbacks. PB is known to complicate the political process and introduce higher costs (Irvin & Stansbury, 2004). Also, a recent review of PB practices within Germany by Schneider & Busse (2018) showed that within municipalities on average only 1.7% of citizens participated. They reported that people participating in PB processes are mostly highly educated and socially integrated elder groups, hardly a reflection of the entire population. Thus, there is ample room for improvement.

Participatory Value Evaluation

The recently proposed alternative approach that promises to make that improvement is Participatory Value Evaluation (PVE)[2], as put forward by Mouter, Koster & Dekker (2017). PVE combines aspects of CBA and PB. With PVE citizen participation is facilitated through an online survey. This PVE survey is distributed amongst a large group of citizens that is reflective of the entire population. The survey is presented to participants in an online tool in which they encounter a choice task. This choice task asks participants to consider a number of project or policy alternatives and to evaluate these based on their personal preferences. Each policy or project is associated with a cost and participants can assemble a project portfolio while respecting the limited budget. Therefore, the choice task in a PVE survey can be defined as being a portfolio-construction task (Hérnandez, personal communication March 15th 2020).

The outcome of a PVE application consists of a portfolio of policies or projects that fit within the budget have been determined to have the highest probability of increasing social welfare (Dekker, Koster & Mouter, 2019). These are supported by motivations that participants are asked to provide regarding the projects that they selected. These motivations provide insight in the aspects that participants take into account.

The online tool is accessed digitally at participants' own convenience and therefore the task intensity for participants is lower compared to PB as they do not need to be present at a specific location and time and they do not participate in public deliberation. This allows for reaching a higher number and wider range of people at a reasonable cost (Mouter et al., 2017).

Essentially, PVE promises to put people in the role of a co-owner of government instead of that of a consumer (Mouter, Koster & Dekker, 2019a). Mouter et al. (2017) promise that PVE will be an efficient and cost-effective tool that supports public-policy making such as CBA while it fosters public acceptance and provides insight in the wishes of citizens, as promised by PB. The benefits of PVE as perceived by Mouter et al. (2019a) are improved support for policy-makers, greater insight in trade-off preferences of citizens, and greater insight in citizens' reasoning. Therefore, PVE has the potential to help answer the call for greater citizen participation, as identified earlier.

1.2. Choice modelling in PVE

So far, two large scale PVEs have been executed, namely on a flood protection scheme in the Netherlands and a transport investment scheme in the city and direct vicinity of Amsterdam. Both were analysed using the choice modelling methodology of Multiple Discrete-Continuous Extreme Value (MDCEV) (Mouter, Koster & Dekker, 2019b; Dekker et al., 2019). Applied to PVE, this methodology estimates project specific parameters for each project as well as taste parameters associated with the attribute levels[3]. The estimated taste parameters indicate the impact that the level of the attributes has on the attractiveness of project while all other preferences of participants are captured in the estimated project specific parameters (Mouter et al., 2019b).

Subsequently, these estimated parameters are used to perform a Social Welfare Analysis (SWF). This analysis results in the policy advice as it estimates for each project the probability that it will improve social welfare, compared to shifting the budget to the next budgetary period (Mouter et al., 2019b). With these probabilities the 'optimal' project portfolios that fit within the budget are constructed and these form the policy advice to the public policy-maker.

[2] The corresponding Dutch name of the method is Participatieve waarde-evaluatie (PWE)

[3] These attribute levels indicate the impacts of the projects that participants can choose from. To facilitate this analysis the attribute levels are varied across different treatment combinations, which means that different participants are presented with different impact levels.

Theory of utility maximisation

This MDCEV choice modelling methodology is based on the theory that people are perfectly rational and that they strive for utility maximisation while performing the choice task (Bhat, 2008). This means that participants apply their preferences for the project alternatives and the attributes with a full understanding of the information that is provided. With that, people are able to optimise utility for their self-interest (Rubinstein, 1998, chapter 1) (Simon, 1955). This theory of perfect rationality and utility maximisation relies on five assumptions relating to the decision-maker and the decision-making process that he/she applies, namely that he/she: (1) has complete knowledge of the choice task and its project alternatives, (2) has clear preferences using which to evaluate the project alternatives and attributes, (3) is able to optimise, (4) is indifferent to theoretically equivalent information, and (5) takes all project alternatives into consideration (Rubinstein, 1998; Hensher, Rose & Greene, 2005).

These assumptions relate to the processes of decision-making applied by participants while they complete a PVE survey. The MDCEV choice modelling methodology applied in PVE adopts a structural approach to decision-making by studying the input (project alternatives and their attribute levels) and output (selected project portfolios) of a choice task. A different approach to decision-making for choice tasks is a process approach which examines the processes with which participants perform a choice task and which can lead to insights in the decision-making processes applied by participants. Both approaches are examined in further detail in section 2.2.

1.3. Problem statement

The assumptions of perfect rationality and utility maximisation by participants of PVE surveys, on which its analysis and therefore the resulting policy advice is based, have not been tested. Decisions made by participants have so far only been approached from a structural approach by studying the input and output. Therefore, the problem statement is formulated as follows: *In Participatory Value Evaluation it is assumed that participants make their decision in a rational and utility maximising manner based on the provided information, regardless of the way in which this information is presented. The estimated choice models and social welfare analysis rely on this assumption and form the basis for the advice to policy makers. However, results from previous PVE applications suggest that the assumptions might be invalid, thereby limiting the validity of the resulting policy advice.*

Knowledge gap

Essentially, a PVE promises to reveal the preferences of a population with respect to the projects and the attribute levels of the impacts that are included in the PVE survey. However, the results of the previous PVE applications suggest that issues exist with respect to this premise and the underlying assumptions of the choice modelling methodology. In the Amsterdam transport investment scheme PVE the methodology resulted in 3 out of 5 estimated attribute level taste parameters being insignificant. For the flood protection scheme PVE 6 out of 8 attribute level taste parameters were estimated to be either insignificant or they showed an unexpected sign (Mouter et al., 2019b; Dekker et al., 2019). This is an indication that the levels of the majority of the attributes presented in these PVE surveys did not impact the choices made by participants. Meanwhile, the analysis of the provided motivations for both these PVE applications revealed that participants took considerations that were not included in the PVE survey into account (Mouter et al., 2019b,a). With the applied choice modelling methodology these considerations are fully accounted for in the project specific parameters.

In the choice modelling methodology applied in PVE the attribute levels play an important role, but the discussion above indicates that these are taken into consideration by participants to a limited extent. As discussed in more detail in section 2.5 different forms of presentation of information have been found to impact how participants perceive information. Also, with respect to the project descriptions an experiment showed that participants made different choices when the descriptions of bicycle policy projects were framed differently in a PVE survey, despite the choice set being theoretically equal (de Geus, 2019). This violates the assumption that participants are indifferent to theoretically equal information.

As is discussed in more detail in section 2.4, PVE presents participants with an online tool in which up to 16 projects are presented with information in the form of project titles, descriptions, locations, and attribute levels. These are presented in separate pages and participants might have to access up to 30 pages while making their choice to consult all available information. Utility maximisation assumes

that all participants will make that effort. Currently no knowledge exists on whether participants actually interact with that online tool in such a way that they consult and process each piece of available information. Therefore, it is not known if the assumption that participants are fully informed is valid.

Similarly, as is discussed in the next chapter, research on decision-making has shown that people do not act perfectly rational when performing choice tasks. Instead, the theory of bounded rationality posits that people possess and/or apply limited cognitive abilities and attempt to simplify the choice task by disregarding pieces of information, for instance. PVE surveys have not yet been studied using a process approach. This is discussed in more detail in section 2.2. Therefore, it is not known if the assumptions that participants are able to optimise based on their preferences are valid.

Currently, it is not known whether participants of a PVE survey take all project alternatives into consideration while performing the choice task. The choice modelling methodology assumes that they do, but this has not been studied yet.

1.4. Research questions

To address the identified problem statement and knowledge gap the following main research question is addressed:

To what extent do participants of a Participatory Value Evaluation survey make their decision in a rational and utility maximising manner?

This question is subdivided into the following sub-questions:

1. To what extent do participants take all information that is provided in a PVE survey into consideration while making their decision?
2. To what extent do participants evaluate the full choice set of project alternatives in a PVE survey?
3. What decision-making processes are applied by participants while making their decision?
4. Are participants indifferent to whether attribute levels are presented as a set of numbers with separate attribute titles, or as a set of short sentences that include the attribute titles?

The research main question and sub-questions are structured by the assumptions of perfect rationality and utility maximisation. Sub-question 1 serves to test whether participants are fully informed and base their decision on the information that is presented to them. Sub-question 2 serves to test whether participants evaluate the complete choice set. Sub-question 3 serves to test whether participants make optimal decisions based on an evaluation of the attribute values while incorporating their preferences. These three sub-questions are addressed by applying a process approach.

Sub-question 4 serves to test whether participants are indifferent to different forms of presentation of theoretically equivalent information. This question addresses the attribute levels specifically because these are a major part of the choice modelling methodology. This sub-question is addressed by applying a structural approach.

This research applies a multi-method research approach by applying both a process and structural approach, which result in qualitative data and quantitative date, respectively.

1.5. Relevance of research

This section discusses the relevance of the research from the perspectives of stakeholders, scientific fields, society, and the CoSEM programme.

Stakeholders

Policy makers applying PVE: the outcomes of this research give insight in what is actually measured in a PVE survey as it tests the assumptions that participants consult and process all available information. If participants make their decisions based on just the project titles this results in different outcomes compared to when participants study the project details and attribute levels. This research can provide insight in what preferences are actually measured in PVE applications. By knowing what preferences are measured PVE designs and policy outcomes can be adjusted accordingly. This can make the outcomes more valid and help to make clear how the outcomes of a PVE survey should be valued.

PVE designers: in this research the interaction of participants with PVE's online tool is studied. The conclusions can help to improve the online tool to make it more user friendly and facilitate participants to be fully informed on the projects. This research can result in practical suggestions because it studies the process and interaction with which participants complete a PVE survey.

Also, as discussed in the next chapter, there are plans to further develop the online tool with innovative ways of information presentation. The outcomes of this research can help guide this future development.

The conclusions of this research can give an indication towards follow-up questions that could be posed to participants of PVE surveys regarding preferences that supplement the quantitative outcomes. Currently, participants are only asked to provide a motivation for the projects that they selected.

PVE researchers: this research approaches PVE surveys from the perspective of decision-making research by studying the decision-making processes applied by participants. Such a new perspective is expected to result in new avenues for future research.

Scientific relevance

Participatory Value Evaluation: this research adds to the existing body of scientific knowledge because the field of PVE is as of yet in an early stage of development. The research will provide a practical and relatively small scale illustration of the method in a controlled environment. This can serve as an example for future research or practical applications. Also, within this research the current state of the art of PVE is summarised and an overview of PVE survey elements is composed that can be used as a basis for future PVE applications.

The research will apply existing decision-making research to the PVE scientific field that has not yet been studied from that perspective. This can help support further development of the PVE methodology by providing insights in the manner in which participants tackle the problem of processing the provided information and choosing their preferred project portfolio. Vice versa, with PVE surveys presenting participants with the special choice task of portfolio-construction the outcomes of this research can also yield new insights for the field of decision-making research.

This research tests the assumptions that form the basis of the choice modelling methodology that is currently applied in PVE. A confirmation or rejection of these assumptions can shed light on whether the outcomes of PVE MDCEV and SWF analyses are valid.

Furthermore, the interaction of the participant with the online tool is investigated and using those outcomes that online tool can be improved to better suit the (research) objectives of PVE. The research will make clear what the impact is of design choices regarding the presentation of attribute values using either numbers or texts within a PVE.

Decision-making research: the outcomes of this research are interpreted using constructs from the scientific field of decision-making and therefore it can provide empirical evidence confirming or rejecting the validity of these constructs in portfolio-construction tasks in a complex environment. These constructs are discussed in the following chapter.

Stated-preference experiments & choice modelling: the special choice task of portfolio-construction that participants face in PVE surveys is highly complex and it is presented in a dedicated online environment. The conclusions of whether participants are indifferent to the presentation of attribute values quantitatively or in a narrative in such a complex environment can be applied to other stated-choice experiments as well.

The theory of perfect rationality and utility maximisation is widely applied in analyses of stated-preference experiments. The outcomes of this research can provide empirical evidence confirming or rejecting the validity of the underlying assumptions of choice modelling for complex choice tasks.

Societal relevance

The results of this research can aid further development of the PVE method from a societal perspective as it will support development towards effective presentation of project alternatives. Knowing to what extent participants in a PVE consult and process the information, and adjusting information presentation accordingly is important to collecting usable and valid results from future appraisal of public projects using Participatory Value Evaluation. Trialling the application of process tracing methodology to test

run PVE surveys can help to make future PVEs more comprehensive to participants and thereby be more valid. By applying and further developing PVE the incorporation of citizen participation in public policy-making in general is aided.

Municipality of Delft: for the purposes of answering the main research question a PVE survey of medium complexity is defined. In this PVE survey participants are asked to consider six realistic public infrastructure projects in the municipality of Delft. These were taken from published policy documents of government bodies. Therefore, the outcomes of this PVE survey can provide insight in the preferences of people who live, work and/or study in Delft with regards to public infrastructural projects that are currently under consideration. A policy advice based on the outcomes are communicated to the municipality of Delft.

Relevance to CoSEM programme

The research fits within the Complex Systems Engineering & Management Masters programme of the faculty of Technology, Policy and Management. The public decision-making processes that concern issues ranging from, for example, neighbourhood level water management projects to national level infrastructure investment projects are inherently complex. Within public policy making for such projects many governmental as well as non-governmental parties are involved and the eventual impacts are felt by many people, depending on the scope of the projects. As such, the design of these methodologies is key to effective government policies and projects that are supported by the public.

1.6. Structure

The structure of this report is as follows: chapter 2 reviews PVE and decision-making research to identify knowledge gaps and a toolkit with which to conduct the research. Chapter 3 outlines the research approach and methodology. Then, based on a review of previous PVE applications and on actual considered infrastructural projects in the municipality of Delft a PVE survey is defined in chapter 4. Chapter 5 presents the process tracing study and its outcomes. Chapter 6 presents the variation experiment and those outcomes. The conclusions of this research are presented by revisiting the research questions in chapter 7 and, finally, the research is discussed in chapter 8.

2

Decision-making & PVE

This chapter examines decision-making literature with the aim of establishing a toolkit of research methodologies with which to conduct the research, as introduced in the preceding chapter, and decision-making constructs with which to interpret the results. First of all, the two behavioural models that serve as the basis for decision-making research are discussed in section 2.1. Then, the methodologies for studying decision-making and its constructs are presented in sections 2.2 and 2.3, respectively. The relevant aspects of PVE, namely the provision of information and the online tool interface, are discussed in section 2.4. Research on the impact of information presentation on outcomes of surveys are discussed in section 2.5. Finally, this review is reflected upon in section 2.6.

2.1. Behavioural models

In this section the two main behavioural models of neoclassical economics and behavioural economics are examined to establish the context within which decision-making is researched.

Neoclassical economics

Originally, the neoclassical behavioural model served as the underpinning of economic theory. This theory assumes that people are perfectly rational and that they intend to maximise utility. Given their preferences and with full understanding of available information they are able to optimise utility for their self-interest (Rubinstein, 1998, chapter 1) (Simon, 1955). The five assumptions of this rational and utility maximisation theory were introduced in the preceding chapter and these serve as the basis for the research questions addressed in this research.

Behavioural economics

As early as 1955 the neoclassical economics model with its perfect rationality and utility maximisation theory has been criticised (Rubinstein, 1998, chapter 1) (Simon, 1955). In the subsequent decades the alternative model of behavioural economics was developed. According to this model people do not make decisions by acting perfectly rational and by maximising utility, instead it proposes the theory of bounded rationality. This theory posits that instead of making a decision with the five assumptions mentioned earlier, people possess or are only willing to apply limited cognitive abilities (Gsottbauer & van den Bergh, 2011). To deal with a choice task people tend to make use of rules-of-thumb or decision shortcuts when making a decision, which are commonly referred to as heuristics (Gsottbauer & van den Bergh, 2011; Kahneman, 2003). These are closely associated with the idea of “cognitive misers” (Petty, Cacioppo, Strathman & Priester, 2005).

2.2. Methodologies for studying decision-making

For studying decision-making two distinct approaches are identified: a structural analysis of the resulting choices and process tracing techniques (Svenson, 1979). The former approach includes the use of choice modelling to examine the effects of the input on the output of a choice situation. This can take the form of, for example, manipulations in the presentation of the choice situation (the input)

on the resulting choices (the output). In the latter approach the focus is on collecting data while the decision-maker is in the process of making his decision. These approaches are discussed in further detail below.

Process approach: process tracing techniques

Process tracing is defined by Shah & Oppenheimer (2008) as: *"Process tracing refers to observing how people search for information before making a judgment or decision."* By using process tracing researchers can determine the types of decision-making processes that are applied by participants, in cases such as PVE.

On the level of application, Schulte-Mecklenbeck, Johnson, Böckenholt, Goldstein, Russo, Sullivan & Willemsen (2017) discuss process tracing techniques and its various forms. As described above, they contrast process tracing, which makes observations before a decision is made, to more traditional methods of studying decision-making that depend on the eventual choice data. They identify four categories: subject reports, movement-based techniques, peripheral psycho-physiological techniques, neural techniques. The first two categories are discussed in further detail below.

Subject reports: these depend on reports by participants. Verbal protocols fall within this category (Schulte-Mecklenbeck et al., 2017). Verbal protocols depend on verbal reports by the decision-maker on their thoughts. These verbal reports can provide insight in the decision-making strategies applied and the motivations adopted by the decision-maker.

Procedures of verbal protocols are divided into four categories, namely combinations of either being structured or being unstructured and either being collected concurrently or retrospectively (Ranyard & Svenson, 2011, as cited in Schulte-Mecklenbeck, Kühberger & Ranyard, 2011). A form of the combination of unstructured and concurrent collection is the think aloud procedure. During such a procedure the respondent is instructed to think aloud while performing the choice task. Data is collected through audio and/or video registration, which is transcribed into verbal reports that can eventually be coded and used for analysis.

For think aloud, the methodology is discussed by Walsh & Gluck (2016). An important part of the procedure is the applied instruction text to respondents. Walsh & Gluck (2016, p. 81) applied the following text: "*I will ask you to think aloud as you work on the problems. What I mean by think aloud is to say out loud everything that you say to yourself silently. Just act as if you are alone in the room speaking to yourself.*"

Also, on the analysis of the resulting verbal protocol they give a description of how this verbal protocol was transcribed. This transcription was subsequently partitioned into the smallest identifiable statements that represented a complete thought. This partitioning was done based on a sentence being completed, a period of silence, and verbal pauses. The resulting statements were coded using categories based on examined theory.

Recommendations from Ericsson & Simon (1993, as cited in Schulte-Mecklenbeck et al., 2011) include training respondents in the think aloud procedure, reminding respondents to think aloud in case they are silent, and to refrain from instructing respondents to verbalise specific aspects other than to think aloud in general.

Movement-based techniques: these consist of observing actions undertaken by decision-makers. Information boards are a form of movement-based techniques (Schulte-Mecklenbeck et al., 2017). This technique allows a researcher to track which information is consulted by a decision-maker because information is hidden until the decision-maker chooses to consult it. Application of this technique can provide insight in the strategy applied in search of information (Schulte-Mecklenbeck et al., 2017).

Limitations: the main drawback of process tracing techniques is the sheer amount of data that is generated and which requires analysis (Schulte-Mecklenbeck et al., 2011). Also, Walsh & Gluck (2016) mention limitations related to the influence that the instruction to verbalise thoughts might have on the actual thought processes that are under investigation. Verbalisation could both improve and worsen task performance due to on the one hand encouraging more elaborate processing and on the other hand increasing the cognitive load. Also, they note, verbalisation is viewed as being incomplete and inaccurate.

Structural approach: choice modelling

An introductory book on choice analysis by Hensher et al. (2005) explains that choice analysis of Stated Preference (SP) surveys is generally done using choice modelling. These models fit within the neo-classical paradigm as they assume that participants strive to maximise utility. Opposing theories, such as bounded rationality and satisficing behaviour as described in the previous sections, are criticised because they imply that individuals choose not to consider certain alternatives from the start and therefore not everyone evaluates the same choice set, which is contradictory to key assumptions of utility maximisation. As introduced in the preceding chapter, MDCEV choice modelling serves as the basis for analysis of PVE surveys. This fits within the structural approach.

2.3. Decision-making constructs

To provide the toolkit to interpret and explain the results of the process tracing study and answer research sub-question 3 this section presents decision-making constructs. These are five decision-making strategies, five effort-reducing methods related to heuristics, and six decision-making tendencies.

Decision-making strategies describe the processes that people apply to make evaluations and comparisons of choice alternatives (Payne, 1976). Effort-reducing methods describe how people simplify choice tasks and relate to heuristics as introduced earlier (Shah & Oppenheimer, 2008). Decision-making tendencies describe with what aim people approach a choice task and to what extent they spend effort in information search on alternatives or in comparing aspects between alternatives (Misuraca, Faraci, Gangemi, Carmeci & Miceli, 2015).

In this research, the strategies are used to interpret in what way participants make evaluations of the project alternatives and the effort-reducing methods describe how participants simplify the choice task. The tendencies are used to describe how participants approach the choice task, to link the strategies to effort-reducing methods, and to give an indication of the extent to which participants act in a rational and utility maximising manner.

Decision strategies

Four simple models of decision strategies, adopted from Payne (1976), are listed below. In addition to these, a fifth strategy (weighted additive) is presented that is in line with the strategy that participants would be expected to adopt when they act in a utility maximising manner. When acting in a utility maximising manner, participants are expected to weigh the attributes according to their personal preferences.

Additive/linear: the decision-maker makes a separate evaluation for each alternative. Through addition of the scores assigned to each attribute of each alternative composite scores are obtained for each of the alternatives. Based on these scores the highest-scoring alternative is identified and chosen. This strategy is characterised as compensatory as attributes with high scores can compensate for attributes with low scores within an alternative.

Conjunctive/satisficing: the decision-maker checks each attribute against a certain minimum level. If an alternative does not pass this test it is discarded as a viable option. According to Payne (1976), it is not entirely clear how the decision-maker would continue with the reduced set of alternatives that remains. He hypothesises that the decision-maker would continue by altering the minimum level and re-evaluating the alternatives until he/she would arrive at a single option.

Additive difference: with this strategy the decision-maker makes a comparison of the levels of a certain attribute between two alternatives. The difference is established and the procedure is executed for each of the attributes. All the obtained differences are summed and used to determine the best alternative. As Payne (1976) notes, this would not be feasible for a comparison of more than two alternatives. In the case of a multitude of alternatives he hypothesises that the decision maker would use the alternative that has, for the time being, been identified as the best as the benchmark. If he/she identifies an alternative that is better it is subsequently used as a benchmark. This strategy is characterised as intra-dimensional as well as compensatory.

Elimination-by-aspect: using this strategy the decision-maker chooses an attribute using which to evaluate. If an alternative does not possess this attribute it is eliminated. Then another attribute is chosen using which to evaluate. This process is repeated until one alternative remains. Importantly, the probability with which an attribute is chosen reflects the importance the decision-maker attaches to this attribute. Therefore attributes that are important to the decision-maker will be used early in the process. This strategy is characterised as intra-dimensional.

Weighted additive: Payne, Bettman & Johnson (1993, as cited in Shah & Oppenheimer, 2008) describe another strategy that is a more complex version of the additive/linear strategy that was described earlier. When applying this strategy the decision-maker assigns weights to the different attributes and using multiplication and summation arrives at the value for an alternative. Overall, the alternatives with the highest value is selected by the decision-maker. This strategy is characterised as compensatory.

Decision-making tendencies

Six decision-making tendencies are listed below. These are adopted from Misuraca et al. (2015), who identified two decisional constructs from literature, namely the tendencies to maximise and to satisfice. In addition, they proposed a third tendency, which is to minimise. From their research a scale emerged that is divided further into 6 tendencies, using which to classify people as different types of decision-makers.

Maximising: resolute maximising and fearful maximising. The former is characterised as being persevering and focused on the goal while collecting a large amount of information. The latter is focused on the fear of making the wrong decision while collecting an endless amount of information.

Satisficing: less ambitious satisficing and more ambitious satisficing. The former is characterised as having low levels of conscientiousness, scrupulousness, and perseverance. The latter has comparatively higher standards and a search for information to a larger extent.

Minimising: indolent minimising and parsimonious minimising. The former lacks conscientiousness, scrupulousness, and perseverance. The latter is characterised by the same elements as the former, but to a lesser extent. Meanwhile, the parsimonious minimiser searches for more information than indolent minimisers.

Effort reduction through heuristics

Heuristics are described by Shah & Oppenheimer (2008) as serving to reduce the effort in performing a task, such as a choice task. They describe a framework of five methods of effort reduction that form the basis of heuristics. These methods are based on the most thorough decision-making strategy, the weighted additive strategy, as described earlier.

The methods are: 1) examining fewer attributes, 2) reducing the difficulty associated with retrieving and storing attribute levels, 3) simplifying the weighting principle for attributes, 4) integrating less information, and 5) examining fewer alternatives. Shah & Oppenheimer (2008) specifically mention the ability of process tracing methods to identify effort-reducing methods 1 and 5, which are examining fewer attributes and examining fewer alternatives, respectively.

2.4. Participatory Value Evaluation surveys

This section reviews information presentation within PVE surveys, the interface of the online tool, and proposals for further research that were identified in literature. This discussion is based on the five PVE applications to date, which were a flood protection scheme, a transport investment scheme, an urban storm water management (USWM) programme, the transition to zero natural gas, and a framing experiment on bicycle projects (Mouter et al., 2019a; Dekker et al., 2019; Mouter et al., 2019b, 2017; Dartée, 2018; Pak, 2018; de Geus, 2019). These are reviewed in detail in appendix B.

Information presentation

Mouter et al. (2019a) describe the basic process of a PVE experiment. During the experiment the participants are presented with a survey in the form of an online tool that they can interact with. This

online tool, discussed in more detail below, allows the participants to allocate a certain limited budget through selection of project alternatives. These project alternatives are defined by their title, description, attribute levels, location, and cost. A screenshot of the main screen of the online tool as was used in the Amsterdam transportation policy project is shown in figure 2.1. This tool can still be accessed online[1]. The tool applied in the flood protection investment scheme project is accessible as well[2].

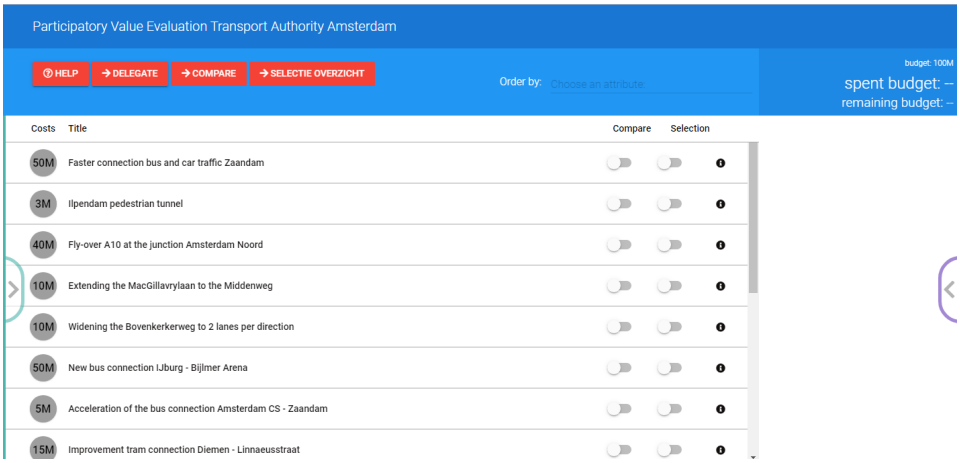

Figure 2.1: Screenshot of the main screen of the TAA PVE. Obtained from: `http://pve.splicedgene.com/participatory-value-evaluation-transport-authority-amsterdam`

As discussed in the introduction in chapter 1, the attribute levels are of high importance as these provide the participants with a measure of the projected impacts of the projects. These attribute levels are varied between participants to facilitate choice modelling. Up to now these were mostly presented in the form of numbers, referred to as quantitative in this report. The transport investment scheme, gas transition, and framing experiment PVEs presented the attribute levels only quantitatively (Mouter et al., 2019b; Pak, 2018; de Geus, 2019). However, some forms of information are not particularly suitable for presentation using numbers and have been presented using texts, referred to as narrative in this report. Therefore, in the flood protection scheme and urban storm water management PVEs the two forms of presentation of attribute levels were presented together, as shown in figures 2.2 and 2.3 (Mouter et al., 2019a; Dartée, 2018).

Online tool

Upon accessing the PVE survey participants are shown multiple pages with information on the context and survey, after which they encounter a video file with instructions that is mandatory to watch. Once on the main page, participants are presented the list of projects with short titles and a cost indicator. Depending on the settings chosen by the researcher this list can be ordered based on attribute value. Again, depending on the settings more information on projects can be accessed by expanding the list entry and/or accessing the project's dedicated page. In some PVEs those project pages contain a map of the project's location or an illustration of the project.

A comparison of attribute levels can be made on a selection of (or all) projects on a separate page where the attribute levels are presented in a matrix. Projects can be added to the portfolio by toggling them in the main page. Then the participant can continue to the confirmation page where an overview of a projects' cost, location (depending on settings) and impact (depending on settings) is shown. After confirming the selection the participant is asked to provide a motivation per selected project. And, finally, the participant arrives at the questionnaire with a range of questions on socio-demographic characteristics, case specific aspects, and with Likert-scale statements.

Summarising, while constructing their project portfolio participants have access to the following pages of the online tool: (1) the main page that displays the project titles and cost, (2) the project specific pages that display the applicable project's title, description, cost, attribute values, and a map with the project's location, (3) the comparison page that displays the project titles, types, costs, and

[1] `http://pve.splicedgene.com/participatory-value-evaluation-transport-authority-amsterdam`
[2] `http://participatie-begroting.nl/`

Participatory Value Evaluation flood protection

Compare

	Gendtse Waard classical project	Gendtse Waard combination project	Oosterhout classical project	Oosterhout combination project	Sleeuwijk classical project
Type	Gendtse Waard	Gendtse Waard	Oosterhout	Oosterhout	Sleeuwijk
Costs	62M	67M	29M	74M	95M
Protection against flooding	In line with standards	In line with standards	In line with standards	In line with standards	In line with standards
Prevent damage caused by water	No impact	No impact	No impact	No impact	No impact
Number of households experiencing nuisance	0	50	0	3	0
Size nature/recreational area	0	55	0	85	0
Improvement biodiversity	No increase	Substantial increase	No increase	Substantial increase	No increase
Change quality recreational area	No improvement	No improvement	No improvement	Improvement	No improvement
Number of travelers	0	0	0	0	0
Minutes travel time savings	0	0	0	0	0
Decrease in severe traffic injuries	0	0	0	0	0

Figure 2.2: Screenshot from the flood protection PVE, retrieved from link in footnote 2.

Bewonersonderzoek

Vergelijken

	SUBSIDIE 500 REGENTONNEN	10 GROENE DAKEN	VERHOOGD BOUWEN	SUBSIDIE 500 GEVELTUINEN	REGENTUIN
Kosten [€]	94.000	52.000	72.000	94.000	180.000
Parkeerplekken [# plekken]	0	0	0	0	23
Wateroverlast voorkomen [# dagen per jaar]	6	6	23	11	16
Hergebruik water [# wasbeurten per hh per jaar]	5	16	0	0	40
Groene ruimte [# m2]	0	550	0	440	245
Fase van ontwikkeling	Werking bewezen in tientallen commerciële projecten	Werking bewezen in tientallen commerciële projecten	Werking bewezen in tientallen commerciële projecten	Werking bewezen in enkele commerciële projecten	Werking bewezen in testomgeving
Participatie [# uur per hh per jaar]	20	25	1	23	1
Huishoudens [# hh]	500	70	50	500	92

Figure 2.3: Screenshot from the USWM PVE [Dutch] (Dartée, 2018)

attribute values for all or a selection of projects, and (4) the help page that contains an instruction video.

Proposals in literature for further research on PVE

Mouter et al. (2019b) propose, among others, further research on PVE specifically within the field of information provision to the respondents. Analysis of the qualitative results of their research, in the form of statements provided by respondents, indicated that respondents tend to take impacts and considerations into account that are not included in the survey information. Inclusion of such considerations might result in reduced validity of the survey outcome, partly because respondents tend to over- or underestimate the related impacts when they are not provided the appropriate information. The research

that the authors propose intends to develop the PVE further into, for example, an iterative method where outcomes of PVEs of a smaller size are used to design subsequent larger scale PVEs. Also, research into the application of novel methods of information provision is proposed, such as immersive and visual information.

Avenues for further research were proposed by de Geus (2019) based on research into framing, which is discussed in the following section. One of these is further research into whether different methods of presentation of survey information result in different outcomes. Such differences might be due to different decision-making processes and therefore further insight in the applied decision-making processes is warranted.

2.5. Impact of information presentation

Choice tasks

The adoption of different decision-making strategies by participants performing a choice task under the influence of the presentation of information has been researched by various researchers (Huber, 1980; Payne, 1976; Stone & Schkade, 1991). Huber (1980) performed an experiment in which the presentation of information (verbal versus numerical), the number of alternatives (two versus five), and the number of attributes (three versus six) were varied. It was concluded that with a low number of alternatives and with numerical information strategies similar to the previously defined additive and the additive difference strategies were more likely to be employed. Also, decision-makers were more likely to apply a weighting strategy when there were more alternatives. Payne (1976) concluded that increased task complexity (by increasing the number of alternatives) leads to decision-makers employing strategies that allow quick dismissal of alternatives. With a low amount of alternatives, compensatory strategies are more likely to be used. Stone & Schkade (1991) executed a process tracing experiment where the presentation of information was either numerical or verbal. Their findings were in line with the findings of Huber (1980). They explain the findings by saying that verbal presentation leads to non-compensatory operations as direct comparison of attribute levels is more difficult.

Dilution effect and length-implies-strength heuristic

A more recent study by De Vries, Terwel & Ellemers (2014) presented research on the dilution effect on the persuasiveness of public communications. The authors presented participants with positive or negative information on carbon dioxide capture and storage technology that was either only highly relevant or diluted with moderately relevant information or diluted with irrelevant information. The authors argued that the length-implies-strength heuristic (Stec & Bernstein, 1999, as cited in De Vries et al., 2014) would predict that a message's persuasiveness is enhanced when the message is longer. In contrast to this, the dilution effect would predict that a message's persuasiveness is reduced by the longer message (Nisbett, Zukier & Lemley, 1981). The outcomes of the experiments indicated that inclusion of irrelevant information reduced a message's persuasiveness while the inclusion of moderately relevant information had no effect. Based on these results the authors recommend to spare the details and focus on providing highly relevant information to the public (De Vries et al., 2014).

Framing effects in PVE

One research project examined the effect of framing on the outcomes of a PVE and discussed the associated ethical implications (de Geus, 2019). In this research three groups of participants were presented with either one of two emphasis-framed descriptions of project alternatives or a neutral description. It was concluded that emphasis-framing has a significant impact on the outcomes of a PVE experiment.

2.6. Reflection

Studying PVE decision-making using a process approach

This research tests the assumptions of the neoclassical paradigm's theory of perfect rationality and utility maximisation, which relate to the processes of decision-making. As discussed in section 2.2, decision-making literature offers several suitable tools with which to study decision-making by adopting a process approach. The process tracing techniques of think aloud and information boards are deemed to be applicable here because these can be applied to answer research sub-questions 1, 2, and 3. The

resulting data can then be interpreted using the identified decision-making constructs.

PVE in its current form already collects more than only input-output type information, which relates to the attribute levels and the project portfolios. To some extent process information is collected that can give insight in the decision-making processes of participants. The information boards aspect of PVE is readily available because the online tool that is used generates logs of the actions that a participant performs within the user interface. Such action logs could possibly yield insight in the decision-making processes. Also, asking for a motivation for the choices that a participant made can be seen as a written form of verbal protocol. This can be classified as retrospective and structured, following the classification by Ranyard & Svenson (2011, as cited in Schulte-Mecklenbeck et al., 2011).

PVE and decision-making research

PVE is closely related to decision-making because essentially within a PVE survey the participants are asked to complete a choice task. Therefore, the identified decision-making literature on the approaches adopted by people when facing a choice task can help to understand how participants approach a PVE survey and therefore understand PVE outcomes better. Conversely, PVE research can be of interest to the scientific field of decision-making because of the special character of a PVE survey. In a PVE survey participants are facing a somewhat unconventional choice task because: (1) they are put in the position of a public decision-maker spending public money instead of that of a direct consumer spending private income, (2) the choice task does not apply a straightforward 'choose-the-best' task but it asks the participant to select a portfolio of projects while keeping in mind the budget and possibly even the tax rate, (3) participants can construct a portfolio of multiple projects, thereby making it a portfolio-construction task. On top of that, the environment within which participants complete the choice task is quite complex, depending on the number of project and attributes that are considered in a PVE survey.

PVE and Stated Preference research

PVE essentially deals with the choices of the participants and the analysis of these choices using choice modelling. This is done by asking participants to consider a hypothetical scenario in which they are asked to make a choice from a number of alternatives defined by, at least, title, description, and attribute levels. Therefore PVE survey can be regarded as a form of stated preference (SP) surveys. A unique aspect of PVE is that these alternatives would normally not be considered by a citizen as they involve (policy) alternatives that are usually considered on governmental or organisational levels. Another unique aspect with respect to regular SP surveys is that participants have the option to construct a portfolio of choices, as opposed to being able to choosing only one alternative. However, because of the similarities that do exist it is considered useful to review literature on SP surveys as well as the analysis of the outcomes, because lessons could be learned for either side.

PVE's online tool interface

The online tool that is used for PVE surveys has been developed specifically for that purpose, but in no literature on PVE the tool itself has been studied or the way in which participants make use of that tool. At first glance, the interface cannot necessarily be considered straightforward. For a complex PVE survey with, say, five information/instruction pages and 16 projects a participant who reads through all project pages and makes some comparisons easily accesses about 30 pages.

From a utility maximisation perspective it is assumed that each and every participant will be fully informed and therefore that they have processed every project's info and attribute levels. From a behavioural economics perspective it is considered likely that participants will apply heuristics to lower the cognitive burden of the choice task. This could result in participants who make a pre-selection of projects based on first instinct and therefore do not consult each project page. Or, due to the complexity or information overload participants might not process certain pieces of information. Also, currently it is not known how participants make use of the interface and whether the interface is intuitive to use. It might be that participants are confused by the interface which might result in a boundary to participation or participants not being fully informed of the options.

Process tracing techniques as applied in this research can shed light on the interactions between participants and the online tool.

3

Research approach & methodology

This chapter presents the research approach and methodology, based on the four research sub-questions that were established in chapter 1. Section 3.1 presents how a PVE survey was defined in preparation of this research. Section 3.2 presents how sub-questions one, two, and three were addressed using a process tracing study. Section 3.3 presents how sub-question four was addressed by applying a variation experiment with manipulation of the form of information presentation.

3.1. Research preparation

In order to present participants in the two subsequent phases of research with a realistic survey[1] it was necessary to build a PVE survey that: was similar to previous PVE applications, considered a realistic case study at a local level, and that was of medium complexity. This was necessary for respondents to take the survey serious and thus for the results to be valid. The PVE survey considered projects within the municipality of Delft as the research would be conducted in Delft. With that the recruitment of participants, without the aid of a survey company, would be easier in the researcher's immediate surroundings. As the majority of previous PVE surveys considered infrastructure and mobility projects these were also chosen to be the focus of this PVE survey.

The first step in this research preparation was to perform a structured review of five previous PVE applications. The second step was to review policy documents from government bodies, local political parties, and other institutions to establish the context of the PVE survey applied in this research. The third step was to define and compose the PVE survey.

The outcome of these steps consisted of a PVE survey of six infrastructural projects with five impact attributes and one cost attribute. The PVE survey is presented in detail in chapter 4.

3.2. Process tracing study

Process approach

In this part of the research a process approach was adopted by applying the process tracing techniques of think aloud and information boards, which were introduced in section 2.2. Think aloud is an unstructured and concurrent form of process tracing that provides insight in the decision-making process applied by participants. Information boards is a movement-based technique that provides insight in the information that is consulted by participants. These were applied by making audio recordings to record the verbal utterances of participants while they completed the PVE survey's choice task on a computer. The computer screen was recorded to trace the information search of participants and to support the audio recordings.

[1] The language in which the PVE survey was presented to participants was Dutch because the case dealt with local issues and it kept the boundary to participation low for native Dutch speakers

Aim

This methodology is suitable for studying the process of decision-making by observing the uttered thoughts and performed actions while participants perform the choice task. As such, this served to test the perfect rationality and utility maximisation assumptions addressed in the first three sub-questions: *To what extent do participants take all information that is provided in a PVE survey into consideration while making their decision?*, *To what extent do participants evaluate the full choice set of project alternatives in a PVE survey?*, and *What decision-making processes are applied by participants while making their decision?*

An additional aim of this study was to serve as a pilot study for the developed PVE survey. This means that with the findings possible weaknesses could be identified within the PVE survey's set-up and content. These weaknesses would then be addressed in the final PVE survey version which would be applied in the subsequent variation experiment.

PVE survey

The PVE survey as defined in chapter 4 was applied in this study. All participants were presented the same survey. The attribute levels were fixed because no choice modelling was applied to the outcomes and a variation of levels might impede direct comparison of outcomes between participants.

Participants and recruitment

Because of the high volume of data that is generated when applying this method, as explained in section 2.2, the number of participants was limited to 10 persons. The participants were recruited from the researcher's personal network by contacting friends and neighbours. In the recruitment process a variation in age and working situation was ensured. Within the scope of this research a variation in education level was not feasible nor desirable. To a certain extent homogeneity of the sample was desirable in this case because otherwise observed differences in decision-making can be attributed to the wide variation in respondent characteristics instead of the variation in decision-making strategies and tendencies within a somewhat homogeneous group.

All participants were residents of Delft. Participation was voluntary and participants had the option of entering their e-mail address to have a chance at winning one of the prizes of €25.- that were offered as an incentive towards participation in the subsequent variation experiment, as explained below in section 3.3.

Sessions

The ten separate sessions were held in quiet rooms at the researcher's house or at the respondents' houses. Each respondent completed the survey on the researcher's laptop. During the sessions the researcher was present in the room. At the start of the session the respondents were told the following:

- A short introduction on PVE and how it serves to value of public projects.
- That they were about to make a selection of projects within the municipality of Delft.
- That an audio and screen recording would be made and that these would be destroyed after transcription.
- The following instruction, which was based on the instruction by Walsh & Gluck (2016) as presented in section 2.2: "*I ask you to think aloud during the experiment. What I mean by think aloud is to say out loud everything that you would normally say to yourself in your thoughts. Act as if you are alone in the room and that you speak to yourself*[2]".
- That verbalisation of thoughts should be done from the moment they started the choice task by accessing the main page until they confirmed their project selection.
- That the results would be processed anonymously.
- That they would first encounter several pages with information on the context, after which they would make their project selection and subsequently they would encounter a questionnaire.
- That skipping questions in the questionnaire was allowed.

During the session, if a respondent was quiet for a longer period of time he or she was reminded by the researcher to think out loud. In line with the recommendations from Ericsson & Simon (1993, as cited

[2] In Dutch: *Ik vraag je om hardop te denken tijdens het experiment. Wat ik bedoel met hardop denken is dat je alles hardop zegt wat je normaal stil tegen jezelf zegt in gedachten. Doe alsof je alleen in de ruimte bent en tegen jezelf praat*

in Schulte-Mecklenbeck et al., 2011), as discussed in section 2.2, the participants were not instructed to verbalise specific aspects.

Output
The output of the process tracing study consisted of verbal protocols of statements based on the transcribed audio recordings, action logs based on the screen recordings, and a comma-separated values (CSV) file export from the online tool with the selected project portfolio, the motivations, and the responses to the questionnaire.

Analysis
The verbal protocols of statements were coded in two rounds, one for identification of categories and a second for assignment to those categories, following the methodology of Walsh & Gluck (2016). Of these categories the frequencies with which they were mentioned by participants were determined. From the action log the frequencies of actions per participant were determined. The motivation statements were coded using the categories as identified for the subsequent variation experiment. The sample characteristics were processed in Microsoft Excel (Microsoft, 2020).

Also, to facilitate the interpretation the verbal protocol of each participant was shortened to a more easily digestible length and format by scrapping utterances that were deemed to be irrelevant and short reports of the thought and actions were constructed.

The interpretation had the aim of identifying decision-making tendencies as described by Misuraca et al. (2015), strategies as described by Payne (1976), and effort-reduction methods as described by Shah & Oppenheimer (2008). These were presented in section 2.3. This provided insight in the decision-making processes applied by the participants. Additionally, the consultation of information and the interaction with the online tool was studied through analysis of the action log.

The process tracing study results and their analysis are presented in chapter 5.

3.3. Variation experiment
Structural approach
In contrast to the preceding process tracing study, this experiment adopted a structural approach by considering the input and output of the PVE survey's choice task. The experiment applied a variable-in-attributes design by manipulating the input, in the form of the attribute information presentation, to respondents.

Aim
The variation experiment served to answer the fourth research sub-question: *Are participants indifferent to whether attribute levels are presented as a set of numbers with separate attribute titles, or as a set of short sentences that include the attribute titles?*

PVE survey
To answer the research sub-question in this experiment participants were presented a PVE survey in which the presentation of attribute values was manipulated. These were either presented in the form of full sentences or with numerical values. In the remainder of the report these are referred to as the narrative variant and the quantitative variant, respectively. In both versions the essential information presented to respondents was identical, only the manner of presentation differed.

The attribute levels were varied across 15 treatment combinations in order to facilitate analysis of the output using choice modelling.

Participants and recruitment
In order to be able to make reliable conclusions it was necessary to get as many respondents as possible to complete the survey and the aim was to have a group of 100 respondents for each variant, thus 200 respondents in total. To achieve this a large effort was spent on the promotion process. The channels and artwork that were used in this process are listed in appendix C. As an incentive for participation four prizes of €25,- were offered. To have a chance at winning a prize the participants had

to enter their e-mail address. These e-mail addresses were only used to award the prizes.

The PVE survey was accessible through one link and access to the two variants was managed through the website `https://www.rebrand.ly`. To present an easy to remember and trustworthy link the domain name of `https://www.onderzoek.live/delft` was bought. This link could be configured to direct visitors to either the variation variant or the quantitative variant. Over the period in which the experiment was live the researcher switched these variants at least on a daily basis, and occasionally it was switched more often at periods of high intensity traffic after promotional efforts. This was done to ensure a balanced completion of both variants.

Respondents could complete the PVE survey at their own convenience using their own laptop or computer. Participation was voluntary. Participants were asked to complete the survey only if they lived, worked, or studied in Delft.

Responses were considered valid when respondents, after making a project selection, provided motivations for their project selection and/or responded to the follow-up questions. If both of these were missing the response was not included in the analysis. Formulating a motivation or answering the follow-up questions was considered a sufficient indicator for effort having been spent on completing the survey.

Output

The output of the experiment consisted of a CSV file export generated by the online tool with the selected project portfolio, the motivations, responses to the questionnaire, and the version ID corresponding to one of the 15 different treatment combinations of attribute levels.

Analysis of descriptive data

The descriptive data consisted of the responses to the follow-up questions. The data was loaded into Microsoft Excel and the SPSS statistical programme (IBM Corp., 2017) in order to establish the degree to which the sample captured in the experiments was representative of the population and to what extent the samples captured in the two variations differed.

Analysis of quantitative data

The quantitative data consisted of the project portfolios assembled by participants. These were studied by establishing the project counts and by estimating an MNL choice model, as described below. In this study the commonly applied MDCEV and SWF analyses were not conducted because these are not suited to the relatively limited sample size that this experiment dealt with.

Project counts: using the project portfolios constructed by the participants the counts were determined with which the projects were chosen. These counts were loaded into the SPSS statistical programme (IBM Corp., 2017) and Chi-square tests were performed to statistically test whether a relation exists between the variation and the project selection. The Chi-square test is applicable to categorical data, as is the case in this situation, and it tests the null hypothesis which says that there is no relation between two variables. In this instance, such a test gives an indication whether there is a statistically significant difference between the actual frequency and expected frequency, based on the overall frequency, with which a project was chosen.

Choice modelling: the results from the experiment were analysed using the Bahamonde-Birke methodology, which applies a multinomial logit (MNL) model to estimate the choice probabilities for project portfolios based on the social utility of the included projects (Bahamonde-Birke & Mouter, 2019). So far, the Bahamonde-Birke methodology has only been applied to a synthetic data set and the data set from de Geus (2019), of which only the synthetic data set was discussed in the paper.

The MNL model estimation results in project specific constants (PSCs) as well as taste parameters relating to attribute levels, the marginal utility of not spending budget, and synergy effects between pairs of projects. Also, for each parameter the t-values are determined as a measure of the level of confidence with which the parameters are estimated to be different from zero. The model fit of the estimated models for the two variants is checked based on McFadden's rho-squared, with the following equation: $\rho^2 = 1 - (LL_{final}/LL_0)$ (Hauser, 1978).

The estimations performed in this research did not fully follow the methodology because the parameters associated with the synergy between projects were not included in the estimations. These were not included because the sample size was relatively limited and as such a larger number of parameters could not be estimated reliably. The MNL model estimations were performed using a Matlab (The Mathworks Inc., 2018) coding file that was written by José Ignacio Hernández, advisor to this thesis project (Hernández, personal communication January 15th 2020). This coding file was adapted for the 6 projects and 5 attributes, excluding the budgetary attribute of cost, that were applicable to this project.

The values of the different attribute variation versions were normalised to values between 0 and 1 using the corresponding maximum values of €40 million, 6 minutes of travel time savings, 5.000 bicycle users, and 25.000 car users. Estimations were made for the separate data sets of the narrative and the quantitative variants as well as the combined data set.

The outcomes of this analysis were the PSCs and parameters related to the attribute levels and the marginal value of not spending the budget. For each parameter t-values were estimated to give an indication of the level of significance.

Analysis of qualitative data

The qualitative data consisted of motivations and general remarks provided by participants. Both were analysed by coding: in a first round of coding (main) categories were identified and in a second round of coding the statements were assigned to these categories. For the motivations the categories as applied in the Amsterdam transport investment scheme by Mouter et al. (2019b) were used as a first basis, which are listed below. In the list the changes applied in this research are presented in italics.

- Fully aligned with traditional goals:
  - Safety improvements.
  - Travel time and congestion reductions.
  - Noise pollution reductions.
  - Personal benefits.
  - *Need for extra car parking spaces.*
- Closely related to traditional goals:
  - *Accessibility improvements.*
  - Traffic situation orderliness improvements.
- Related to broader goals of transport planning:
  - Health and environment improvements.
  - Area attractiveness improvements.
  - Public transport and cycling promotion.
  - Car traffic reduction through mode substitution.
  - Equity considerations.
- *Case specific*
- *Synergy of projects*
- All other motivations.

The coding scheme that was defined after the first round of coding added two main categories, namely case specific and synergy of projects. The case specific category contains motivation statements that specifically refer to the attribute values included in the PVE and the desire to fully spend the budget. The synergy of projects category includes a wide range of synergies mentioned by participants. Within the traditional goals category the need for extra parking spaces was added and the noise pollution reduction was removed. Within the closely related to traditional goals main category the suburb accessibility improvement category was changed to improving accessibility in a more general sense as many participants mentioned accessibility of both neighbourhoods and the university campus.

The experiment, its results and the analysis are presented in chapter 6. The overall results of the PVE survey are presented in appendix D.

4

PVE survey construction

This chapter presents the construction of the PVE survey that was used for the process tracing study and variation experiment. In section 4.1 a reflection of the structured review of previous PVE applications is presented. Section 4.2 presents the determination of the content of the PVE survey. Subsequently, the composition of survey in the online tool is presented in section4.3. Finally, the outcomes of this process are discussed in section 4.4.

4.1. Reflection on review of PVE applications

To establish a PVE survey that was in line with previous PVE surveys a review was performed of previous PVE applications. The previous applications that were reviewed were: the flood protection scheme in the Netherlands, the transport investment scheme in Amsterdam, urban storm water management (USWM) measures in The Hague, the transition to zero natural gas in the neighbourhood of Hengstdal in Nijmegen, and an experiment on the impact of framing on project selections (Mouter et al., 2019a; Dekker et al., 2019; Mouter et al., 2019b, 2017; Dartée, 2018; Pak, 2018; de Geus, 2019). This review resulted in a structured framework that contains three phases of PVE execution using which a full PVE survey's content, composition, and execution can be communicated or analysed in a structured manner. For details on these phases and their underlying elements as well as the review of previous PVE applications structured using that framework, the reader is referred to appendix B. This section reflects on that review and the findings are used in the subsequent section to establish the content of the PVE survey applied in this research.

Phase I - Content determination

Element 0 - Experimental setup: the application of an experimental setup fully depends on the goals of the research.

Element 1 - Context: a distinction can be made between PVE surveys with a specific context and a generic context. On the one hand there are specific context PVE surveys in which respondents are presented with information pertaining to a fully defined context with specific projects. The flood protection scheme, transport investment scheme, and gas transition PVE surveys fit within this category. On the other hand there are generic context PVE surveys that ask respondents to consider a context that is not explicitly defined. Within the USWM PVE this took the form of a generic neighbourhood in The Hague and within the framing experiment the respondents were asked to consider a generic Dutch city.

Element 2 - Constraints: the larger scale PVE surveys considered both fixed and variable budgets, while two smaller scale PVE surveys considered the simple form of a fixed budget. An interesting variation in this respect was the gas transition PVE survey that did not apply a budget and instead presented the respondents with the extent to which the target of renewable energy sources' share in the energy mix in the year 2045 would be reached.

Elements 3 & 4 - Projects and attributes: the number and type of both projects and attributes determine to a large extent the complexity of PVE surveys. Four PVE applications were highly complex with 11 to 16 projects and 6 to 8 attributes, excluding cost. Only the framing experiment PVE was of a low level of complexity with 6 projects in a generic Dutch city and 5 attributes, excluding cost.

Element 5 - Attribute levels: presenting respondents different treatment combinations of attribute levels is required for choice modelling using MDCEV methodology, as applied in the case of the large scale PVEs. A drawback of the MDCEV methodology is that it requires such a large number of participants that it was eventually not applied in the USWM PVE due to the limited success rate in recruitment of respondents.

Element 6 - Delegation: the option to delegate was included in both larger scale PVE surveys while in the three smaller scale PVE surveys only the gas transition survey included this option. Within the small scale PVEs which are executed as a Master thesis it already seems to be a challenge to gather a large number of respondents due to limited resources. Therefore, not including the delegation option seems reasonable. For the larger scale PVEs it can lower the boundary towards participation of a large group of citizens as participants can have a voice without investing a large amount of effort and time. In that case this does ask for inclusion of a financial incentive towards not delegating but composing a portfolio yourself, as was done in the large PVEs.

Element 7 - Follow-up questions: the questions included in the studied PVE surveys were found to be related to five main categories: motivation of choices, Likert-scale statements, socio-demographic characteristics, case-specific questions, and open questions.

Motivation of project choices were asked in all PVE surveys apart from the framing experiment. The resulting qualitative statements are considered to be one of the main results of PVE surveys as they can provide insight in the broader considerations of respondents when they compose their project portfolio (Mouter et al., 2019b).

Likert-scale statements were similar across the large scale PVE surveys and the gas transition PVE survey. The statement related to participants being convinced of their choices, whether they found the experiment realistic, whether it was good that the relevant government body applied the PVE method, and whether it offered relevant information to that government body. The framing experiment posited statements related to the applied experimental design on framing.

Socio-demographic characteristics were covered to a varying extent across the studied PVE surveys. Three out of five asked for at least gender, age, and education level. The form in which they were asked and in which the possible answers were presented varied.

Case-specific questions varied across the studied PVE surveys, as expected. Four out of five PVE surveys included case-specific questions.

Open questions were asked in three out of five PVE surveys. These related to reflection on the PVE methodology, whether the relevant government body was expected to use the results, and reflection on the experimental design, where applicable. Providing participants with the chance to reflect on the PVE methodology and to provide feedback in general seems useful for any PVE survey as it can provide a measure of how respondents perceived the survey and it might yield useful new suggestions as well.

Phase II - Survey composition

Element 1 - Choice task instruction: the instruction given to participants at the start of a PVE survey seems especially relevant from a decision-making perspective, as taken in this research, because it initiates the choice task that respondents are asked to perform.

The relevance of the choice task that the respondent is asked to complete is stressed in four PVE surveys by mentioning that the relevant government body will consider the outcomes. Such a statement could invoke a feeling in the respondent that their choices within the survey have a consequence and this might cause the respondent to make a more well thought-through choice. Only in the framing experiment this could not be done as the city under consideration was a generic one.

Four out of five PVE surveys present the choice task as allocating a certain limited budget to possible projects. Only the gas transition transition PVE survey was framed differently because it did not consider a budget. The instruction to respondents with regards to what will be done with the remainder of the budget seems to be important as it constitutes the alternative to allocating the entire budget.

Element 2 - Information presentation: within the provision of information the following elements were identified: project descriptions, attribute values, attribute units, graphic information, and location information. Project descriptions were present in all surveys in 100 to 160 words. The attribute values were mostly communicated using numbers and with some ordinal variables in short texts. The attribute units were presented in tool-tip texts in three out of five surveys and within the attribute title or attribute value in the two other surveys. Graphic information was only applied in the USWM PVE survey. Location information can only be applied in the surveys with a specific context and within these the large PVEs indicated the location information of projects using a map as well as within the project titles.

Element 3 - Debriefing: the page with which participants were debriefed after completing the survey was only reported on in the framing experiment. The debriefing page is important in cases where the experimental setup introduces a need for respondents to be debriefed.

Element 4 - Online tool design options: the current online tool for PVE surveys has certain design options that need to be configured by the researcher and many options exist that could yet be developed. It is important for researchers and PVE designers to be aware of the (lack of) availability of options when they compose a PVE.

Element 5 - Testing: judging by the reviewed literature, testing of the PVE tool seems to be an overlooked element or at least an element that is not reported on.

Phase III - Execution & Analysis

Element 1 - Respondents: recruitment or respondents through other means than survey companies for complex PVE surveys has proven to be a challenging task. The large scale PVE surveys employing survey companies reached over 2,000 respondents, while the small scale PVE surveys without survey companies and financial incentives struggled with recruitment.

Element 2 - Analysis of results: here a distinction can be made between three types of data, namely descriptive, quantitative, and qualitative data.

The descriptive data consists of the responses to the socio-demographic characteristics and case specific questions, as well as the Likert-scale statements. Analysis provides insight in the degree of representation of the sample with respect to the entire population as well as the perceptions of participants to the survey.

The quantitative data is suitable for MDCEV & SWF analysis if the attribute levels were varied and a sufficient number of responses were obtained. Otherwise, analysis using frequency tables was applied. In addition to these methods, a new methodology was recently developed that is based on the choice probabilities of portfolios (Bahamonde-Birke & Mouter, 2019), as described in section 3.3.

The qualitative data on motivations of project selection was found to be consistently analysed using coding of the statements in two rounds, one for identifying categories of statements and a second for assigning the statements to those categories.

Element 3 - Policy advice: the policy advice that is eventually given depends on the client and the specific case that a PVE is applied to, as expected.

4.2. Content determination

Having established a basis using which to construct the PVE survey for this research, the subsequent step was to identify realistic public infrastructure projects within the municipality of Delft. This was the case study of this research, as explained in section 3.1. To get an overview of issues that are currently discussed in the area of Delft reports from different government bodies were studied, such as policy documents from the municipality of Delft (Gemeente Delft: Bestuur, 2016b,a; Gemeente Delft: Centrale Staf, 2011; Gemeente Delft: Ruimte, 2013; Gemeente Delft: Wijk- en Stadszaken, 2005a,b, 2011; Gemeente Delft & Provincie Zuid-Holland, 2018) and of the province of South Holland (Provincie Zuid-Holland, 2014).

Also, election programmes were studied from local (branches of) political parties that were published for the Delft municipal elections of 2018, namely[1]: GL (Green), STIP (Local, student focused), D66 (Social-liberal), Onafhankelijk Delft (Local), VVD (Conservative-liberal), CDA (Christian), SP (Socialist), PvdA (Labour), ChristenUnie (Christian), and Stadsbelangen Delft (Local) (GroenLinks, 2018; STIP, 2018; D66, 2018; Onafhankelijk Delft, 2018; VVD, 2018; CDA, 2018; SP, 2018; PvdA, 2017; ChristenUnie, 2018; Stadsbelangen Delft, 2018).

After the 2018 elections a coalition was formed between the parties GL, STIP, D66, VVD and PvdA. Their coalition agreement was studied to establish the current state of affairs (Gemeente Delft: Programma's en projecten, 2014). In addition, the vision on mobility from the Delft University of Technology and a plan focused on bicycles as composed by the local branch of the bicycle lobby group *Fietsersbond* were studied (Van de Klugt, Oostlander, Ykema, Lakerveld, Walta & Numann, 2018; Fietsersbond afdeling Delft, 2017).

This section presents the content of the PVE survey. Where applicable the differences between the PVE surveys used in the process tracing study and the variation experiment are indicated.

Element 0 - Experimental setup

As discussed in section 3.3, for the variation experiment two versions were constructed with a narrative form and quantitative form of attribute information presentation. For the process tracing study no experimental setup was applied.

Element 1 - Context

In the experiment it is assumed that the municipality wants to gain insight in the preferences of citizens with regards to investments that have the aim of increasing accessibility in the south side of Delft. This is an especially crowded area with the Delft University of Technology campus as a major source of traffic demand and new development being planned for the future. Specifically, the campus is a daily destination for 27.000 people and the TU Delft has identified a number of issues (Van de Klugt et al., 2018). These issues relate to the steep increase in cyclists which also impacts car traffic because of limited options of crossing bicycle lanes in peak traffic periods, the TU Delft ramp to the A13 highway being overburdened, and free car parking spaces at the TU Delft campus being used by people for whom the campus is not their destination.

Also, personal observations of the researcher showed that the Schoemakerstraat, the N470, the Technopolis' roads and the ramps to the A13 are very busy at peak traffic periods, which leads to increased travel times for car users. These issues lead to decreased accessibility not only for the campus but also for other areas in Delft, such as the neighbourhoods of Tanthof, Voorhof, and the city centre.

It is expected that the pressure on the existing infrastructure will increase further due to the following developments (Gemeente Delft & Provincie Zuid-Holland, 2018): (1) the planned development of Schieoevers-North from an industrial estate into a living, working, and recreational area, and (2) the further development of the Technopolis industrial estate.

Currently, three large infrastructural projects have been approved and will be completed in the next few years. The experiment asks the participants to consider these as completed: (1) the construction of the Gelatinebridge will be started this year and is expected to be finished in 2022 (College van Burgemeesters en Wethouders, 2019; van der Veldt, 2018), (2) the reconstruction of the Sint Sebastiaansbridge (Gemeente Delft, 2019b), (3) the construction of Tramline 19 from Delft train station to Technopolis (Gemeente Delft, 2019c). The timeline for the projects included in the survey is 5 to 10 years.

Element 2 - Constraints

The constraint that applies is a fixed budget which is set to be €40 million. With the determined project costs as described below this allows the participants in the process tracing study to select up to 3 projects out of the total of 6 projects. In the variation experiment the number of projects that participants could select depended on the attribute levels that they were presented with. A variable budget was not

[1] The parties have been ordered based on the number of seats that they won in the elections, with the party that won most seats named first. This order is applied throughout this report. Source: `https://ris.delft.nl/internet/actueel_3173/item/definitieve-verkiezingsuitslag-gemeenteraad-delft_72550.html`

applied because this would make the PVE survey too complex and this did not fit the research aims.

Element 3 - Projects

6 projects were chosen from the reviewed sources. These are car parking facilities, bridges, tunnels and a new ramp for the A13 highway that are being considered for construction. Figure 4.1 shows the locations of these projects. Project 1 is a Transferium Technopolis parking facility with description: free car parking spaces with an easy connection to Delft campus & city centre using Tramline 19. Project 2 is a Park&Bike parking facility described as: at multiple locations free car parking spaces with rental bikes for the last part of the journey. Project 3 is a Gelatine bicycle tunnel under the train tracks that has this description: this bicycle tunnel connects the Voorhof neighbourhood to the campus and connects to the Gelatinebrug (as mentioned: construction on this bridge starts this year). Project 4 is a new A13 ramp for Technopolis described as: a new ramp for the highway A13 at petrol station Ruyven. Project 5 is the Faraday bridge over the Schie (river) with description: this bridge for cars and bicycles connects the neighbourhood of Tanthof and the industrial estate Schieoevers-Zuid with Technopolis and the campus. And, finally, project 6 is the Faraday bicycle tunnel under the train tracks that is described as: this bicycle tunnel connects the Tanthof neighbourhood with the industrial estate Schieoevers Zuid, Technopolis and the campus.

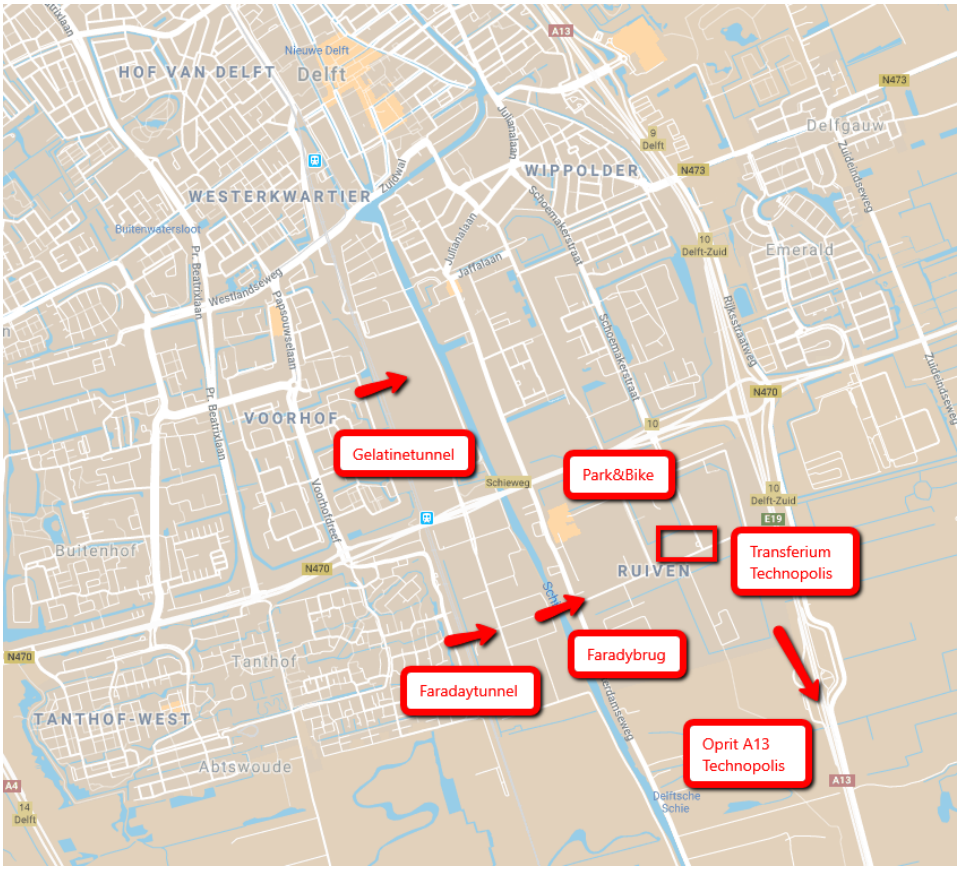

Figure 4.1: The locations of the projects included in the PVE survey. Source of map: Google LLC (2019)

Element 4 - Attributes

Budgetary attribute: as with the majority of the reviewed PVE surveys, cost is the budgetary attribute in this survey. This is expressed in millions of €.

Other attributes: 5 attributes were defined. Attributes A, B, and C reflect the impact of the projects on travel time with respect to origin/destination and travel mode. Attributes D and E indicate the number of directly impacted users on bicycles or in cars. Within the process tracing study attributes A, B, and

C indicate the reduction in travel time but this was changed to change in travel time for clarity in the variation experiment.

(A) Change in travel time per car at peak times around the campus [minutes]
(B) Change in travel time per bicycle between Tanthof and Campus [minutes]
(C) Change in travel time per bicycle between Voorhof and campus [minutes]
(D) Daily number of direct users on a bicycle [# of cyclists]
(E) Daily number of direct users in a car [# of car users]

Element 5 - Attribute levels

The sources and reasoning used for determining the attribute levels for the cost and other attributes are shown in appendix E. For the variation of the attribute levels a distinction is made between the process tracing study and the variation experiment.

Process tracing study: for this study no statistical choice modelling is applied to analyse the outcomes. Therefore, the attribute levels are fixed. These are shown in table 4.1.

Table 4.1: Process tracing study, cost & attribute levels

Label	Cost [million €]	A [minute]	B [minute]	C [minute]	D [bicycle users]	E [car users]
1 Transferium	15	8	0	0	0	1,000
2 Park&Bike	10	4	0	0	600	1,000
3 Gelatine tunnel	10	3	1	5	1,200	0
4 Ramp A13	30	8	2	2	0	20,000
5 Faraday bridge	15	8	6	2	4,000	10,000
6 Faraday tunnel	10	4	6	2	5,000	0

Variation experiment: to allow for statistical choice modelling the attribute levels were varied over 15 treatment combinations. The minimum and maximum levels that were applied are shown in appendix E.

Element 6 - Delegation

The respondents did not have the option to delegate their choice because the research focuses on the decision-making processes applied while making the choices and on the impact of the applied manipulation in information presentation on a PVE outcome.

Element 7 - Follow-up questions

Below the follow-up questions are presented together with the reasoning as to why they are asked. Readers who want to see the complete overview for both the process tracing study and the variation experiment are encouraged to consult appendix F. Below the aims and reasoning behind the categories of follow-up questions are discussed. None of the questions were mandatory for respondents to fill in.

Motivations of choices: these serve to gain insight in the motivations for project selection. This is done by asking the respondents to provide qualitative motivations for the projects that they included in their portfolio. The review of PVE applications showed that this is a standard element of PVE surveys. The results will give an indication of the factors that respondents include in their decision-making processes. Also, it gives an indication whether these factors are considered often or only by a select number of respondents and whether factors specific to this PVE survey and the applied variation are mentioned.

Likert-scale statements: two types of statements were included, namely to gain insight in the respondents' perception with respect to the experimental setup that was applied within this PVE survey specifically and to gain insight in the respondents' perception with respect to their choices within this experiment and with respect to PVE methodology in general. The former is done by asking the respondent to indicate to what degree he or she agrees with statements on information provision and the

latter is done by asking the respondent to indicate to what degree he or she agrees with statements on PVE surveys and public policy making. The review of PVE applications showed that both are elements included in several of the reviewed PVE surveys.

For the variation experiment a statement is included in which participants are asked to reflect on the manipulation. This is done by including this statement: *"I used the information on travel time and the number of direct users while making my decision"*.

Socio-demographic characteristics: these serve to be able to evaluate the degree of representation of the two samples captured in the variation experiment. If the socio-demographic characteristics reported by participants differ greatly between the samples captured by the two variants this can result in differences in project selections that cannot be attributed to the variation. In addition, the reported socio-demographic characteristics of the overall sample captured in both the process tracing study and the variation experiment can show to what extent the captured sample is representative of the overall population.

The SDCs included in this survey deal with the basic characteristics of gender, age, and education level. The review of PVE applications showed that these are included in most of the reviewed PVE surveys. In addition, considering the local characteristics of the projects and that they were proposed by specific local political parties, the respondents are asked for their vote in the Delft municipal elections of 2018. Also, the respondents are asked for their current occupation because it was expected that the sample captured in the variation experiment would be dominated by students due to the promotion in the researcher's personal network. Finally, the postal code is relevant as it allows for checking to what extent the sample is distributed spatially.

Case specific questions: these serve to allow evaluation of the link between respondents' case specific characteristics to observed preferences. As shown in the review case specific questions are a standard element of PVE surveys. The case specific questions included in this survey concern the frequency of visits to the TU Delft campus and the travel mode that is used most on a daily basis. These were relevant because the projects were built in the direct vicinity of the university campus and focused on different travel modes.

Open questions: these allow the respondents to reflect on this specific survey and PVE methodology in general as well as to provide any comment that they wish. This is done by including a question that asks the respondents if they have anything to add. As shown in the review this is a common element of PVE surveys.

Prize draw: to facilitate the promotional prize draw the respondents were asked to enter their e-mail address for the prize draw.

4.3. Survey composition

Having established the content of the PVE survey in the previous section, the next step was to compose the survey in the online tool. Each element of the composition phase is discussed below. Where applicable the differences between the PVE surveys used in the process tracing study and the variation experiment are indicated.

Element 1 - Choice task instruction

In the introduction and information pages the respondents were briefed on the following elements:

Introduction: this included regular instructions and information relating to surveys. The respondents were informed of the survey's target group, the requirement to complete the survey on a laptop or personal computer, the structure of the survey, the aims of the research, contact details of the researcher, and participation being voluntary and anonymous. To give respondents an incentive to take the research serious, they were told that the results of the study would be communicated to the municipality of Delft. However, it was made clear that the study was not executed in direct collaboration with the municipality.

Context: this included the contextual information as presented in the Context element of the preceding section. These related to the problems that are currently experienced, the future developments in the area, the timeline of the projects, and the projects that the participants had to consider as being complete. The instruction to the participants was as follows: *..there are plans to improve accessibility. However, there are not sufficient funds to execute all these project plans. Therefore, choices will have to be made. We ask you in this research to make that choice and to spend the available funds on the projects that you find most important.*

Constraints: the participants were told that there were insufficient funds available to execute all projects.

Help: the respondents were provided a narrated instruction video that presented the interface. Also, in contrast to earlier PVE surveys, a written help text was included. This was done because it might be considered as a barrier to participation if help is only available in audiovisual format and, also if a participant did watch the video, it is easier to consult a text again in case a participant does not know how to proceed.

Element 2 - Information presentation

Each project included one descriptive sentence of up to 15 words. The attribute values were presented in the form of a sentence or as a single number, depending on the variant. In the process tracing study the attribute values were presented as a single number. The attribute unit was presented within the sentence or included in the attribute title, depending on the variant. Within the process tracing study the unit was only shown in a tool-tip that was displayed when the user hovered the mouse indicator over it. No graphic information was included. The location of each project was indicated on a map and it was mentioned in the project description.

Element 3 - Debriefing

On the debriefing page the respondent was thanked for his/her contribution and he/she was informed of the variation that was applied, in the case of the variation experiment. Also, the contact details of the researcher were displayed and it was reiterated that the research was not executed in collaboration with the municipality of Delft or any other governmental body.

Element 4 - Online tool design options

The design option to include the open questions for project motivations was enabled. The following design options were disabled: ordering projects in the main page, expanding project detail rows in the main page, adjusting the tax rate for a flexible budget, delegating the selection, selecting multiple units of a project, selecting one project at most, and randomising the project order in the main page.

The following new features were added by the developer of the online tool on request of the researcher after the process tracing study (Borst, personal communication January 2020): (1) the participants could choose to include no projects in their portfolio and in that case they were asked why they chose not to do so, (2) viewing the help video was no longer mandatory as it was feared to pose a barrier to participation, and (3) the default zoom level of the maps in the project pages was made adjustable.

Element 5 - Testing

Testing before the process tracing study was done by the researcher. Testing for the variation experiment was a side goal of the process tracing study, the outcomes of which are presented in the next chapter.

4.4. Outcomes

This chapter presented the review of previous PVE applications and used that as a basis to construct the PVE survey that is used in this research. Appendix G presents screenshots of the survey content of the process tracing study. For the variation experiment the screenshots of the project page corresponding to the two variants are shown in figure 4.2 and 4.3. Screenshots of the corresponding comparison

pages are shown in appendix H. For the full texts included in the survey for both the process tracing study and the variation experiment the reader is referred to appendix I.

The PVE survey applied in the process tracing study is accessible through this link: `http://pve.splicedgene.com/process-tracing-experiment`. The two variants applied in the variation experiments are accessible through these links: `http://pve.splicedgene.com/tomas-variation-experiment` and `http://pve.splicedgene.com/tomas-variation-experiment-quantitative`, respectively.

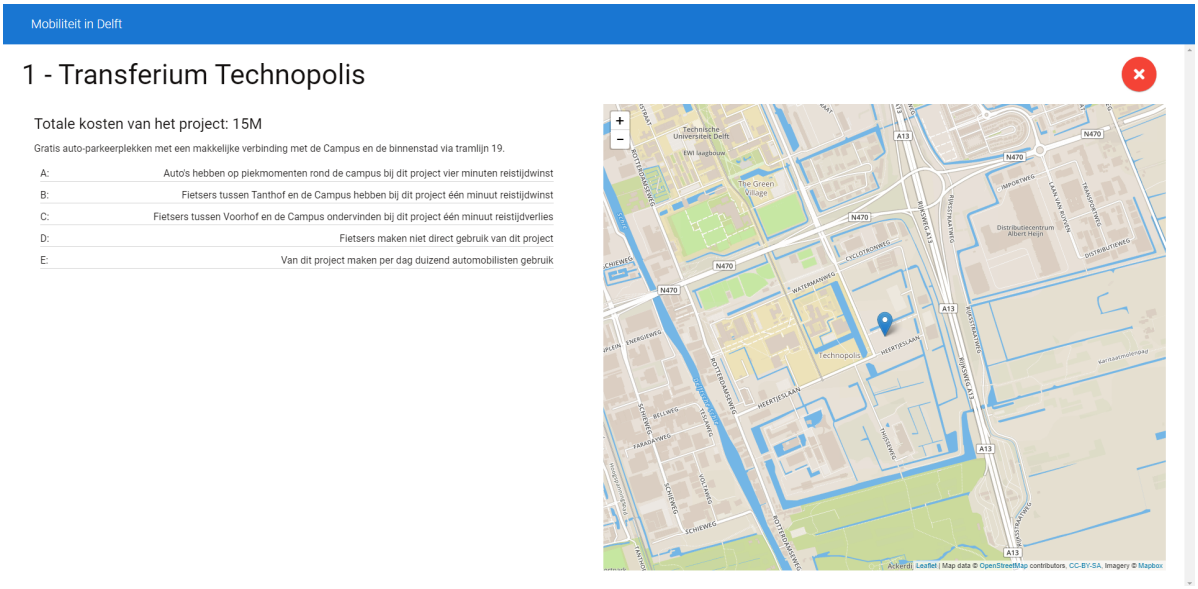

Figure 4.2: Variation experiment, narrative variant project page for project 1

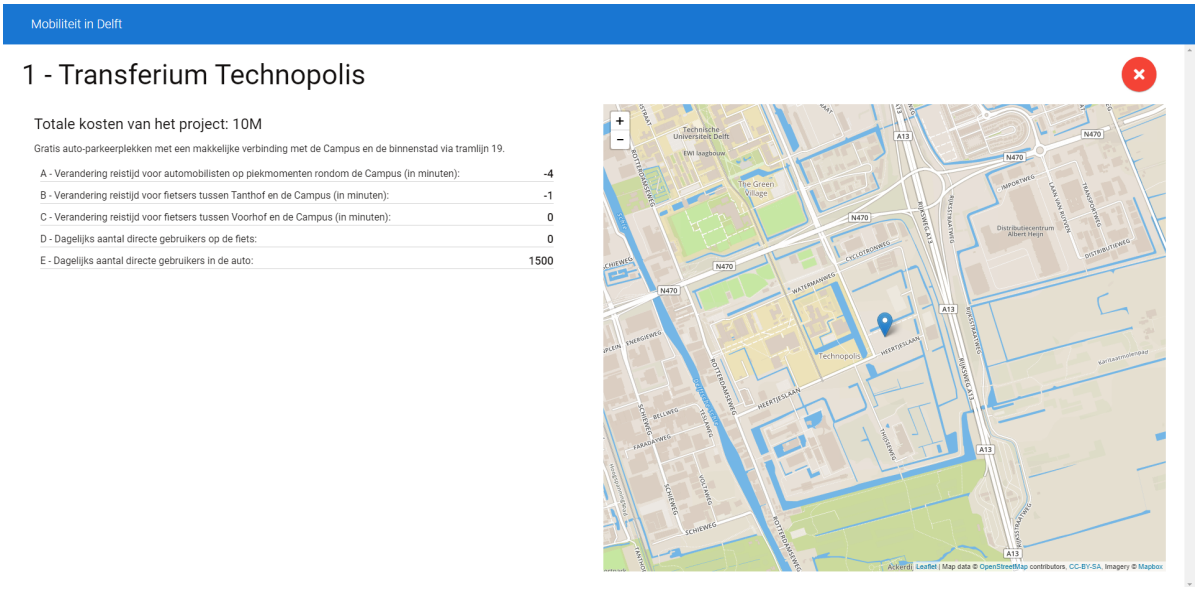

Figure 4.3: Variation experiment, quantitative variant project page for project 1

5

Results process tracing study

A short recap of the applied approach is presented in section 5.1. The characteristics of the population sample captured in this study are discussed in section 5.2 and their project selections are presented in section 5.3. An overview of the verbal protocols and action logs is presented in section 5.4, which serve to study the consideration of provided information by participants. Section 5.5 interprets the verbal protocols and logs per participant with the aim of identifying decision-making processes and checking whether participants considered the full choice sets. An overview of these processes is presented in section 5.6. The conclusions related to the addressed sub-questions are discussed in section 5.7. And, finally, the test aspect of this study and the resulting changes to the PVE survey for the subsequent variation experiment are presented in section 5.8.

5.1. Approach

As presented in section 3.2 the process tracing study was conducted with the aim of answering sub-questions 1, 2, and 3: (1) *To what extent do participants take all information that is provided in a PVE survey into consideration while making their decision?* (2) *To what extent do participants evaluate the full choice set of project alternatives in a PVE survey?* (3) *What decision-making processes are applied by participants while making their decision?* In addition, this study served as a test for the PVE survey before it was applied in the variation experiment.

Ten sessions were held in which participants completed the PVE survey as presented in chapter 4 while they verbalised their thoughts. Audio and screen recordings were made that resulted in verbal protocols and action logs for each participant. The applied methodology was presented in section 3.2.

Below a recap is presented of the various forms of information and screens in the survey. Also, the decision-making constructs are listed for easy reference. These were all introduced in chapter 2.

Information and screens within the survey

The different screens included in the online tool during the execution of the choice task are, as explained in the literature review on PVE in section 2.4: the main page, the project specific pages, the comparison page for all or a selection of projects, and the help page.

The different forms of information available to participants are: project titles, descriptions, attributes, locations, and costs, as well as the available budget.

Decision-making processes

The verbal protocols and action logs are interpreted based on the research sub-questions. Therefore it focuses on participants consulting and considering information, evaluation the full choice set or a subset, and the decision-making processes that can be identified. As discussed in section 2.2 the identification of decision-making processes is based on existing decision-making literature from a behavioural economics perspective. In that section these constructs are explained. For easy reference they are again listed here:

Strategies: additive/linear, conjunctive/satisficing, additive difference, elimination-by-aspect, and weighted additive.

Tendencies: resolute maximiser, fearful maximiser, more ambitious satisficer, less ambitious satisficer, indolent minimiser, and parsimonious minimiser.

Effort-reducing methods: examining fewer attribute levels, reducing the difficulty associated with retrieving and storing attribute levels, simplifying the weighting principle for attribute levels, integrating less information, and examining fewer alternatives by reducing the choice set.

In this research another effort-reducing method was identified: sequential evaluation. When participants apply this method they make an evaluation resulting in the selection of one or two projects first and subsequently make another evaluation to select a third project. This is an effort-reducing method specific to portfolio-construction tasks as are presented in PVE surveys.

5.2. Sample characteristics

Appendix J presents tables with the reported socio-demographic characteristics and votes, as well as the responses to the case specific questions by participants. The sample captured in the process tracing study is composed mainly of young people in the age groups of 18-25 and 26-35, either studying or working, and two people within the 65+ age group, working. All participants were higher educated and almost all participants lived in the inner city of Delft, with two others living in the same neighbourhood which contains the campus. Regarding the votes the green party of GL dominates. The frequency of visits to the TU Delft campus varies quite a bit, but this is deemed to be due to the way in which the question was asked and this was subsequently changed for the variation experiment. Most participants use the bicycle as the main mode of daily transport and none of the participants use a car.

The sample captured in this study is hardly representative of the population of Delft. However, as indicated in chapter 3, capturing a representative sample was not the aim of this experiment. To a certain extent a homogeneous sample is useful because in that case identified differences in decision-making strategies can be linked to different decision-making tendencies instead of different personal backgrounds. It does, however, introduce limitations to the extent to which the outcomes of this research can be generalised.

5.3. Project selections

Projects 5 and 6, the Faraday projects, are clearly the most popular as these were selected most often and a clearly perceived synergy can be observed between these projects as 7 participants selected both. Each participant selected at least one Faraday project. These were followed by projects 3, 1, and 2, which were the Gelatine tunnel, Transferium, and Park&Bike, respectively. After that project 4, the A13 ramp, was not selected by any of the participants. However, this is not completely unexpected as it cost three quarters of the budget and therefore the same as projects 2, 3, and 6 combined. Also, it is a project mainly focused on car users and none of the respondents indicated that they use a car as their main mode of daily transport. Observing the totals shows that all participants selected 3 projects, apart from participant C.

5.4. Verbal protocol and action log

Apart from the quantitative and qualitative results as in normal PVEs, the conducted sessions resulted in verbal protocols of statements for each participant. These verbal protocols contain all statements of the participants from the moment they accessed the online tool's main screen until they finalised their selection, as described in section 3.2.

All in all 906 statements and 351 actions were recorded and table 5.1 shows the respective counts recorded per participant as well as the time spent on the project selection. As can be seen the total counts of statements per participant differ greatly as they range from 45 to 146. Similarly, the time spent differs greatly as the time spent on the project selection, which started when accessing the main page and ended when confirming the selection, ranges from six minutes up to 20 minutes. The graph shows that the number of statements and actions in relation to the time spent differs considerably.

Table 5.1: Process tracing, counts of statements and actions and time spent on selection per participant

Participant ID / Variable	A	B	C	D	E	F	G	H	I	J
Statements [count]	45	112	90	61	77	89	62	94	146	130
Actions [count]	33	19	44	23	34	29	26	40	67	36
Time [minutes]	6:14	11:58	13:15	6:23	8:55	12:31	6:01	7:11	12:14	21:05

In the following paragraphs the three steps related to information are discussed: participants accessing information, participants processing information, and participants considering information.

Accessing information

To be able to consider all information, all information must have been accessed. The counts of actions related to participants consulting the provided sources of information are presented in table 5.2. These relate to the main page, the project pages and its elements, and the comparison page for either all projects or a selection of projects.

Project pages: to access all information a participant must have accessed all project pages. Out of the ten participants, nine accessed all project pages. One participant did not access the project pages at all and instead only reviewed the main page and accessed the comparison page. This was due to this participant fully missing the option to access project pages, despite having watched the instruction video. Five other participants visited each project pages once and revisited a limited number of project pages. Four participants visited the project pages repeatedly.

Map: five participants interacted with the maps on the project pages to study the locations of the projects. As described above, one participant missed the project pages altogether and as such did not see the maps either. For the other four participants who did not interact with the maps the verbal protocol showed that they were familiar with the area and therefore understood the locations just by reading the titles and the descriptions.

Comparisons: nine participants made some sort of comparison, while one participant fully missed the comparison option. A comparison of all projects was made by four participants, indicating that the other five made a pre-selection of which projects to compare.

Table 5.2: Action log, counts of selected actions

Participant ID/ Action	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**Total**
7. Study main page	1	1	1	0	0	0	3	6	1	0	13
8. Visit project page	8	0	15	7	18	6	6	11	21	7	99
9. Zoom in or pan map	6	0	11	0	0	6	0	0	17	5	45
11. Compare all projects	0	1	3	0	0	1	0	0	0	3	8
12. Compare a selection of projects	2	2	1	1	2	1	0	3	8	0	20

Processing information

To see whether participants actively consulted the various pieces of information the percentages of statements within the information category are studied. This category is subdivided in seven types of information, as can be seen in table 5.3. These are project titles, descriptions, attributes, locations, costs, and types, as well as the budget. The total counts show that participants mentioned between 22 and 84 pieces of information.

Project titles: mentioned often and by all participants. This is as expected as it is the main piece of information, visible in each screen, and also used to refer to projects while thinking out loud.

Project descriptions: mentioned by all participants apart from one, who did not access the project pages at all. The participants who did mention the project descriptions mentioned these up to 6 or 7 times, which indicates that participants only consulted this information once for each project.

Project attributes: the count varies greatly with three participant only mentioning attributes 7 or 8 times, while others mentioned attributes 35 or 40 times. This indicates that the extent to which attributes are taken into account in making decisions differs greatly between participants.

Cost and budget: eight participants mentioned the cost of projects while nine made references to the available budget. Taken together each participant considered costs and budget at least at some point while performing the choice task. The verbal protocol showed that all participants strove to spend the entire budget.

Table 5.3: Verbal protocol, counts of statements within the main category of information processing

Participant ID/ Category	A	B	C	D	E	F	G	H	I	J	Total
Title	5	25	15	6	13	19	20	30	22	16	171
Description	6	0	6	6	7	6	5	4	7	2	49
Attribute	8	28	13	7	16	19	7	21	35	40	194
Location	2	2	6	0	0	7	2	3	9	5	36
Cost/budget	1	9	5	7	4	5	8	2	11	13	65
Total	22	64	45	26	40	56	42	60	84	76	515

Considering information

To identify to what extent participants took the information into consideration while making their decision the statement counts in the motivation category are studied. As described in section 3.2 the motivation category is subdivided into the categories applied in the Amsterdam transport investment scheme PVE (Mouter et al., 2019b), with the addition of motivations based on attribute values, the desire to spend the budget, the synergy of projects, and judgments without explanation.

Relevant to the question whether participants took the information of attribute values into account is the category of attribute values. Table 5.4 shows that the attribute values were mentioned most often as being the motivation towards selecting or not selecting projects. Only one participant did not indicate the attribute values as being a motivation.

The verbal protocol adds some nuance to this result as it showed that while six participants used their evaluation of attribute values as the main criterion, one participant did not use this at all. The remaining three participants used the attribute values to a limited extent or only to confirm their initial selection based on first instinct.

Table 5.4: Verbal protocol, statement counts within the main category of motivation

Participant ID/ Category	A	B	C	D	E	F	G	H	I	J	Total
Traditional goals	0	2	0	3	0	7	0	1	4	1	18
Closely related to traditional goals	1	0	0	4	0	3	2	1	0	0	11
Broader goals	0	10	2	5	8	2	3	2	2	2	36
Based on attribute values	2	7	3	3	4	5	0	6	10	7	47
Desire to spend budget	1	1	0	1	2	0	2	2	2	1	12
Synergy of projects	1	0	2	0	1	4	0	1	3	1	13
Other motivations	0	0	1	1	1	4	0	1	5	0	13
Judgement without explanation	3	0	0	1	3	0	1	3	1	0	12
Total count	8	20	8	18	19	25	8	17	27	12	162

5.5. Interpretation per participant

In this section the verbal protocols and action logs are interpreted per participant. This interpretation focuses on identifying the decision-making processes as described at the start of this chapter as well as determining whether participants considered the full choice set. These are identified simultaneously because reduction of choice sets is one of the effort-reducing methods.

Participant A

Participant A is classified as a less ambitious satisficer because no clear goal was formulated and a limited amount of time was spent with limited comparisons. An additive strategy was applied twice. He/she first composed a reduced choice set of similar projects (3, 5, and 6) for which the projects with the best attribute values were chosen. Then, another reduced choice set of similar projects (1 and 2) was evaluated and the project with the best attribute value was chosen. Participant A applied effort-reducing method of reducing the choice set by initially restricting the evaluated choice set to bridge and tunnel projects. Also, this means that the alternatives were evaluated sequentially.

Even though this participant applied the effort-reducing method of reducing the choice set, in the overall process all projects were considered and therefore the full choice set was considered.

Participant B

Participant B is classified as a more ambitious satisficer because a clear goal was formulated with higher standards in the form of wider considerations and significant time was spent on comparing the projects. An additive strategy was applied twice. First for all projects the travel time savings were added and the best three were identified (4, 5, and 6). Project 4 did not fit the budget, so another evaluation was made of the attribute values of the remaining projects. Participant B applied three effort-reducing methods, namely examining fewer attribute values, reducing the choice set, and sequential evaluation. Firstly, within the initial comparison only the TTS were used, not the number of users. Secondly, the participant initially restricted the evaluation based on projects being car or bicycle focused. And, thirdly, sequential evaluations were applied.

Even though this participant applied the effort-reducing method of reducing the choice set, in the overall process all projects were considered and therefore the full choice set was considered.

Participant C

Participant C is classified as a resolute maximiser as a clear goal was formulated and to achieve this each project was analysed in detail with broader implications. A desire for more information was expressed. This participant decided to not select a third project because of limited information and this is an indication of being thorough while not experiencing regret. An additive strategy was applied with an added consideration of cost by evaluating a cost-benefit ratio, which was best for Faraday projects 5 and 6. This participant only applied the sequential evaluation method.

This participant considered the full choice set.

Participant D

Participant D is classified as a less ambitious satisficer because all information was consulted once and no further time was spent on comparisons, apart from a confirmatory one with only the selected projects. An elimination-by-aspect strategy was applied. These aspects were not based on attribute values but on considerations of personal benefit, reduction of traffic-related burden, and equity considerations across different areas in Delft. After making the selection the selected projects were confirmed through a comparison of only those projects. By evaluating the projects based on other considerations information about attribute values was not fully integrated and therefore the participants applied effort-reducing method of integrating less information. With this, the participant applied the effort-reducing method of reducing the choice set.

By quickly dismissing projects this participant did not consider the full choice set.

Participant E

Participant E is classified as a less ambitious satisficer as all information was consulted and the choice came down to first instinct. The subsequent comparison of selected projects was purely confirmatory. An elimination-by-aspect strategy was applied. These aspects were based on substitution of car traffic

by bicycle or public transport and equity considerations across different groups of people. After making the selection the selected projects were confirmed through a comparison of only those projects and the discarded projects were reviewed individually. This participant applied effort-reducing methods 4 and 5. By evaluating the projects based on other considerations information about attribute values was not fully integrated and therefore the participants applied method 4. Also, by restricting the comparison to three projects after the initial review of the project pages this participant applied the effort-reducing method of reducing the choice set.

By quickly dismissing projects this participant did not consider the full choice set.

Participant F

Participant F is classified as a resolute maximiser as a clear goal was followed and significant time was spent on analysing the projects including wider considerations. Initially an additive strategy was applied with an added consideration of cost by evaluating a cost-benefit ratio. This resulted in Faraday projects 5 and 6. Subsequently the participant applied an elimination-by-aspect strategy based on a personal evaluation of feasibility of the projects. No effort-reducing methods could be identified for this participant.

This participant considered the full choice set.

Participant G

Participant G is classified as a less ambitious satisficer because all information was consulted once and no further time was spent on comparison. An elimination-by-aspect strategy was applied twice. First by eliminating car-focused projects 1 and 4, and secondly by eliminating not fully bicycle focused project 6 in a comparison between 5 and 6. This participant applied effort-reducing methods of integrating less information and reducing the choice set by considering other aspects than the attribute values and by focusing on bicycle projects.

By quickly dismissing projects this participant did not consider the full choice set.

Participant H

Participant H is classified as a more ambitious satisficer as a clear goal was formulated and time was spent on comparing the projects. Two strategies were applied. First an elimination-by-aspect strategy was applied based on whether projects targeted cyclists. Then an additive strategy was applied based on the number of users. This participant applied effort-reducing method 1 by only considering the number of users and disregarding the TTS.

This participant considered the full choice set.

Participant I

Participant I is classified as a fearful maximiser as no clear goal was formulated and the participant repeatedly searched for information and made many comparisons, expressing doubt at various moments. There seemed to be a desire to approach the choice task in a structured manner, but without a clear goal this resulted in a long process of comparing projects and revisiting project pages. No consistent strategy could be identified and also no effort-reducing methods could be identified.

This participant considered the full choice set.

Participant J

Participant J is classified as a fearful maximiser as the participant expressed a desire to apply an objective measure, but failed in the application because the initially applied strategy did not fit the available data. This resulted in a long process of making calculations based on the attribute values. Finally, a personal preference was assumed. The participant expressed doubt with regards to the conducted calculations and the outcomes. Also, the participant expressed a desire for more information. An additive strategy was applied with weights and the added consideration of cost by evaluating a cost-benefit ratio. For this participant no effort-reducing methods could be identified.

This participant considered the full choice set.

5.6. Identified decision-making processes

This section presents a summary of the identified decision-making processes based on the interpretation of the preceding section.

Observed strategies

Additive/linear: applied seven times by five participants (A, B, C, F, and H). Five applications were purely attribute focused and two applications focused on cost-benefit ratios.
Elimination-by-aspect: applied six times by five participants (D, E, F, G, and H), all based on a variety of non-attribute aspects. These aspects were: personal benefits, reduction of traffic related burdens, equity considerations, substitution of car traffic, equity considerations, perceived project feasibility, and whether projects were car or bicycle focused.
Weighted additive/linear: applied once using TTS by one participant (J).
Not classified: for one participant (I) the applied strategy could not be determined.
Conjunctive/satisficing: not applied.
Additive difference: not applied.

Interestingly, five participants applied a strategy twice, which meant that they first made a choice and subsequently made a new choice out of the remaining projects. This is related to the identified effort-reducing method of sequential evaluation, as described below. Out of these five participants two applied an additive/linear strategy twice (A & B), one applied the elimination-by-aspect strategy twice (G), one applied first an elimination-by-aspect strategy to reduce the choice set and subsequently applied an additive/linear strategy (H), and one applied first an additive/linear strategy to select two projects with the best cost-benefit ratio and subsequently used an elimination-by-aspect strategy for the remaining projects (F).

Of these strategies, the additive/linear strategies all made use of the attribute values, while those applying an elimination-by-aspect strategy made use of non-attribute aspects.

Observed effort-reducing methods

As described in section 5.1 an additional effort-reducing method was identified, which is specific to portfolio-construction tasks: sequential evaluation.

Examining fewer attributes: applied two times (participants B and H).
Integrating less information: applied three times (participants D, E, and G).
Reducing the choice set: applied four times (participants A, B, E, and G).
Sequential evaluation: applied three times (participants A, B, and C).
Participants who did not apply effort-reducing methods: three participants (F, I, and J).

Not all methods could be identified in this study. Method 2, reducing difficulty associated with retrieving/storing attribute values, seems to not be applicable as the attribute values are easily accessible and comparable within the online tool. Method 3, simplifying the weighting principle for attributes, is not applicable as only one participant applied a weighted additive strategy and the applied weighting principle was not difficult.

Identified tendencies

Resolute maximiser: two participants (participants C, F).
Fearful maximiser: two participants (participants I, J).
More ambitious satisficer: two participants (participants B, H).
Less ambitious satisficer: four participants (participants A, D, E, G).
Indolent minimiser: none.
Parsimonious minimiser: none.

Both maximising and satisficing tendencies were observed, but no minimising tendencies were identified in this study.

Identified interrelations

Participants C and F are classified as resolute maximisers, but they do not share a clear approach in terms of strategy or effort-reducing methods. Participants I and J are classified as fearful maximisers and for these no strategy and the, relatively complex, weighted additive strategy were identified. Also, both did not apply a effort-reduction method. Participants B and H are classified as more ambitious satisficers and both applied the effort-reduction method of examining fewer cues. Participants A, D, E, and G are classified as less ambitious satisficers and three of these participants are also linked to the elimination-by-aspect strategy and reducing the effort by integrating less information.

5.7. Conclusions

In this section the conclusions are drawn for the research sub-questions based on the results of the process tracing study as presented in the preceding sections.

Sub-question 1

In section 5.4 participants' patterns of accessing, processing, and considering of information were studied. This showed that nine out of ten participants accessed all information of each project, while one did not. This was because he/she did not discover the project pages in the online tool's interface, despite watching the instruction video.

The analysis of participants' processing of information showed that the titles were mentioned regularly and used to refer to projects, while the descriptions were mentioned only once by most participants. The attributes were mentioned very often, but the number of time per participant varied greatly. The cost and budget were mentioned by all participants, which is as expected as this was the constraint of the choice task.

The analysis of participants' motivations showed that for six participants the attribute values were the main factor considered in the project selection, while four participants mainly focused on other considerations. Only one participant made no reference to attribute values as a motivation.

Subsequent analysis of the decision-making processes showed that two and three participants applied the effort-reducing methods of examining fewer attributes and integrating less information, respectively.

Based on these results it is concluded that while participants strive to consult all information, half the participants chose to not take all information into consideration while making their decision. The interface of the online tool is of importance in this respect, because the interface caused one participant to not access all available information.

Sub-question 2

The verbal protocols showed that seven participants evaluated the full choice set, while three did not. The participants who did not evaluate the full choice set quickly discarded projects based on other considerations than the attribute levels. It seemed that the participants discarded these projects based on a very quick read of the project title and description.

Of the participants who evaluated the full choice set it was found that two made sequential evaluations of subsets of the choice set, instead of evaluating all projects at once.

Sub-question 3

Interpretation of the verbal protocol in section 5.5 showed that out of five decision-making strategies adopted from literature three were identified as being applied by participants. These were: additive/linear, elimination-by-aspect, and weighted additive. Of these, the (weighted) additive/linear strategies were all associated with a focus on the attribute values and the elimination-by-aspect strategies were associated with other impacts not related to attribute values. It was observed that half of the participants actually applied two strategies in the decision-making process. These could be the same strategy twice, or two separate distinct strategies.

Out of five effort-reducing methods adopted from literature three were identified in the analysis. These were: examining fewer attributes, integrating less information, and examining fewer alternatives.

Also, one additional method was identified for the PVE choice task specifically in which participant construct portfolios of multiple projects. With this method participants make a sequential choice instead of a simultaneous choice for the full portfolio. For seven participants one or more effort-reducing methods were identified.

Out of six decision-making tendencies four were identified in the analysis, namely resolute maximiser, fearful maximiser, more ambitious satisficer, and less ambitious satisficer. A variety in decision-making tendencies was observed, with two resolute maximisers, two fearful maximisers, two more ambitious satisficers, and four less ambitious satisficers.

5.8. Test of PVE survey

This study also served as a test of the PVE survey before it would be applied to the larger variation experiment. Overall, the PVE survey was well received by the respondents as all took the survey and choice task seriously. This section discusses first the reflection of participants on the survey by examining the responses to the Likert-scale statements as well as comments made by participants while completing the PVE survey. Then, the changes to the PVE survey are discussed and the usefulness of a process tracing study for testing a PVE survey is discussed.

Reflection of participants on survey

The responses to the five statements included in the survey are shown in appendix J. The responses show that almost all participants seem to be convinced of their choices in the research, but on whether they felt fully informed the opinions differ greatly. On the realism of the research most indicated that they agree. Regarding the usefulness of the outcomes most participants take a neutral position, with some agreeing. According to the responses to the last statement it would be considered good for the municipality to apply this method in this context.

Considering these responses it seems that even though participants indicate that they are convinced of their choices this does not mean that they feel fully informed. The perception with regards to the realism and thus usefulness of the research is between neutral and positive, judging by the responses to statements 3 and 4. Comments made by participants regarding the PVE, captured in the verbal protocol and presented in appendix K, show that this could be attributed to the limited amount of info and some attribute levels that were perceived as being unrealistically high.

Changes to PVE survey

Based on the test of the PVE survey in the process tracing study the following changes were made.

Projects: the frequency with which the different projects were selected was not very balanced, but this was as expected as the sample captured in this study was not very balanced. Also, it was apparent that several participants did consider the ramp seriously, however they did not choose it because of the high cost. In the variation experiment, the cost will vary and also participants with other socio-demographic backgrounds will participate and therefore the overall set of projects is retained. The description for project 3, the Gelatine bicycle tunnel, was changed to more clearly refer to the Gelatine bridge as a project that is already being realised.

Attributes: as discussed above, the travel time savings were perceived as being unrealistically high by some participants and therefore these were adjusted to be somewhat lower. Also, a possible increase in travel time (negative travel time savings) was included for projects 1 and 2 as these might result in more bicycles or cars around the campus. In line with this, the titles of the attributes were changed to *change in travel time* instead of *reduction in travel time* to prevent confusion with positive values indicating negative effects. Several participants missed the units of the attributes, as these were only visible when hovering the mouse indicator over the attribute title. Therefore, the attribute units were included within the attribute title. Several participants confused the attribute value related to the number of direct users with the number of people who would in general be impacted by the project. Therefore, the title of the attribute was changed from *number of users* to *number of direct users*.

Follow-up questions: appendix F presents the changes to the follow-up questions.

Survey pages: appendix I presents the texts included in the introduction, instruction, and debriefing pages.

6

Results variation experiment

This chapter first presents a short recap of the approach in section 6.1. Then, the participant recruitment and responses are presented in section 6.2. The analysis of the descriptive characteristics is presented in section 6.3 and the project counts are presented in section 6.4. The estimated choice model is presented and discussed in section 6.5. Section 6.6 discusses the responses of participants to the follow-up questions on the applied manipulation. Finally, the outcomes are summarised and discussed in section 6.7.

The overall results of the PVE survey, the associated qualitative results, and the resulting policy advice are discussed in appendix D.

6.1. Approach

As presented in section 3.3 the variation experiment was conducted to answer research sub-question 3: *Are participants indifferent to whether attribute levels are presented as a set of numbers with separate attribute titles, or as a set of short sentences that include the attribute titles?* Therefore, this chapter has the aim to investigate whether the choices made by participants differ when the attribute levels are presented in full sentences instead of as a single number. This was tested by distributing the PVE survey, as presented in chapter 4, with a manipulation on the presentation of attribute levels amongst participants. A short recap of the PVE survey and the manipulation are presented below.

PVE survey

In the PVE survey participants were asked to make a choice from six realistic projects within the municipality of Delft, as explained in chapter 4. These projects were: (1) a Transferium at Technopolis, (2) Park&Bike facilities around the campus, (3) the Gelatine bicycle tunnel under the train tracks, (4) a new ramp for the A13 highway at Technopolis, (5) the Faraday bridge over the river Schie, and (6) the Faraday bicycle tunnel under the train tracks. These projects were characterised by a cost, a description of one sentence and its location. Also, the projects' impacts were presented in five attributes, namely: (A) change in travel time for cars around the campus at peak times, (B) change in travel time per bicycle between Tanthof and Campus, (C) change in travel time per bicycle between Voorhof and Campus, (D) daily number of direct users on a bicycle, and (E) daily number of direct users in a car.

Manipulation

In this PVE survey a manipulation was applied with respect to presentation of the attribute levels. In line with the experimental setup of this experiment the attribute levels were either presented in a set of numbers with separate attribute titles, or as a set of short sentences that included the attribute titles. Screenshots of the two variants, referred to as quantitative and narrative, were presented in section 4.4.

6.2. Responses

The experiment was live over a period of just short of four weeks, starting on January 14th and ending on February 9th. The survey's target group were people who lived, worked, and/or studied in the municipality of Delft as the content was relevant to them. The promotion and distribution of the link was executed as described in section 3.3.

In total, 169 valid responses were recorded. These responses were balanced between the two variants as 85 and 84 valid responses were recorded for the narrative and quantitative variant, respectively. Clicks of the link could be tracked and over the live period the link had 450 unique visits in total. About 15 of those clicks could be linked to one day in which the *rebrand.ly* server seemed to be partly offline and access was checked through a website accessibility test that accessed the link from several countries. Also, it is indicated that 32% of clicks originated from mobile devices, which was to be expected because the link was distributed through online channels such as Facebook, LinkedIn, and direct WhatsApp messages. Because respondents were asked to complete the survey on a laptop or personal computer these clicks should not have resulted in an attempt to complete the survey. As such, it is estimated that the survey had up to 290 unique visitors with a laptop or personal computer. With that, 121 unique visitors are estimated to have accessed the survey but subsequently decided not to complete it. This leads to an estimated success rate of 58%.

6.3. Descriptive results

This section presents and discusses the socio-demographic characteristics of the respondents as well as their answers to the case-specific questions.

Socio-demographic characteristics

Table 6.1 presents the SDCs of gender, age, education level, and current situation as well as the reported votes. The reported genders show an overrepresentation of male participants within the sample with approximately two-thirds of participants being male and one-third being female. In the municipality of Delft the proportion is 53.2% versus 46.8%, respectively (Gemeente Delft, 2019a). The reported ages show a very high overrepresentation of relatively young people with only a handful of respondents reporting an age over 36 years old. Within the SDC of education level higher education is extremely overrepresented with only four participants reporting a vocational education and five missing answers. The current situations reported by participants are about two-thirds students and one-third working or other situations. The overrepresentation of young and studying males was to be expected because the recruitment process was mostly successful among students of the Delft University of Technology and at this university the proportion of male and female students is 72% versus 28%, respectively (TU Delft, 2019).

Considering the reported votes it is apparent that, within the part of the sample that had and used the right to vote within the municipal elections, the parties of GL, STIP, D66, and VVD are overrepresented when compared to the outcomes of that election (Griffie Delft, 2018). These are green, student, social-liberal, and conservative-liberal parties, respectively. The populist local parties of Onafhankelijk Delft and Stadsbelangen Delft are not represented in the sample, while the socialist (SP), labour (PvdA) and Christian parties (CDA and CU) are hardly represented.

When comparing the samples captured by the two variants it can be concluded that these are highly comparable, which is beneficial for the subsequent analysis because in that case observed differences can be attributed to the variation that was applied.

Table 6.1: Variation experiment, reported socio-demographic characteristics. N = 85 and N = 84 for the narrative and quantitative variant, respectively.

	Narrative	Quantitative		Narrative	Quantitative
Gender			**Vote**		
Male	65.9%	63.1%	I was not eligible to vote	15.3%	15.5%
Female	32.9%	28.6%	GL (green party)	22.4%	14.3%
Prefer not to say	0.0%	2.4%	STIP (student party)	28.2%	25.0%
NA	1.2%	6.0%	D66 (social-liberal)	18.8%	15.5%
			Onafhankelijk Delft (local)	0.0%	0.0%
Age group			VVD (conservative-liberal)	8.2%	10.7%
18 - 25 years	65.9%	59.5%	CDA (christian)	3.5%	0.0%
26 - 35 years	23.5%	17.9%	SP (socialist)	0.0%	1.2%
36 - 45 years	1.2%	3.6%	PvdA (labour)	0.0%	1.2%
46 - 55 years	1.2%	6.0%	CU (christian)	0.0%	3.6%
56 - 64 years	7.1%	4.8%	Stadsbelangen Delft (local)	0.0%	1.2%
65 years or older	0.0%	2.4%	I did not vote	1.2%	2.4%
Prefer not to say	0.0%	1.2%	Prefer not to say	1.2%	4.8%
NA	1.2%	4.8%	NA	1.2%	4.8%
Situation			**Education**		
Studying	60.0%	59.5%	Higher education	96.5%	92.9%
Working > 32 hours	27.1%	17.9%	Vocational education	2.4%	2.4%
Working 16 to 32 hours	5.9%	7.1%	Middle education	0.0%	0.0%
Working < 16 hours	1.2%	3.6%	Lower education	0.0%	0.0%
No job, but searching	1.2%	2.4%	Prefer not to say	0.0%	0.0%
I am retired	1.2%	2.4%	NA	1.2%	4.8%
Other	1.2%	1.2%			
NA	2.4%	6.0%			

Case specific questions

Table 6.2 shows the responses to the case specific questions regarding the frequency of visits to the Delft University of Technology and the main daily mode of transport. In line with expectations due to the large number of students most participants report daily visits to the university and the bicycle as the most used daily mode of transport.

6.4. Project counts

Project counts

Figure 6.1 displays the number of times each project was selected in both variants. In total 225 projects were selected in the narrative variant and 231 projects in the quantitative variant. The Gelatine bridge and Faraday bridge projects have been selected most often and the Faraday tunnel follows as third. Then the Transferium project ranks as fourth and the Park&Bike and A13 ramp projects have a comparable score in last place. Between the two variants the project counts do not differ to a great extent,

Table 6.2: Variation experiment, responses to case specific questions. N = 85 and N = 84 for the narrative and quantitative variant, respectively.

Frequency of visits to TU Delft	Narrative	Quantitative	Most used travel mode	Narrative	Quantitative
Daily	69.4%	67.9%	Bicycle	78.8%	79.8%
Weekly	8.2%	16.7%	Car	8.2%	9.5%
Monthly	8.2%	6.0%	Train	8.2%	6.0%
Yearly	4.7%	1.2%	Bus, tram or metro	0.0%	0.0%
(Almost) never	7.1%	3.6%	Walking	2.4%	0.0%
NA	2.4%	4.8%	Other	1.2%	0.0%
			NA	1.2%	4.8%

with the counts for five out of six projects differing with a maximum of four. The only difference that can be observed is the selection of the Faraday tunnel with a difference of 9.

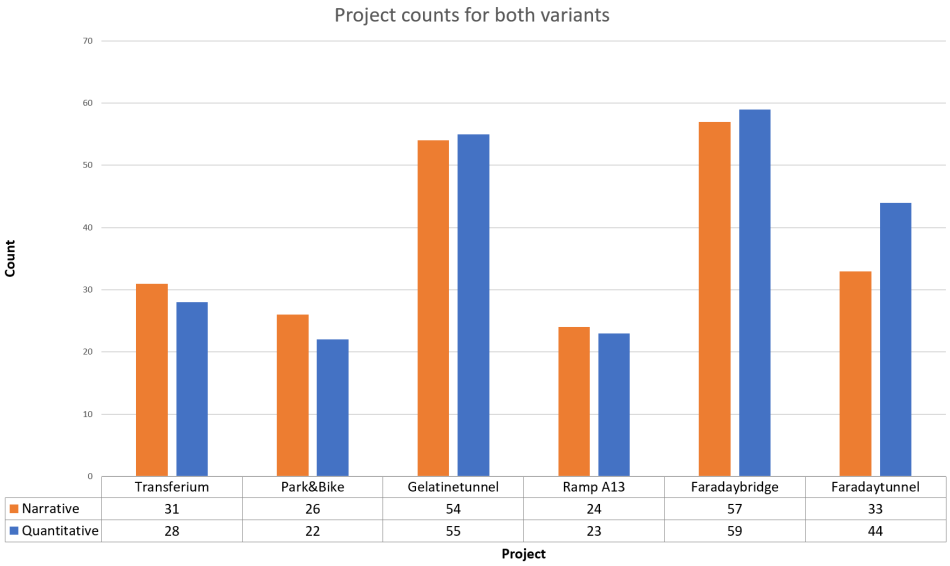

Figure 6.1: Variation experiment, counts of selected projects per variant

Chi-square tests

As explained in section 3.3 Chi-square tests were performed. These tests give an indication whether there is a statistically significant difference between the actual frequency and expected frequency, based on the overall frequency, with which a project was chosen. This resulted in the values as presented in table 6.3.

The table shows that the null hypothesis of no relation between the variation and the various projects cannot be rejected at a 95% confidence level as all significance levels are higher that 0.05. This is very clear for the first five projects as the significance levels range between 0.526 and 0.901, but for project 6 it is 0.077. Therefore, if a 90% confidence level is adopted the hypothesis can actually be rejected.

Table 6.3: Variation experiment, results of Pearson's Chi-square test of variation versus project selection frequencies (1 degree of freedom)

	Chi-square	Significance
Project 1	0.183	0.669
Project 2	0.402	0.526
Project 3	0.070	0.791
Project 4	0.015	0.901
Project 5	0.198	0.656
Project 6	3.131	0.077

Number of projects selected

Table 6.4 presents the number of times that participants selected a certain number of projects. Most participants selected 3 or 2 projects, while only a handful selected 4 or 1 project(s) and none selected no project at all. It must be noted that selecting four projects was not a possibility for all participants due to the varying cost attribute levels.

6.5. Choice modelling

As explained in section 3.3, a MNL choice model was estimated using a simplified version of the Bahamonde-Birke methodology. This choice model estimated project specific constants (PSCs) and

Table 6.4: Number of projects selected by participants per variant.

Number of projects	**Number of respondents** Narrative	Quantitative
4	2	5
3	51	55
2	32	22
1	0	2
0	0	0

taste parameters related to the attribute levels. The choice model estimation relies on the different treatment combinations of attribute levels. Appendix L presents an overview of the counts with which the 15 treatment combinations were encountered by participants.

First estimation

The first estimation of the choice model included separate taste parameters for attributes B and C, which corresponded to the change in travel time savings for cyclists from two different neighbourhoods. These were combined into one parameter for the second estimation as their estimated values were similar and of a low magnitude, while the attributes measure roughly the same impact. Also, a taste parameter was estimated related to the marginal utility assigned to not spending budget. For the second estimation this parameter was taken out because it interacted in an unexpected manner with the PSCs (Hernández, personal communication February 21st 2020). The initial estimation is presented in appendix L.

Second estimation

The results of the second model estimation are presented in table 6.5. Within this table the parameters that were found to be significant at a 95% confidence level with a t-value of 1.96 or higher are indicated with two asterisks and those at a 90% confidence level with a t-value of 1.645 or higher are indicated with one asterisk.

Table 6.5: Variation experiment, resulting MNL choice model estimation using the Bahamonde-Birke methodology. Indicated with one asterisk and two asterisks are the parameters that are significantly different from zero at confidence levels of 90% (t-value 1.645 or higher) and 95% (t-value 1.96 or higher), respectively.

		Narrative		**Quantitative**	
N	Observations		85		84
Parameter	Project/attribute	Estimate	t-value	Estimate	t-value
0-LL		-266.5		-252.7	
Final-LL		-243.1		-217.5	
ρ^2		0.088		0.140	
PSC_1 (fixed)	1 - Transferium	0.00	-	0.00	-
PSC_2	2 - Park&Bike	-0.19	-0.53	0.019	0.05
PSC_3	3 - Gelatine tunnel	0.76	1.31	1.59**	2.68
PSC_4	4 - Ramp A13	1.74*	1.77	3.52**	3.32
PSC_5	5 - Faraday bridge	-0.67	-0.56	1.18	0.94
PSC_6	6 - Faraday tunnel	-1.94	-1.44	0.19	0.15
β_{X_A}	A - Change in travel time car	-0.92**	-2.51	-1.56**	-4.07
$\beta_{X_{BC}}$	B & C - Change in travel time bicycles	-0.27	-0.65	-0.40	-0.91
β_{X_D}	D - Number of direct bicycle users	2.62*	1.87	0.91	0.66
β_{X_E}	E - Number of direct car users	-0.69	-0.57	-2.57*	-1.92

Check of taste parameter signs

The first step of consulting this table is to check the signs of the taste parameters related to the attributes and verify that these are as expected[1] For both variants the signs of the estimated taste parameters have the same sign. The parameters for the change in travel time of car users (A) are negative, which is as expected. The parameters for the change in travel time of cyclists (B/C) are also negative, as expected. The parameters related to the number of direct bicycle users (D) are expected to be positive and they are. The parameter related to the number of direct car users (E) is negative, which is as expected.

The performed check shows that the estimated parameters do not have any unexpected signs for both variants. This is an indication that participants took the attribute values into account while making their decision.

Model fit and significant parameters

The estimated ρ^2 values show that the estimated model fits the data for the quantitative variant better than for the narrative variant. This is reflected by the significant parameters for both variants. For the narrative variant only one taste parameter is significant at a 95% confidence level while one project specific parameter and one taste parameter are significant at a 90% confidence level. Meanwhile, the quantitative data set the model is able to estimate one taste parameters and two project specific parameters at a 95% confidence level, and one taste parameter at a 90% confidence level.

The better model fit and higher number of significant taste parameters indicates that for the narrative variant the project selections for the quantitative variant were more homogeneous and consistent and that the attribute levels were taken into account by participants to a bigger extent, compared to the narrative variant.

6.6. Reflection on manipulation

In the questionnaire participants were asked to reflect on the manipulation by indicating what attributes they considered most and least important, and to indicate to what extent they incorporated the attribute levels in their decision. The responses to both are discussed in this section.

Attributes considered most and least important

Table 6.6 shows what attributes participants considered most and least important for both variants. The attribute that is considered most important in both variants is by far the number of daily bicycle users, attribute D, with around 50%. Cost follows second with about 20%. Between the two variants no large differences are observed.

However, for the attribute that participants indicated as being least important differences are observed between the two variants. The attributes related to travel time for car users and the number of car users (A and E) were chosen more often by participants of the quantitative variant. The attributes related to travel time for cyclists from both the Tanthof and Voorhof neighbourhoods were chosen more often by participants of the narrative variant.

This indicates that for the narrative variant participants considered car users as being more important while the quantitative variant considered cyclists as more important.

Statement on consideration of attributes

Figure 6.2 shows the responses to Likert-scale statement 5 for both variants. Statement 5, *I used the information on travel time and the number of direct users while making my decision*, asked the participants to reflect on the manipulation. This shows that the extent to which participants reported to use the attribute values varies, with participants for the narrative variant choosing (fully) agree more often than those for the quantitative variant.

[1] For the attributes related to changes in travel time, which are A and B/C, a negative value constitutes a positive experience for the car or bicycle user. Therefore, a negative value of the parameter relates to more negative values and thus travel time savings being valued by participants.

Table 6.6: Variation experiment, attributes considered most and least important by respondents. N = 85 and N = 84 for the narrative and quantitative variant, respectively.

Variant / attribute	**Cost**	**A**	**B**	**C**	**D**	**E**	**NA**
	Attribute considered most important						
Narrative	22.4%	7.1%	2.4%	7.1%	49.4%	8.2%	3.5%
Quantitative	16.7%	13.1%	6.0%	8.3%	47.6%	3.6%	4.8%
	Attribute considered least important						
Narrative	11.8%	31.8%	20.0%	17.6%	5.9%	8.2%	4.7%
Quantitative	11.9%	38.1%	11.9%	8.3%	6.0%	16.7%	7.1%

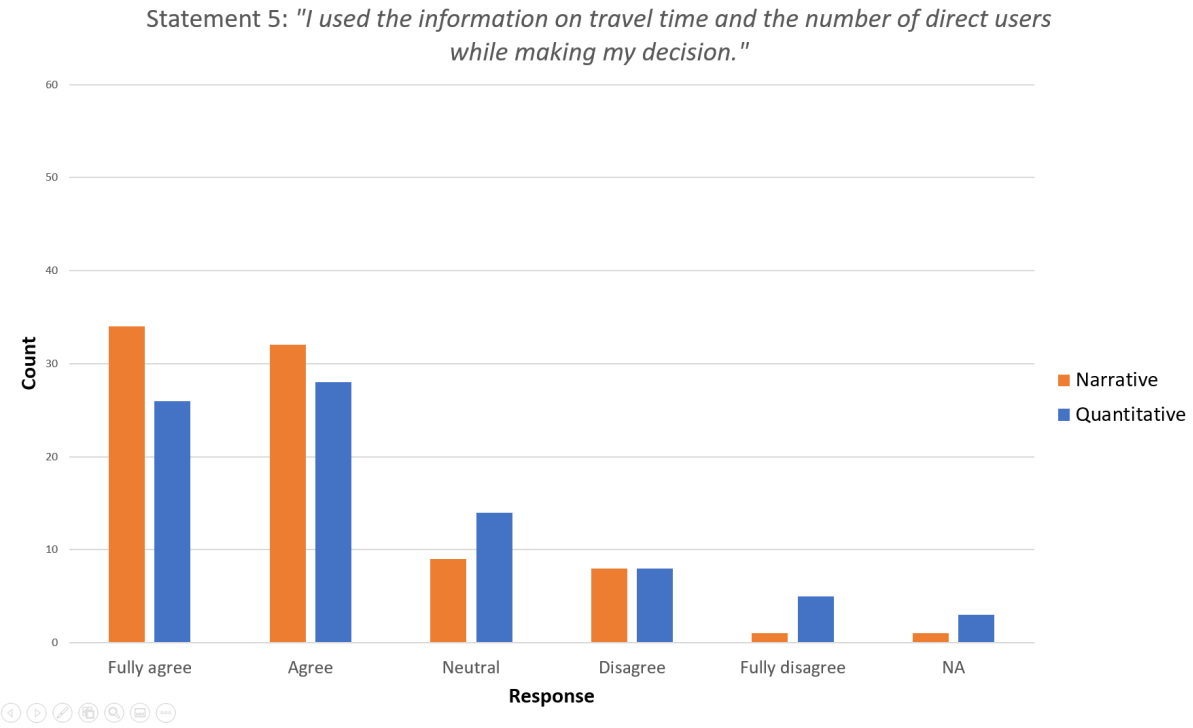

Figure 6.2: Likert-scale, responses to statement 5 with which participants reflected on the manipulation

6.7. Conclusions

The comparison of the characteristics of the samples captured by both variants showed that the samples are highly similar. This means that observed differences or similarities between the two variants should be attributable to the applied manipulation. Also, for both variants the number of projects that were selected in total were highly similar.

As was shown in figure 6.1 the difference in project counts between the two variants related to project 6 were selected less often and the three car-focused projects of 1, 2, and 4 being selected slightly more often. This is confirmed by the Pearson's Chi-square tests that were performed as these showed that there was a relation between the variation and the count of project 6, at a 90% confidence level.

The response to the Likert-scale manipulation reflection statement 5 *"I used the information on travel time and the number of direct users while making my decision"*, shown in 6.2, shows that participants who encountered the narrative variant used the attribute levels to a greater extent than the participants of the quantitative variant.

The responses to the question as to what attribute was considered least important by participants showed a difference between the two variants. The participants who were presented the attributes in a narrative form indicated more often that they considered the attributes related to travel time of cyclists from both neighbourhoods as least important.

The estimated MNL models showed that for the quantitative variant the model fit was higher and

more taste parameters were significant than for the narrative variant. This indicates that the attribute levels were taken into account more when presented as a set of numbers than if presented as a set of sentences. However, this contradicts the responses to statement 5, as discussed above.

Because of this contradiction, the percentages of motivation statements referring specifically to the attribute values were checked. These show that for the narrative variant 12.5% of the statements referred specifically to the attribute values, compared to 12.9% for the quantitative variant. Also, a check of the time spent on the information pages and project selection shows that for the narrative variant this was on average 12:06 minutes and for the quantitative variant this was 11:45 minutes. Both are highly similar and do not indicate a difference in how participants approached the survey.

The contradicting results show that participants reported that they perceived the attribute values as being more important when presented in a narrative form, while the estimated MNL model indicates that for the quantitative variant the attribute levels were taken into account to a greater extent. It is theorised that participants perceive the attribute levels as being more important when these are presented in a narrative, but that in the quantitative variant the comparison of attribute levels is easier and as a result had a greater impact on the outcomes.

7

Conclusions

This chapter presents the conclusions of the research by addressing the research questions. First, the research sub-questions are revisited in section 7.1 and subsequently the main research question is addressed in section 7.2. The limitations of this research are discussed in section 7.3.

7.1. Revisiting research sub-questions

This section presents the conclusions for the four sub-questions that were defined in chapter 1. These were based on the assumptions of the theory of perfect rationality and utility maximisation, which posit that a participant: (1) has complete knowledge of the choice task and its project alternatives, (2) has clear preferences using which to evaluate the project alternatives and attributes, (3) is able to optimise, (4) is indifferent to theoretically equivalent information, and (5) takes all project alternatives into consideration. The sub-questions and their conclusions are presented below.

Sub-questions 1, 2, and 3 were addressed by performing a process tracing study with 10 participants, the results of which are presented in chapter 5. Sub-question 4 was addressed by executing a variation experiment with a manipulation in information presentation in the PVE survey. This PVE survey was completed by 169 participants in total, of which 85 were presented the narrative variant and 84 were presented the quantitative variant. The results are presented in chapter 6.

Both the process tracing study and the variation experiment applied a specific context, fixed budget PVE survey of medium complexity. The realistic PVE survey had the municipality of Delft as context and presented participants with six infrastructural projects. The participants were asked to assemble a portfolio of projects that fitted within the available budget, thereby asking them to perform a portfolio-construction task. The impacts of each project were communicated through five attributes. The PVE survey is described in detail in chapter 4.

The overall results of the PVE survey and the resulting policy advice are presented in appendix D.

1. To what extent do participants take all information that is provided in a PVE survey into consideration while making their decision?

The process tracings study showed that all participants intended to access and consult all available information. Nine out of ten participants were successful in this and accessed and consulted all available information. However, the verbal protocols showed that only six out of ten participants took all information into consideration while making their decision.

Therefore, it is concluded that in the complex environment of a PVE survey participants are likely to access and consult all available information, but half of the participants were only considering part of the available information.

Of the different forms of information, the titles were consulted and considered by all participants. The descriptions were only consulted once by most participants. Whether the attributes were taken into consideration to a large extent differed greatly between participants. Cost and budget were considered by all participants, and the cost was used to determine cost-benefit ratios by various participants.

The importance of the online tool's interface is highlighted by the one participant who did not access the project pages because he/she was unaware that these existed, despite watching the instruction video. Also, another participant expressed the expectation that the comparison page would present a complete overview of all available information. When considering that participants were completing this PVE survey under supervision of the researcher it can be expected that participant made a greater effort to browse through the online tool's pages than they would have if they completed the survey at their own convenience. This shows that the design of the user interface and guidance of users is instrumental in facilitating participants to access and consult all available information.

2. To what extent do participants evaluate the full choice set of project alternatives in a PVE survey?

The process tracing study showed that seven out of ten participants made an evaluation of the full choice set of project alternatives. The three other participants quickly discarded projects, seemingly based on instinct and not on the provided information. This shows that information on preferences of participants is not captured in the current PVE methodology.

An interesting finding that is specific for the portfolio-construction task of PVE surveys was that participants made partial and sequential evaluations of choice sets. This means that participants, in an attempt to reduce the task complexity, first make an evaluation of a subset of projects from which they select one or two projects. Subsequently, they make another evaluation of the projects that remain within budget. This is actually facilitated by the online tool's interface through the comparison page, for which participants have to toggle the projects for which they want to compare the attribute levels. Therefore, some participants make an evaluation of the full choice set by considering two subsets of projects separately

Some participants were found to select projects quickly by first instinct and make a comparison of just those projects. Subsequently, they made a comparison of only the projects that remained. By not making a comparison of all projects, this seemed to only serve to confirm the first instinct.

3. What decision-making processes are applied by participants while making their decision?

The process tracing study showed that participants applied three decision-making strategies: additive/linear, elimination-by-aspect, and weighted additive. Four effort-reducing methods were identified: examining fewer attributes, integrating less information, examining fewer alternatives, and sequential choices. This last method was identified in this research and applies to the portfolio-construction task specifically. Four decision-making tendencies were identified: resolute maximiser, fearful maximiser, more ambitious satisficer, and less ambitious satisficer.

The strategies that were not identified were: conjunctive/satisficing and additive difference. This indicates that participants did not establish minimum levels against which to check the attribute levels and that the additive difference is not applicable to complex choice task environments such as in PVE. The effort-reducing methods that were not applied were: reducing the difficulty associated with retrieving and storing attribute values and simplifying the weighting principle for attribute values. Both were as expected because the comparison of attribute values is facilitated in the PVE's online tool with the comparison screen and weighting was not applied by nine out of ten participants. No minimising tendencies were identified as all participants took the survey seriously and were willing to apply effort to some extent to consult and process the available information.

It is concluded that participants who complete a PVE survey tend to either focus on the attribute levels or on other aspects of project alternatives. The former is associated with (weighted) additive/linear strategies, while the latter is associated with elimination-by-aspect strategies. However, participants might adopt both strategies by using one strategy to reduce the choice set and using another to evaluate the remaining projects, or applying the same strategy twice. This is one of the effort-reducing methods that were identified as participant were observed to not take into account specific attributes, ignoring part of the provided information, or swiftly reducing the choice set by discarding projects. Additionally, another effort-reducing method was identified that was specific to the portfolio-construction task presented in PVE surveys in which participants chose to make a sequential choice instead of a simultaneous choice for the full portfolio. Not all participants were observed to apply effort-reducing methods as three out of ten participants based, or tried to base, their selection on all available information, which

was still possible with the relatively low level of complexity of the applied PVE survey.

The tendencies could be linked to a different approach to the choice task as presented in PVEs: resolute maximisers approach a PVE with an open but critical mindset, they have a clear goal and try to be fully informed on the projects. They could not be directly linked to a specific strategy or effort-reducing method. Fearful maximisers lack a clear goal and consult information in an unstructured manner. They did not reduce the complexity of the choice task by applying an effort-reducing method. More ambitious satisficers approach the PVE with an open mind without being too critical. They do not try to be fully informed and apply the effort-reducing method of examining fewer attributes by focusing on specific aspects. Less ambitious satisficers approach the PVE with a closed mind and project their own ideas onto the projects. They apply the effort-reducing method of integrating less information and this seems to be linked to the elimination-by-aspect strategy.

4. Are participants indifferent to whether attribute levels are presented as a set of numbers with separate attribute titles, or as a set of short sentences that include the attribute titles?

For the quantitative variant the MNL choice model estimation resulted in a better model fit and a higher number of significant taste parameters than for the narrative variant. This indicates that participants who were presented the attribute levels in a set of numbers made their decision based on the attribute values to a greater extent than the participants who were presented the attributes in a narrative. However, the responses to the follow-up questions in which participants reflected on the applied manipulation show that participants for the narrative variant incorporated the attribute levels in their decision more than the participants for the quantitative variant.

It is theorised that participants for the narrative variant perceived the attribute levels as being more important after completing the survey, but that while performing the choice task the direct comparison of attribute levels was easier with the quantitative variant. This could explain the contradiction between the responses to the manipulation questions and the MNL choice model estimation.

When regarding the project counts, the overall impact of the manipulation was found to be fairly limited. The Chi-square values showed that no relationship existed between the variation and the project counts, other than for project 6 at a 90% confidence level. Within the complex environment with different pieces of information across six projects the impact of the presentation of attribute levels in either a quantitative or narrative form does not have a large impact.

7.2. Revisiting main research question

To what extent do participants of a Participatory Value Evaluation survey make their decision in a rational and utility maximising manner?

For the medium complex PVE survey with six projects and five attributes that participants were presented in this research, the assumption that participants have complete knowledge of the choice task and the project alternatives was valid for the majority of participants because almost all participants accessed and consulted all available information.

The assumptions that participants are able to optimise using clear preferences with which to evaluate the project alternatives and attributes seem to be valid to a limited extent. Participants expressed preferences on broader aspects such as a project being bicycle or car-oriented, or a project being perceived as environmentally friendly. And with that participants adopted simple approaches without weighting procedures for the attribute levels to incorporate their preferences in a computation, apart from one participant. The preferences of participants mostly manifested themselves in elimination-by-aspect strategies in which, for example, projects were discarded that were car-oriented or perceived as being environmentally unfriendly.

The assumption that participants are indifferent to theoretically equivalent information was determined to be valid to a limited extent for the specific case of presenting attribute levels as a set of quantitative numbers with separate attribute titles or as a set of short narrative sentences including the attribute title. The outcomes for the two variants differed to a limited extent. Within the complex environment of the online tool of a PVE survey the presentation of a narrative was found to positively impact the perceived importance of the attribute levels, but the estimated choice model showed that the choices were more consistent and based on the attribute levels when these were presented in a

quantitative manner. It is theorised that this is due to the complexity of the environment and the inclusion of other consideration than just the attribute levels by participants, which reduces the impact of variations in presentation.

The assumption that participants take all project alternative into consideration is found to be valid to a limited extent as the majority of participants considered the full choice set, but several participants were found to quickly dismiss projects on first instinct.

Overall, four participants in the process tracing study were found to approach the PVE survey in a rational and utility maximising manner while the remaining six did not.

To what extent participants act in a rational and utility maximising manner could be linked to decision-making tendencies, which are an indication for the extent to which participants consult the available information, apply decision-making strategies, and apply effort-reducing methods. The tendencies are an indication of the overall approaches participants adopt for the PVE survey. Resolute maximisers and more ambitious satisficers were found to act in a manner approaching rational and utility maximising decision-making. Less ambitious satisficers were found to act differently because they were not interested in considering all information and easily made quick decisions based on first instinct. Fearful maximisers are difficult to categorise, with one participant not applying any strategy nor any effort-reducing method and another participant applying an approach closest to rational and utility maximising by applying a weighted additive strategy.

7.3. Limitations

Process tracing study

The act of verbalising thoughts in think aloud studies might influence the thought processes of participants and are known to either increase the cognitive load or actually serve to structure these thought processes. This was discussed in section 2.2. Also, the sample captured in the process tracing study was very limited with only 10 highly educated participants. As a result of these aspects generalising the results to how participants in general approach a PVE survey is problematic, but it does give valid indications towards the improvement of PVE surveys.

Variation experiment

The sample captured in the variation experiment was somewhat large, but heavily tilted towards young studying males and almost purely daily bicycle users. Voting behaviour was also quite specific with many GL, STIP, D66 and VVD voters. The policy advice that is provided to the municipality includes a disclaimer on the limited degree of representation of the overall population in the sample.

Also, the hypothetical character of the PVE survey limits the applicability of the results to the current situation in Delft and overall generalisation because several aspects of the study might not have been realistic, such as the budget and the attribute values.

With the structural approach that was adopted in the variation experiment, drawing conclusions was difficult due to contradicting results and a lack of insight into the process with which participants reached their decision.

8

Discussion & future research

This chapter presents a discussion of the performed research, the PVE methodology, and the applied methodologies for studying decision-making. The research and its implications are discussed from the viewpoints of decision-making research and stakeholders in sections 8.3 and 8.4. Recommendations for future research are presented in section 8.5 and, finally, practical suggestions for PVE methodology are discussed in section 8.6.

8.1. Main takeaways

This research showed that the assumptions underlying the choice modelling done in PVE are for the most part valid in the case of PVE surveys of medium complexity. However, not all preferences of participants are captured in a PVE survey because part of the participants reduce the choice set quickly. Such a specific dislike for a project that is not based on attribute levels or a full consideration of the project is not captured in the current PVE methodology. Also, some participants were found to ignore specific attribute levels, attributes in general, or other parts of the provided information. Currently, there is an incentive to disregard projects because participants have to actively include projects in a comparison.

Knowing what you intend to measure and presenting the PVE survey accordingly seems to be important. The choice task instruction seemed to be a cause for confusion because participants mused about basing their decision on the provided attribute levels, their own interpretation of projects and their impacts, personal benefits, or other aspects.

This research showed that there is room for improvement for PVE methodology as well as its online tool design. These are discussed in further detail below.

8.2. Reflection on research

Perceptions of participants

The final question in the follow-up questions was a request for participants to provide any remark or point of feedback that they wished to share. Just as with the motivations these were coded in two rounds, one to identify categories and another to assign the statements to these categories. In total 221 statements were recorded and an overview of the categories that they were assigned to is shown in appendix N.

During the process tracing study and in the remarks at the end of the PVE applied in the variation experiment participants made comments on the PVE methodology. Some participants asked for sources on the provided information and many participants indicated that wanted more info or that they wanted illustrations and visualisations, while several participants indicated that the task was too complex. This is a difficult balance to strike. In the case of this research some projects had synergy and would be expected to have a greater impact when combined, but this was not reflected in the presented attribute values. Several remarks mentioned a desire to have a kind of interactive tool where combinations of projects would result in specific impacts.

Regarding the motivations, one participant of the process tracing study indicated that he/she made

a choice for a portfolio, not individual projects. Also within the motivations in the variation experiment several participants submitted the exact same text for different projects, which is an indication that these participants chose a portfolio instead of a set of distinct projects.

Testing of PVE surveys

For further development of the PVE methodology with regards to innovative ways of information provision or iterations on the online tool this research provides clear indications that such innovations should be tested thoroughly before these should be rolled out. The complexity of the current PVE method might already be too much for participants to fully grasp. However, at the same time participants indicate that they would want to have more information on projects or interactive ways of impact presentation. Niek Mouter (personal communication, February 18th 2020) already floated the idea of having participants choose between different levels of complexity and thereby facilitate different participants' wishes. This does answer a need voiced by participants, but care should be taken to ensure that everyone to some extent makes their decision based on the same information.

For the design of the PVE survey that was applied in this research the process tracing study was very helpful in understanding how participants, who were not familiar with the PVE methodology, perceive the information and interact with the interface. This helped greatly in establishing a clear and complete PVE survey that could be applied in the variation experiment. Therefore, for conducting test runs with PVE surveys the application of a small scale process tracing study would be recommended before proceeding to a larger scale distribution.

Recruitment of participants

Recruiting a large group of participants proved to be difficult as the final number of participants was lower than initially hoped and the period in which the variation experiment was live was longer than planned. Eventually, the recruitment leaned heavily on the personal network of the researcher and this situation is far from ideal as it creates a sample in which a specific group is overrepresented.

A specific feature that seemed to put people off and cause them to not complete the survey was the large amount of text that was included in the introduction pages. Also, the inability for participants to complete the survey on a mobile device was probably a reason for people to not go through with completing the survey after initially accessing it on their mobile device.

8.3. Decision-making research

Behavioural economics - process approach

This research provides a empirical example of the strategies, tendencies, and effort-reducing methods that were identified in section 2.3 and discussed in chapters 5 and 7. Within the category of effort-reducing methods an additional method was identified which is applicable specifically to portfolio-construction tasks. Also, this research shows that within complex choice tasks such as a PVE survey participants might adopt strategies multiple times or even mix strategies while completing the same choice task. The tendencies helped to link information search, strategies and effort-reducing methods to the overall approach that participants adopted for the PVE survey.

Also, this research provides empirical evidence for the theory of cognitive misers, introduced in section 2.3 and part of the behavioural economics paradigm, which says that people are not able to, or not willing, to process all available information. This was clearly demonstrated in the process tracing study, together with the heuristics and their underlying effort-reducing methods that participants applied.

All participants read the texts in the introductory pages fully. A check to see to what extent the provided information was processed and remembered was to check whether participants identified the synergy between the Gelatine projects. This showed that only four participants identified that synergy and even of those four two participants seemed to have subsequently forgotten that synergy. This can be regarded as an indication that the participants experienced information overload, which fits with the bounded rationality paradigm that says that participants apply or possess limited cognitive abilities.

Neoclassical economics - structural approach

The assumptions of perfect rationality and utility maximisation were found to be valid to a limited extent for complex portfolio-construction tasks as presented in PVE surveys.

This research showed that different forms of attribute level presentation resulted in a limited impact on the outcomes, which fits with the assumption of indifference to difference presentations of theoretically equivalent information. This finding is applicable to portfolio-construction tasks in a complex environment in which participants are likely to take broader aspects into account while making their decision.

8.4. Stakeholders

Policy-makers applying PVE

The results of this research indicate that policy-makers who want to apply PVE have to make a decision with respect to what preferences they want to elicit from participants. The two existing large-scale PVE applications presented impact attributes that are usually considered in a Cost-Benefit Analysis process. The results from these PVEs as well as the PVE applied in this research show that participants take into account broader aspects as well as the attribute levels. Currently, the choice task instruction applied in PVE is ambiguous as it asks participants to select the portfolio of projects that they consider as being best. With that, it does not instruct participants regarding the pieces of information that they should build their decision on. As a result, participants interpret the survey in different manners and are unsure whether to base their decision on, for example, the attribute levels, their own perception of impacts, or broader aspects. This results in a disconnect between approaches of different participants, which impacts the validity of the results. Therefore, it is recommended that policy-makers make clear what specific preferences they want to elicit and that the PVE survey design is adjusted accordingly.

PVE designers

Establish a complete and structured reference or archive of past PVE applications: in the initial phase of this research it was difficult to get a complete picture of the content of previous PVE surveys because publications did not include all relevant information. For the two larger PVEs of Amsterdam and flood protection the publications included links to demo versions, but these versions were translations to English, did not include the delegation info nor the follow-up questions, and only related to one experimental setup (Mouter et al., 2019b,a). For the three smaller PVEs no links were provided or the links were broken (de Geus, 2019; Dartée, 2018; Pak, 2018). For future references it is recommended to provide an archive of all published PVE surveys.

Default comparison of all projects: currently, a participant has to actively toggle projects in the main screen in order to include these in a comparison. By including all projects in the comparison by having these toggled in the main screen by default, participants are forced to consciously make the decision to exclude projects from a comparison. This could serve as an incentive for participants to compare the attribute levels of all projects and as a result participants are more informed and it is more likely that they evaluate the complete choice set.

Standard socio-demographic characteristics: knowing the socio-demographic characteristics of the sample covered by a PVE survey is important for determining the value of resulting policy implications as well as for conducting scientific debate. This seems especially important because of the promise for PVE to reach a wider audience than with conventional participatory methods. However, as shown in the structured review of PVE applications in appendix B, the form in which SDCs were gathered differed between every application. This can make comparisons difficult and a harmonisation of these, and perhaps a default integration in the online tool, might be useful.

Personal benefits: asking whether participants experience personal benefits could be a check for personal relevance of projects. The process tracing study showed that personal benefits were mentioned by several participants while making their decision. However, these participants did not include these personal benefits in their written motivation.

Policy advice Municipality of Delft

Based on the outcomes of the PVE survey and taking into account the limited degree to which the captured sample is representative of the Delft population, the projects of Gelatine bicycle tunnel and Faraday bridge should be realised. For any further investments a parking facility combining the aspects of the Transferium and the Park%Bike projects as well as the Faraday bicycle tunnel should be

considered. The ramp to highway A13 near Technopolis was perceived surprisingly positively, given the sample characteristics, and is recommended to be studied in more detail to see whether the large required investment is justified by the realised impacts.

8.5. Recommendations for PVE research

Execute a process tracing study of a highly complex PVE: within this research a PVE of moderate complexity was studied and already at that level most participants choose to ignore certain pieces of information, but still several participants performed the choice task without applying effort-reducing methods. Building on the outcomes of this research, performing a process tracing study of a PVE at the levels of complexity of the large scale PVEs and the USWM and Hengstdal survey can show how participants approach surveys with 2 to 3 times the projects. It would be expected that the application of effort-reducing methods would be much greater and more rigorous. Also, this can show to what extent participants are able to comprehend the content of such a large survey.

Study the session exports of large scale PVEs: such as those of the TAA & flood protection scheme, if these are available, or of future PVE applications. The actions logs that they contain can yield insights in the usage of different parts of the interface and the duration of considerations of large groups of participants. This is a methodology akin to information boards, as described by Schulte-Mecklenbeck et al. (2017).

Study the impact of the choice task instruction: within the process tracing study, several participants wondered whether they should include personal experiences and perceptions, whether they should choose what is best for them personally, or whether they should rely fully on the information provided within the survey. This could be the result of a somewhat ambiguous choice task instruction, which in this research asked the participants to choose the projects that they considered important. In this case this was deliberate as it might result in different interpretations across participants.

Establish designs for mobile devices: within this research participants were explicitly asked to complete the survey on a personal computer or laptop because the online tool was not displayed properly on mobile devices and also the amount of information was deemed to be too much to digest using such a small screen. However, from a participant recruitment perspective it might be desirable to allow and facilitate completion of the PVE surveys on mobile devices as it lowers the participation threshold and thereby increase response rates. But, it is currently not known how this would work on a mobile device and what would be the impact on the information processing and resulting decision-making processes. This could be a subject of future research and possibly the process tracing methodology could be applied to study how participants would use such new interfaces.

Study the value of fully spending the budget: within the process tracing study participants indicated that they wanted to spend the entire budget and when they did they seemed very satisfied with that result. If participants attach value to spending the available budget to the penny this could impact the project selection when two projects are left, of which one leaves some budget and the other spends it fully. Also, the PVE survey applied in the variation experiment was the first PVE survey in which participants did not have to select at least one project to be able to proceed to the follow-up questions. It was interesting to see that no participant chose the null-portfolio.

Study the possibilities of offering different complexity levels: as discussed above, Niek Mouter floated the idea of offering participants different levels of complexity. Such designs could use the decision-making tendencies that were identified in this literature as a basis and thereby facilitate different approaches.

Study how participants would use an option to vote projects down: the process tracing study showed that some participants quickly discarded projects early in the process. This is currently not captured in PVE methodology and these discarded projects are included in the choice modelling estimations in the same way as projects that were considered further but were eventually not selected. An inclusion of an option to vote projects down could yield more insights into the preferences of participants.

Study the impact of the order of projects within the main screen: in the process tracing study eight out of ten participants accessed the project pages in the order that it was presented to them. This might have an impact on the outcomes of the survey.

Study the impact of framing in the project titles: in the process tracing study the titles were found to be the piece of information that was mentioned most often by participants. Because these were mentioned most often, selecting a clear title that covers the content without being framed is important. In this research one project had the title of Park&Bike, which essentially is infrastructure that serves car users. However, this project was chosen by participants for whom this was not expected. This could be due to the framing of the project title and this is suggested as an avenue for future research.

8.6. Practical suggestions

This section presents a number of practical suggestions, based on the research presented in this report.

Repeat essential info: something that stood out while conducting this research is the inability of most participants to fully understand and remember pieces of information over the time it takes to complete the choice task in a PVE. Evidence of this is the low number of participants who remembered the introduction information in the process tracing study, especially regarding synergies between projects and existing infrastructure. If certain information is absolutely necessary for participants to fully understand the content and the project alternatives it should be made sure that this information is abundantly clear and that it is repeated if necessary.

Revisiting introduction info: currently, participants cannot go back to the introduction pages that present the context and background information. As discussed above, participants seemed to have a hard time remembering information. Within the process tracing study two participants accessed the help page to try and find more info on the problem. It might be useful for people to be able to access the introduction information again.

Improved guidance of the user in understanding the online tool interface: within this research the choice was made to not make watching the instruction video mandatory, in contrast to all earlier PVE surveys. This was done because an audiovisual instruction might be a reason for potential participants to abandon the survey as it may be a nuisance in a situation where someone does not have the option to listen to audio. Instead, participants had the option to read the instruction text, or proceed directly to the survey. This might lead to people not being aware of certain options within the interface. A better solution would be to instruct participants using a sort of guided tour through the interface that they can go through at their own pace and without audio. Ideally, such a tour would use a generic test setup not related to the actual content of the PVE as that might prime participants.

Likert-scale statement on participants being convinced of their choices: the responses in the variation experiment showed that there was a disconnect between the responses to the statements on participants being convinced of their choices or participants feeling fully informed. Considering these responses it seems that even though participants indicate that they are convinced of their choices this does not mean that they feel fully informed. In earlier PVE surveys, only the first statement on being convinced was included. It is advised to ask participants whether they felt fully informed.

Reduce barriers to participation: as discussed above, barriers to participation seemed to be large swathes of text and the inability to complete the survey on mobile devices with a small screens. Therefore, it is advised to reduce text lengths and to cut these up into sections. Also, a design of PVE suitable for mobile devices is advised to be studied.

Provide access to project specific pages in confirmation screen: in the follow-up questions, several participant were surprised that it was not possible to access all information while they were formulating the motivations for the projects that they selected. Currently, it only shows the title and the description and no attribute levels or location.

Begin button: several participants were confused when they clicked the ’Begin’ button to start the selection, at which point the main page is very briefly shown before the help page was displayed with further text and a video. This point of user experience can be improved.

Progress bar: just as with most online surveys, a progress bar with a percentage indicating how much of the survey a participant has completed and what portion still remains. This can give participants an idea of the time that is left to complete the survey and manage expectations.

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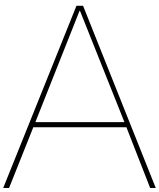

Scientific article

Studying Decision-Making processes applied by participants in Participatory Value Evaluation surveys

Tomas Ben Peeters[1]

Abstract

The research discussed in this article considers decision-making of participants within the participatory public project appraisal methodology of Participatory Value Evaluation. In this relatively new method citizens are presented a survey with a portfolio-construction task for public projects that are defined by descriptions and attribute values. This research adopts a process approach by studying decision-making processes of survey participants. These are explained using decision-making constructs from literature. The research applied a process tracing study in which ten participants completed a realistic PVE survey of medium complexity while verbalising their thoughts. Analysis of the verbal protocol revealed the three strategies of additive, elimination-by-aspect, and weighted additive. Participants applied strategies multiple times or mixed them. Three effort-reducing methods were identified: examining fewer attributes, integrating less information, and examining fewer alternative. A method specific to the portfolio-construction task was identified: sequential evaluation, with which subsets of projects are evaluated separately. Not all participants were found to apply effort-reducing methods. Based on the outcomes it is recommended to allow participants to vote-down projects, incentivize comparison of all projects, and provide clear choice task instructions.

Keywords: Participatory Value Evaluation, Citizen participation, Decision-making, Behavioural economics, Process tracing

Nomenclature

CBA	Cost Benefit Analysis
PVE	Participatory Value Evaluation
USWM	Urban Storm Water Management
WTP	Willingness To Pay

1. Introduction

Public policy-making is supported by public project appraisals. Appraisal methods are used to value the expected impacts of public projects. This is done with the aim to identify the projects that result in the highest benefits for society. Such appraisals are generally executed using cost-benefit analysis (CBA), which is the standard in many western countries (Mackie et al., 2014). CBA is used to determine the societal desirability and economic efficiency of a proposed policy or project by expressing both costs and benefits in monetary terms (van Wee, 2012). If the benefits outweigh the costs the policy or project is considered beneficial to society. In the CBA appraisal process estimations of consumers private Willingness To Pay (WTP) are applied. This approach is criticised

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because people might make different decisions when allocating public budget versus spending their own money, as argued by Sunstein (2005) in the area of environmental policy. Also, CBA does not incorporate citizen participation and therefore there is a search for alternative or additional public project appraisal methods based on citizen participation.

PVE is a methodology that promises to combines aspects of CBA with public participation. Public consultation is done through an online PVE survey that is distributed to a large group of citizens that is reflective of the entire population. Within this survey the participants are asked to perform a portfolio-construction task by selecting a portfolio of projects from a range of project alternatives while adhering to a limited budget (Mouter et al., 2019a).

Outcomes of a PVE are quantitative and qualitative results, namely the selected projects per participant as well as motivations per selected project provided by participants. The quantitative results are analysed using choice models and the qualitative results are analysed through coding of statements (Mouter et al., 2019a). The outcome of a PVE are recommended portfolios of projects that fit within the budget, supplemented with an overview of the motivations provided by participants. These motivations can provide insights into the preferences and considerations of participants.

Since its conception PVE has been applied on various types of projects at different political levels (Dartée, 2018; Mouter et al., 2019a,b; Pak, 2018):

- Flood protection scheme on the Dutch national level.
- Transport investment scheme in the municipal region of Amsterdam.
- Urban storm water management (USWM) programme in the municipality of The Hague.
- Transition to zero natural gas in the neighbourhood of Hengstdal in the city of Nijmegen.
- Bicycle projects in a generic context to investigate the effect of framing of the information provided to survey participants on the results of a PVE.

Mouter et al. (2019b) propose, among others, further research on PVE specifically within the field of information provision to the respondents. Analysis of the qualitative results of their research, in the form of statements provided by respondents, indicated that respondents tend to take impacts and considerations into account that are not included in the survey information. Inclusion of such considerations might result in reduced validity of the survey outcome, partly because respondents tend to over- or underestimate the related impacts when they are not provided the appropriate information. The research that the authors propose intends to develop the PVE further into, for example, an iterative method where outcomes of PVEs of a smaller size are used to design subsequent larger scale PVEs. Also, research into the application of novel methods of information provision is proposed, such as immersive and visual information.

2. Research objective

As shown in the previous chapter, the field of research on PVE is still very small and fully in development. All PVE surveys to date have applied the same online tool with the same setup consisting of a main screen with the project titles, specific project pages with description, location, and attribute information, and a comparison page where participants can make a comparison of the attributes of selected projects. The PVEs listed above contained up to 16 projects, each associated with a cost, description, location, and scores on 6 attributes. Therefore, the choice task that participants face within a PVE survey can be considered highly complex. Currently, it is not known how participants approach the choice task of a PVE and how they interact with its interface.

Also, the developers of the PVE methodology have stated a desire to develop innovative ways of information provision, such as immersive and visual information (Mouter et al., 2019b). To facilitate this development it is necessary to understand how participants approach PVE in its current form. If it is not known how participants make their decision in a PVE survey this can lead to results that cannot be explained or invalid conclusions. Knowing how participants approach the portfolio-construction task can aid the design of PVE surveys and the online tool to better suit the decision-making processes applied by participants and to elicit the preferences that policy-makers intend to capture.

Therefore, the research question addressed in this article is: **What decision-making processes are applied by participants while completing a portfolio-construction task in a Participatory Value Evaluation survey?**

3. Methodology

3.1. Approach

For studying decision-making two distinct approaches are identified: a structural analysis of the resulting choices and process tracing techniques (Svenson, 1979). The former approach includes the use of choice modelling to examine the effects of the input on the output of a choice situation. The choice modelling applied in PVE is such a structural approach. With a process approach the focus is on collecting data while the decision-maker is in the process of making his decision. This fits within the model of behavioural economics, which posits people possess or are only willing to apply limited cognitive abilities (Gsottbauer & van den Bergh, 2011). It is theorised that to deal with a choice task people tend to make use of rules-of-thumb or decision shortcuts when making a decision, which are commonly referred to as heuristics (Gsottbauer & van den Bergh, 2011; Kahneman, 2003). These are closely associated with the idea of cognitive misers (Petty et al., 2005).

Studying how participants deal with the portfolio-construction task calls for adoption such a process approach. Therefore a process tracing study is performed to answer the research question. Process tracing is defined by Shah & Oppenheimer (2008) as: *"Process tracing refers to observing how people search for information before making a judgment or decision."* By using process tracing researchers can determine the types of decision-making processes that are applied by participants. Therefore, this approach is suited to answer the research question. Process tracing studies result in large amounts of data (Schulte-Mecklenbeck et al., 2011). Therefore the study is limited to a group of ten respondents.
In this research two forms of process tracing are applied: subject reports consisting of verbal reports by decision-makers, and movement based techniques in which an action log is composed of the actions of decision-makers (Schulte-Mecklenbeck et al., 2017). The verbal reports are generated by the respondents concurrently with the execution of the choice task and in an unstructured manner by asking the respondents to think aloud (Walsh & Gluck, 2016). The verbal reports are captured using an audio recording. The actions of respondents are logged by making a screen recording of the online tool. Because the online tool consists of different pages with information this is comparable to the information boards technique in which information is hidden until the decision-maker chooses to consult it (Schulte-Mecklenbeck et al., 2017).

3.2. Process tracing techniques

The outcomes of the process tracing study are screen and audio recordings. The former is used to compose the action log. The latter is transcribed and divided into statements that represent a

complete thought, following the methodology of Walsh & Gluck (2016). These statements are then coded in two rounds, first categories are established and secondly the statements are assigned to these categories. In addition, to facilitate analysis the verbal protocols were shortened by only including the most relevant statements and short reports were made describing the expressed thoughts and performed actions for each participant.

3.3. Decision-making constructs

Interpretation of the verbal protocols and action logs is done by identifying decision-making strategies and effort-reducing methods that are based on literature. Effort-reducing methods form the basis of heuristics (Shah & Oppenheimer, 2008).

Decision-making strategies: five strategies were identified from literature (Payne, 1976), (Payne et al., 1993, as cited in Shah & Oppenheimer, 2008): 1) Additive/linear, in which the decision-maker assigns scores for each attribute of each alternative to arrive at composite scores using which the best alternative is chosen. 2) Conjunctive/satisficing, in which each attribute is checked against a minimum level and if the alternative does not pass it is discarded. After which it is hypothesised that the minimum level is altered, using which the alternatives are re-evaluated. 3) Additive difference, in which the difference between the levels of a certain attribute of two alternatives are evaluated. It is hypothesised that the best alternative is used as a benchmark until a better one is found. 4) Elimination-by-aspect, in which the attribute that the decision-maker considers most important is chosen and with which the alternatives are evaluated. 5) Weighted additive, which is a more complex version of the additive/linear strategy in which weights are assigned to the different attributes.

Effort-reducing methods: five effort-reducing methods were identified (Shah & Oppenheimer, 2008): 1) examining fewer attribute levels, 2) reducing the difficulty associated with retrieving and storing attribute levels, 3) simplifying the weighting principle for attribute levels, 4) integrating less information, and 5) examining fewer alternatives. These five methods are related to the weighted additive strategy described above. It is expected that effort-reducing methods 1, 4, and 5 are encountered. In case participants focus on specific attributes and disregard the other attributes they employ method 1. When participants evaluate an alternative on its own without making a comparison to the other alternative they are using method 4. And, when participants disregard alternatives altogether they employ method 5.

3.4. PVE survey

To conduct the process tracing a realistic PVE survey was designed. Therefore, a PVE survey[2] was composed containing six infrastructural projects at or near the Delft University of Technology campus which were actual plans being considered by the municipality of Delft, the province of South-Holland, or local political parties. The projects were associated with project cost and five other attributes related to change in travel time and number of direct car users and cyclists. They were further defined using a title, short description, and a location. With the content established the PVE survey was composed in the same online tool that was used for the earlier PVE applications.

In line with previous PVE applications, the choice task instruction was as follows: *"..there are plans to improve accessibility. However, there are not sufficient funds to execute all these project plans.*

[2]The applied survey is accessible through: `http://pve.splicedgene.com/process-tracing-experiment`

Therefore, choices will have to be made. We ask you in this research to make that choice and to spend the available funds on the projects that you find most important."

After having composed their desired portfolio of projects, the participants of the study are asked to complete a questionnaire in which they are asked to provide socio-demographic characteristics. These serve to understand to what extent the results of the study can be generalised.

4. Results

The 10 participants, identified using letters ranging from A to J, were recruited from the personal network of the researcher, namely friends and neighbours. The ten sessions resulted in a total of 906 statements and 351 actions.

4.1. Sample characteristics

The sample captured in the process tracing study is composed mainly of young people in the age groups of 18-25 and 26-35, either studying or working, and two people within the 65+ age group, working. All participants were higher educated and almost all participants lived in the inner city of Delft, with two others living in the same neighbourhood which contains the campus. Regarding the votes the green party of GL dominates. Most participants use the bicycle as the main mode of daily transport and none of the participants use a car.

4.2. Analysis of verbal protocol and action log

Table 1 shows the recorded counts of statements and actions as well as the time spent on the selection per participant.

Table 1: Counts of statements and actions and time spent on selection per participant

Participant ID / Variable	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**
Statements [count]	45	112	90	61	77	89	62	94	146	130
Actions [count]	33	19	44	23	34	29	26	40	67	36
Time [minutes]	6:14	11:58	13:15	6:23	8:55	12:31	6:01	7:11	12:14	21:05

The counts of statements and actions as well as the shortened verbal protocols and thought and action reports were analysed with the objective of explaining decision-making behaviour using the strategies and effort-reducing methods as described earlier. The identified processes are discussed below.

For the effort-reducing methods, an additional method was identified that relates directly to the portfolio-construction task that is considered in a PVE survey. This method is termed: sequential evaluation. When applied, instead of one simultaneous evaluation in which the full selection is made participants make sequential evaluations. For instance, instead of simultaneously considering the selection of three projects out of the total of two projects, participants first select the two best projects and then make another evaluation out of the reduced choice set. By not constructing the entire portfolio in one go the required effort is reduced.

Decision-making strategies: the additive/linear strategy was applied seven times by five participants (A, B, C, F, and H). Of these, five applications were purely attribute focused and two

applications focused on cost-benefit ratios. The elimination-by-aspect strategy was applied six times by five participants (D, E, F, G, and H), all based on a variety of non-attribute aspects. These aspects were: personal benefits, reduction of traffic related burdens, equity considerations, substitution of car traffic, equity considerations, perceived project feasibility, and whether projects were car or bicycle focused. The weighted additive/linear strategy was applied once using attribute levels by one participant (J). For one participants the applied strategy could not be determined (I). The strategies could be directly linked to whether participants took the attribute values into account or whether they considered other aspects. The (weighted) additive/linear strategies all made use of the attribute values, while those applying an elimination-by-aspect strategy made use of non-attribute aspects.
Not all participants applied only one strategy once. Instead, five participants were observed applying a strategy twice. When they did this they first made a choice and subsequently made a new choice out of the remaining projects. This is related to the identified effort-reducing method of sequential evaluation, as described below. Out of these five participants two applied an additive/linear strategy twice (A & B), one applied the elimination-by-aspect strategy twice (G), one applied first an elimination-by-aspect strategy to reduce the choice set and subsequently applied an additive/linear strategy (H), and one applied first an additive/linear strategy to select two projects with the best cost-benefit ratio and subsequently used an elimination-by-aspect strategy for the remaining projects (F).

Effort-reducing methods: two participants (B and H) reduced the effort by examining fewer attributes, while three participants integrated less information (D, E, and G) and four participants (A, B, E, and G) reduced the choice set by examining fewer project alternatives. The sequential evaluation method was applied by three participants (A, B, and C). As with the strategies, several participants applied multiple methods. Not all participants applied an effort-reducing method as for three participants (F, I, and J) none could be identified.

5. Conclusions

The research served to answer the research question: *What decision-making processes are applied by participants while completing a portfolio-construction task in a Participatory Value Evaluation survey?*
The results showed that participants applied three decision-making strategies: additive/linear, elimination-by-aspect, and weighted additive. Four effort-reducing methods were identified: examining fewer attributes, integrating less information, examining fewer alternatives, and sequential choices. This last method was identified in this research and applies to the portfolio-construction task of PVE surveys specifically.
It is concluded that participants who complete a PVE survey tend to either focus on the attribute levels or on other aspects of project alternatives. The former is associated with (weighted) additive/linear strategies, while the latter is associated with elimination-by-aspect strategies. However, participants might adopt both strategies by using one strategy to reduce the choice set and using another to evaluate the remaining projects, or applying the same strategy twice. This is one of the effort-reducing methods that were identified as participant were observed to not take into account specific attributes, ignoring part of the provided information, or swiftly reducing the choice set by discarding projects. Additionally, another effort-reducing method was identified that was specific to the portfolio-construction task presented in PVE surveys in which participants chose to make a sequential choice instead of a simultaneous choice for the full portfolio. Not all participants were

observed to apply effort-reducing methods as three out of ten participants based, or tried to base, their selection on all available information, which was still possible with the relatively low level of complexity of the applied PVE survey.

6. Discussion

6.1. Participatory Value Evaluation

This research showed that not all preferences of participants are captured in a PVE survey because part of the participants reduce the choice set quickly. Such a specific dislike for a project that is not based on attribute levels or a full consideration of the project is not captured in the current PVE methodology. It is recommended to include the option for participants to vote-down projects.
Also, some participants were found to ignore specific attribute levels, attributes in general, or other parts of the provided information. Currently, there is an incentive to disregard projects because participants have to actively include projects in a comparison. Therefore, it is recommended to include all projects in the comparison by default instead of none of the projects as is the current standard.
Knowing what the policy-maker applying PVE methodology intends to measure and presenting the PVE survey accordingly is deemed to be important. The choice task instruction was found to be a cause for confusion because participants mused about basing their decision on the provided attribute levels, their own interpretation of projects and their impacts, personal benefits, or other aspects. It is recommended to provide a clear choice instruction to participants, instead of the current ambiguous instruction.

6.2. Behavioural economics

This research provides an empirical example of the strategies and effort-reducing methods that were identified. Within the category of effort-reducing methods an additional method was identified which is applicable specifically to portfolio-construction tasks as presented in PVE surveys. Also, this research shows that within complex choice tasks such as a PVE survey participants might adopt strategies multiple times or even mix strategies while completing the same choice task.
Also, this research provides empirical evidence for the theory of cognitive misers, part of the behavioural economics paradigm, which says that people are not able to, or not willing, to process all available information. This was clearly demonstrated in the process tracing study, together with the heuristics and their underlying effort-reducing methods that participants applied.

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B

Structured review of PVE applications

This appendix presents the structured review of previous PVE surveys, which had the following aims: to summarise the current state of the art based on the five PVE surveys that exist to date, to identify and reflect on common aspects and inconsistencies, and to serve as a basis for setting up and executing the PVE survey that is used in this research's process tracing study and variation experiment.

Approach

The review was conducted based on the frameworks formulated by Pak (2018) and Dartée (2018). The Pak (2018) framework consists of two sets of methodological steps: establishing the PVE design and constructing the online tool. Within the first set of steps the following elements were addressed: (1) context, (2) constraint, (3) projects, (4) attributes, and (5) follow-up questions. The second set of steps addressed: (6) constraint & attribute levels, (7) introduction & instruction pages, (8) information pages, and (9) delegation page.

The Dartée (2018) framework consists of three main phases. These are: PVE design, data gathering, and data analysis. The first phase of PVE design consisted of the elements of scoping & framing, measures (projects), attributes, qualitative questions, and online tool development. Secondly, data gathering contained the elements of selection of respondents and communication strategy. Thirdly, the data analysis phase used PVE session data as well as qualitative and quantitative data, which were analysed using coded statements, statistical analysis, and MDCEV modelling. Additionally, this last phase also addressed the survey outcomes regarding methodology evaluation.

These two frameworks served as the initial basis for the review. However, in the process of performing the review and also while establishing the PVE survey for this research, elements of PVE surveys were identified that did not fit within either of these two frameworks. Based on the review three distinct phases were identified that only partially fit the earlier frameworks, namely content determination, survey composition, and execution & analysis. Also, the elements of experimental setup, choice task instruction, information presentation, debriefing, testing, and policy advice were deemed to be relevant for this research and PVE surveys in general and missing from these frameworks. Therefore, these are included in a framework that is applied to present the review in a structured manner and to subsequently guide the construction of the PVE applied in this research.

Applied framework

The applied framework distinguishes three main phases of a PVE application, namely (I) content determination, (II) survey composition, and (III) execution & analysis. The three phases are intended to be executed consecutively, while their elements are interdependent are therefore are not necessarily addressed in a consecutive manner. This framework is intended to be used to conduct a PVE in a consistent and rigorous manner. Also, it can be used to review executed PVEs in a structured way. Within these phases the framework makes a subdivision into process & content element, which are discussed below.

Phase I - Content Determination is the first phase of the framework, presented in figure B.1. This phase covers the process of determining the content of a PVE survey. It includes the following elements:

Figure B.1: Phase I of the applied framework.

element (0) the experimental setup is a special element as it is not necessarily part of a PVE, but within the current early stage of (scientific) development of PVE it can be highly relevant. Elements (1 - 4) concern the context, constraints, projects, and attributes of the PVE and these have been taken directly from the earlier framework of Pak (2018). Element (5 - 7) cover the attribute levels, delegation, and follow-up questions as these are part of a PVE's content and these should be complete before the survey can be built using the PVE's online tool in the next phase.

Phase II - Survey Composition is the second phase of the framework and it is presented in figure B.2. This phase overs the process of composing the survey in the online tool based on the outcomes of the preceding phase. It includes the following elements: (1) choice task instruction, which serves to compose the content of the pages within the online tool using which the participants are instructed on the PVE's choice task. Element (2) relates to the information presentation to the participants through which they are informed on the various projects that they can choose from. Element (3) covers the debriefing, which can be especially relevant for a PVE with an experimental setup. Element (4) covers the choices that need to be made with respect to the design of the online tool. Element (5) deals with the testing of the tool before the PVE can be distributed among participants in the next phase.

Finally, Phase III - Execution & Analysis is the third phase of the framework and it is presented in figure B.3. During this phase the PVE, as composed in the online tool in the previous phase, is actually completed by the participants and the ensuing results are analysed. The phase includes the following elements: (1) the process of recruiting respondents, (2) the various ways in which results can be analysed, and (3) the final policy advice that results from that analysis.

Below, the outcomes of the structured review are presented using the developed framework. The following five PVE applications were reviewed:

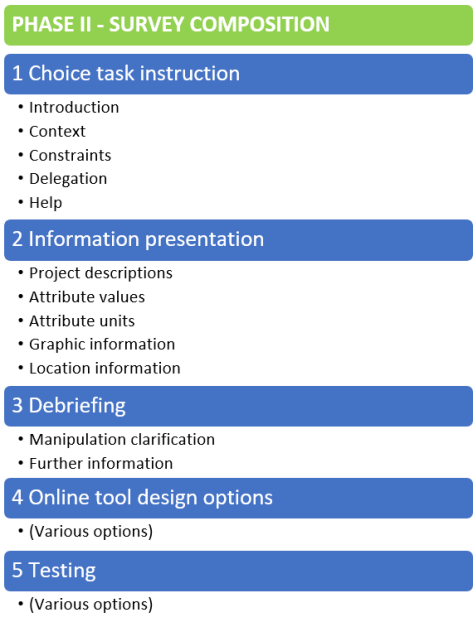


Figure B.2: Phase II of the applied framework.

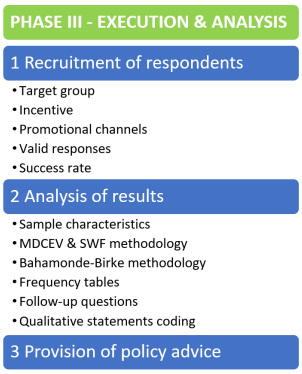


Figure B.3: Phase III of the applied framework.

- Flood protection scheme in the Netherlands: Mouter et al. (2019a); Dekker et al. (2019) & `http://participatie-begroting.nl/`
- Transport investment scheme in Amsterdam: Mouter et al. (2019b, 2017) & `http://pve.splicedgene.com/participatory-value-evaluation-transport-authority-amsterdam`
- Urban storm water management (USWM) in The Hague: Dartée (2018).
- Transition to zero natural gas in Hengstdal, Nijmegen: Pak (2018).
- Framing experiment on bicycle projects: de Geus (2019).

Phase I - Content Determination

This section discusses the elements of the reviewed PVE applications that fall within phase I of the applied framework.

Element 0 - Experimental setup:

Flood protection scheme: this PVE included two experiments that varied with respect to the variability of the budget. In the fixed budget experiment there was a fixed budget of €700 million and the respondents were told that any budget that they did not spent was shifted to the next year. In the variable budget the original budget of €700 million could be changed by adjusting the tax rate for all Dutch residents.

Transport investment scheme : this PVE included four experiments that varied with respect to the variability of the budget. Within the experiments with a fixed budget the participants were told that any budget that they did not allocate would be shifted to the next investment period of 2032 - 2034. In the experiments that had a variable budget the participants could choose to spend less or more than the €100 million budget and based on that residents of Amsterdam got a lower or higher tax rate.

USWM in The Hague: in this PVE no experimental setup was applied.

Transition in Hengstdal, Nijmegen: in this PVE no experimental setup was applied.

Framing experiment: this PVE was mainly about a laboratory experiment with a variation in the descriptions that had the aim of determining the impact of framing within PVEs. The neutral group were presented with a description that included the neutral description with a positive aspect and a negative

aspect. The group that received framing towards traffic safety were presented with positive aspects for the traffic safety projects and with negative aspects for the public nuisance projects. The group that received framing towards public nuisance had the opposite structure.

Element 1 - Context

Flood protection scheme: the Dutch Ministry of Infrastructure and Water Management[1] was the client. The survey considered flood protection projects and alternative projects within the realm of the applicable Ministry. This was a large scale PVE survey designed, executed, and analysed by Mouter, Koster, and Dekker.

Transport investment scheme: the Transport Authority of the municipality of Amsterdam[2] (TAA) was the client. The survey considered transport system improvements within the area managed by the TAA in the period of 2030 - 2032. This was a large scale PVE survey designed, executed, and analysed by Mouter, Koster, and Dekker.

USWM in The Hague: the municipality of The Hague was the client. The survey considered urban water storm management within a generic neighbourhood within the municipality of The Hague. The geographic boundaries of this neighbourhood were not specified. This was a small scale PVE survey designed, executed, and analysed by Dartée as a Master thesis project at the faculty of Technology, Policy, and Management.

Transition in Hengstdal, Nijmegen: the municipality of Nijmegen and the neighbourhood initiative *Duurzaam Hengstdal* were the client. The survey considered the transition towards zero natural gas use in a pilot case for the neighbourhood of Hengstdal. This was a small scale PVE survey designed, executed, and analysed by Pak as a Master thesis project at the faculty of Technology, Policy, and Management.

Framing experiment: the experiment did not have a client as it was a laboratory experiment intended purely for scientific research. The survey considered policy-making on bicycle use in a generic urban environment. The specific urban environment was not defined in order to make the study universally applicable throughout the Netherlands. This was a small scale PVE survey designed, executed, and analysed by de Geus as a Master thesis project at the faculty of Technology, Policy, and Management.

Element 2 - Constraints

Flood protection scheme: a budget of €700 million. Depending on the experimental setup the respondents could change the budget by adjusting the tax rate. In the situation where this was not possible, the remaining budget would be shifted to the next year. At the very least the improved safety standards with regards to flood protection had to be complied with at four distinct locations along the 'de Waal' river.

Transport investment scheme : a budget of €100 million. Depending on the experimental setup the respondents could change the budget by adjusting the tax rate. In the situation where this was not possible, the remaining budget would be shifted to the next year.

USWM in The Hague: a budget of €2.2 million. There was no option to change the budget by adjusting the tax rate. Any remaining budget would be saved and its allocation would be determined in the future.

Transition in Hengstdal, Nijmegen: the constraint in this case was not a budget, instead it was the renewable energy sources' share in the energy mix of the neighbourhood in the year 2045.

Framing experiment: a budget of €7 million. There was no option to change the budget by adjusting the tax rate. Any remaining budget would be saved to be spent on bicycle related policies at a future moment.

[1] Dutch: Ministerie van Infrastructuur en Waterstaat
[2] Dutch: Vervoerregio Amsterdam

Element 3 - Projects

Flood protection scheme: 14 projects in total. The flood protection projects at the four locations could either be classical dike strengthening projects or more extensive combination projects that included providing areas in which the river could flood in a safe manner. Six additional projects related to roads, heavy rainfall mitigation, and further flood risk reduction measures were available .

Transport investment scheme : 16 projects classified within six types. These types were: safety, slow modes, car, bus, bike, and tram.

USWM in The Hague: 11 projects related to urban storm water management. Unique in this survey was the ability for respondents to select projects multiple times. The effects of projects that were selected multiple times were cumulative. Also, some projects concerned subsidies that would come in unison with private spending of citizens.

Transition in Hengstdal, Nijmegen: 16 strategies, of which only one could be selected by the respondents. The sixteen strategies followed from the combinations of options within three processes related to heating: consumption, distribution, and production.

Framing experiment: six projects within the two categories of traffic safety and public nuisance.

Element 4 - Attributes

Flood protection scheme:

- Budgetary attribute: cost in million €
- Other attributes: two sets of five attributes based on the project type. The attributes related to impacts which would also be considered in a CBA evaluation.
  - For the classical, combination, and water management projects these were the following six:
    - Size of nature [hectares]
    - Biodiversity [ordinal 1-5]
    - Recreation [ordinal 1-5]
    - Affected households [# of relocated households]
    - Floods prevented [# per 25 years]
  - For the road and further flood risk reduction projects these were the following six:
    - Affected households [# of relocated households]
    - Flood safety [ordinal 1-3]
    - Users [# of users per day]
    - Travel time savings [minutes per trip]
    - Reduction in severe traffic injuries per year [# severe injuries per year]

Here the 1-5 ordinal attributes corresponded to, including the base level: no improvement, small improvement, improvement, substantial improvement, large improvement, and very large improvement. The 1-3 ordinal attribute corresponded to: below safety standard, at standard, above standard, and well above standard. In the original publication these attributes are referred to as categorical, but as there is a clear ordering in the values these are actually ordinal.

Transport investment scheme:

- Budgetary attribute: cost in million €
- Other attributes: six attributes corresponding to the societal impacts which would also be considered in a CBA evaluation.
  - Number of travellers [travellers per day]
  - Travel time savings [minutes per trip]
  - Additional traffic deaths per year [# of deaths per year]
  - Additional severe traffic injuries per year [# of severe injuries per year]

  - Additional households affected by noise pollution [# of households]
  - Number of trees that need to be chopped down [# of trees]

USWM in The Hague:

- Budgetary attribute: cost in €
- Other attributes: seven attributes.
  - Reduction of available parking spaces [# of parking spaces]
  - Prevention of nuisance arising from superfluous water [# of days per year with superfluous rainwater on the street that can be prevented]
  - Potential re-use of rainwater [# of washing cycles per household per year]
  - Increase in green space [m^2 of green space]
  - Maturity level of project [corresponding stage on the Technology Readiness Level indicator]
  - Participation required of inhabitants [# of hours per year per household spent on operation and maintenance]
  - Positively impacted households [# of households that experience a reduced risk of superfluous water]

Transition in Hengstdal, Nijmegen:

- Budgetary attribute: instead of cost each strategy had an associated share of renewable energy sources in the year 2045 to indicate how far the strategy would go towards the goal of zero natural gas use.
- Other attributes: eight attributes.
  - Affordability [€ per year per household]
  - Availability [1-5 ordinal scale from very unreliable to very reliable]
  - Autarky [% of imported energy]
  - Comfort [1-5 ordinal scale from very uncomfortable to very comfortable]
  - Nuisance [1-2 ordinal scale from no noise disturbance to possible noise disturbance]
  - Ecology [% reduction in carbon dioxide emissions between 2016 and 2045]
  - Safety [# of national accidents per year]
  - Employment impact [% change in employment in full-time equivalent (FTE) between 2016 and 2045]

Framing experiment:

- Budgetary attribute: cost in million €
- Other attributes: five attributes.
  - Reduction of severe accidents [%]
  - Increase in bicycle parking spots [#]
  - Change in travel time for cars [minutes per trip]
  - Change in travel time for bicycles [minutes per trip]
  - Overall effect on bicycle usage [%]

Element 5 - Attribute levels

Flood protection scheme: the attributes levels were varied across 40 treatment combinations.

Transport investment scheme : the attribute levels were varied. It is not mentioned how many treatment combinations were constructed with these varying levels.

USWM in The Hague: the attributes levels were varied across 26 treatment combinations.

Transition in Hengstdal, Nijmegen: the attribute levels were fixed.

Framing experiment: the attribute levels were fixed.

A discussion of the determination of the attribute levels for the five PVE surveys is not deemed to be of considerable interest in this review. Therefore, the reader is referred to the applicable publications.

Element 6 - Delegation:

Flood protection scheme: in the fixed budget experiment the respondents could delegate their choice to an expert. In the flexible budget experiment the respondents could choose to delegate their choice to an expert, the overall group of respondents, or respondents from the villages that were directly impacted by the four main projects.

Transport investment scheme : the respondents could choose to delegate their choice to an expert.

USWM in The Hague: there was no option for the respondents to delegate the decision.

Transition in Hengstdal, Nijmegen: the respondents could choose to delegate their choice to an expert or to the other respondents.

Framing experiment: there was no option for the respondents to delegate the decision.

Element 7 - Follow-up questions

Flood protection scheme:

Motivation of choices:

- Per selected project the respondents were asked to provide their motivation.
- The respondents were asked to motivate their decision to (not) adjust the tax rate to increase/decrease the budget [dependent on experimental design, as explained under Phase I]

Likert-scale statements[3]:

- I am convinced of my choices.
- I feel that this is a realistic experiment.
- I think it is good that the government tries to involve citizens in making choices between strengthening dykes or a combination of providing space for the river and strengthening dykes.
- This experiment provides the government with relevant information for making choices between strengthening dykes or a combination of providing space for the river and strengthening dykes.

SDC:

- Vote in previous election
- Postal code

Case-specific:

- The respondents were asked whether they were planning to move in the coming five years
- The respondents were asked to check the boxes for projects from which they expected to experience effects.

Open questions:

- The researchers want to continuously improve the civilian budgeting method. If you have suggestions/remarks you can note these here.

Transport investment scheme:

Motivation of choices:

- Per selected project the respondents were asked to provide their motivation.

Likert-scale statements:

- I was convinced of my choices.
- I thought that the experiment was realistic.
- I think it is good that the government aims to involve citizens in making choices between transport projects.

[3]In this section the Likert-scale statements and questions all offered the respondent the option to select an option from a Likert-scale of: Strongly disagree, Disagree, Neutral, Agree, Strongly agree

- This experiment provides the government with relevant information for making choices between transport projects.

SDC:

- Gender
- Age
- Education level
- Household gross yearly income
- Vote in previous election

No case-specific questions were asked.

No open questions were asked.

USWM in The Hague:
Motivation of choices:

- Per selected project the respondents were asked to provide their motivation.

Likert-scale statements:

- It is important for the municipality to involve her inhabitants in the decision-making concerning new project investments.
- To what extent do you feel that inhabitants have the capacity to take decision on the expenditure of public money?
- To what extent do you feel that you have sufficient knowledge on this subject in order to reach a selection of projects?

SDC:

- Gender
- Year of birth
- Education level
- Household gross yearly income
- Current situation
- Postal code

Case-specific:

- Number of persons in household
- Ownership of a car
- Owner-occupied property or rental property

Open questions:

- What do you think that the municipality will do with the results from this research?
- What did you find pleasant about this method of research?
- What would you like to see different in this research?
- Do you want to add anything related to this research?

Transition in Hengstdal, Nijmegen:
Motivation of choices:

- For the selected strategy the respondents were asked to provide their motivation.

Likert-scale statements:

- I am convinced of my choices.
- I think that this experiment is realistic.
- I think that it is good that Nijmegen does this.
- I think that this experiment offers relevant information to the municipality.

SDC:

- Postal code

Case-specific:

- Whether respondents were planning to move to a place outside of the neighbourhood Hengstdal in the coming five years.
- Whether respondents had green energy in their home.
- In what way respondents heated their home.
- What the energy label was of the respondents' home.
- What year the respondents' home was built in.
- What respondents used for cooking.

No open questions were asked.

Framing experiment:
Motivation of choices:

- The respondents were not asked to provide a motivation for projects they selected.

Likert-scale statements:

- It is necessary to increase bicycle traffic safety in relation to the current state of traffic safety.
- It is necessary to create more parking possibilities for cyclists.
- The costs of the different options were decisive in making my decision.

SDC:

- Gender
- Age
- Education level

Case-specific:

- How often respondents used the bicycle as a means of transportation.
- How often respondents used the bicycle for their commute to work.
- How often respondents parked their bicycle in a city centre.
- How often respondents used an electric bicycle.
- How often respondents used a racing bicycle?

Open questions:

- Did you get the feeling that you were steered towards a decision in any way, shape, or form within the project descriptions. If yes/no, why?
- Did you feel that sufficient information was given to make a well-considered choice between the different options?
- Do you have any further questions and/or comments regarding this research?

Phase II - Survey composition

This section discusses the elements of the reviewed PVE applications that fall within phase II of the applied framework.

Element 1 - Choice task instruction:

Flood protection scheme: to allocate up to €700 million to classic or extensive flood protection projects at four locations and to alternative projects within the realm of the Ministry of Infrastructure and Water Management. The respondents were told:

- That the Ministry decided to consult a large group of civilians for this choice.
- That they had to choose one of the two options at the four locations and that any remaining budget can be spent on other projects.

- That, depending on the experimental design as described below, the budget they did not spend will be shifted to the Ministry's next year budget or that the tax rate will be adjusted for all Dutch households.

The instruction on the user interface of the online tool was provided in the form of a video that was mandatory to watch.

Transport investment scheme : to allocate up to €100 million for transport system improvements made by the TAA in the period of 2030 - 2032 to a portfolio of projects that match their preferences most. The respondents were told:

- That their recommendations will be considered by the TAA in the eventual decision-making process on investment allocation.
- That there are insufficient funds available and that therefore not all possible projects can be realised.
- That, depending on the experimental design as described below, the budget they did not spend will be shifted to the next year or that the municipal tax rate will be adjusted.

The instruction on the user interface of the online tool was provided in the form of a video that was mandatory to watch.

USWM in The Hague: to allocate up to €2.2 million for projects concerning the prevention of superfluous rain water that they think that the municipality should realise in the generic neighbourhood. The respondents were told:

- That the municipality aims to use the outcomes of the experiment when making choices for any neighbourhood in the Hague.
- That there are insufficient funds available and that therefore not all possible projects can be realised.
- That the budget they did not spend will be saved and that at a later point a decision will be made regarding the purposes of this budget.

The instruction on the user interface of the online tool was provided in the form of a video that was mandatory to watch.

Transition in Hengstdal, Nijmegen: to select a strategy for making the provision of heating more renewable that they considered best. The respondents were told:

- That the municipality wanted to know what form of heating provision was preferred by neighbourhood residents.

The instruction on the user interface of the online tool was provided in the form of a video that was mandatory to watch.

Framing experiment: to allocate up to €7 million for projects concerning bicycle use that they think that the generic municipality should realise. The respondents were told:

- That there are insufficient funds available and that therefore not all possible projects can be realised
- That the budget they did not spend will be saved to be used on bicycle policy at a later point.

The instruction on the user interface of the online tool was provided in the form of a video that was mandatory to watch.

Element 2 - Information presentation:

Flood protection scheme:

- Project descriptions: in the form of texts of up to about 160 words.
- Attribute values: both numerical information and short texts.

- Attribute units: presented in a tool-tip[4].
- Graphic information: no graphic information was provided.
- Location information: of each project the location was named in the title and indicated on a map.

Transport investment scheme :

- Project descriptions: in the form of texts of up to about 100 words with the intended goals and a short description, based on the original TAA project descriptions.
- Attribute values: only numerical information.
- Attribute units: presented in a tool-tip.
- Graphic information: no graphic information was provided.
- Location information: of each project the location was named in the title and indicated on a map.

USWM in The Hague:

- Project descriptions: in the form of texts of up to about 100 words.
- Attribute values: mostly numerical information, only the Technology Readiness Level was indicated using a short text.
- Attribute units: the attributes as well as their units were explained in a tool-tip text of up to about 100 words.
- Graphic information: the projects were explained using illustrations.
- Location information: no location information was provided other than that the projects applied to the generic neighbourhood as described earlier.

Transition in Hengstdal, Nijmegen:

- Project descriptions: in the form of texts.
- Attribute values: both numerical information and short texts.
- Attribute units: shown directly behind the attribute values.
- Graphic information: no graphic information was provided.
- Location information: no location information was provided other than that the projects applied to the neighbourhood of Hengstdal.

Framing experiment:

- Project descriptions: in the form of texts of up to about 100 words. These included a description and, depending on the experimental design as explained below, (dis)advantages of the project.
- Attribute values: only numerical information.
- Attribute units: The units of the attributes were included in the attribute title.
- Graphic information: no graphic information was provided.
- Location information: no location information was provided.

Element 3 - Debriefing:

Within the framing experiment the respondents are thanked for their participation and, in line with the experimental design, they are told that they may have been shown information that was framed towards a certain decision. Also, the respondents were provided with the email address of the researcher for any questions or remarks that remained. The other reviewed PVE applications do not discuss the debriefing of respondents.

Element 4 - Online tool design options:

Flood protection scheme: as this was the first application the basic online tool aspects are discussed in the report.

- The ability for respondents to sort the projects in the main screen based on the attribute levels.
- The ability for respondents to compare projects in a comparison screen.
- The provision of detailed information accessed through an information button.
- The ability for respondents to adjust the tax rate and with that change the budget (depending on the experimental setup).

[4]A tool-tip is a text that only is displayed when the user hovers the mouse indicator over the attribute title

Transport investment scheme : the options were identical to those in the flood protection scheme.
USWM in The Hague: in addition to the sorting, comparison and information options applied in the large PVEs, the report mentions the following online tool design options.

- The ability for respondents to select projects multiple times.
- Generic location information.
- No delegation option.
- Fixed budget.
- Reporting of cumulative impact, related to the ability to select project multiple times.

Transition in Hengstdal, Nijmegen: in addition to the sorting, comparison and information options applied in the large PVEs, for this PVE survey the main page of the online tool was changed considerably.

- A progress bar indicating the extent to which the budgetary attribute of renewable energy generation is achieved.
- A table with an overview of impacts of the selected alternative
- A pie chart indicating the decrease in energy consumption in 2045.
- The option to assign a colour to the circle next to the project title that indicates the budgetary attribute level.
- A text section with a narrative text that conveys the same information as the progress bar and pie chart

Framing experiment: no online tool design options are discussed in the report.

Element 5 - Testing:
None of the reviewed PVE applications discuss the applied testing process.

Phase III - Execution & Analysis
This section discusses the elements of the reviewed PVE applications that fall within phase III of the applied framework.

Element 1 - Respondents:
Flood protection scheme: the target group consisted of people living in the Netherlands as well as people living in the direct vicinity of the river 'de Waal' specifically. The respondents were recruited through a survey company and they were provided with a financial compensation. The respondents had a financial incentive to construct their own portfolio as the financial compensation from the survey company would be lower when the choice was delegated. The study gathered 2,900 valid responses, of which 20% delegated their choice.

Transport investment scheme : the target group consisted of people living within the area managed by the TAA. The respondents were recruited through a survey company and they were provided with a financial compensation. The respondents had a financial incentive to construct their own portfolio as the financial compensation from the survey company would be lower when the choice was delegated. The study gathered 2,498 valid responses, of which 15% delegated their choice.

USWM in The Hague: the target group consisted of residents of The Hague. Letters were sent to randomly sampled postal codes with persons 18 years and older within the municipality of The Hague. No financial incentive was offered. The study gathered 146 valid responses.

Transition in Hengstdal, Nijmegen: the target group consisted of people living in the Hengstdal neighbourhood were recruited through a flyer campaign in the neighbourhood after other promotional efforts failed to materialise. No financial incentive was offered. The study gathered six valid responses.

Framing experiment: the target group consisted of people living in the Netherlands were recruited in two ways: through an online news article on PVE and bicycle policy where people could indicate that they were interested in participating in a study and through a flyer campaign at the Delft University of

Technology. No financial incentive was offered. The study gathered 181 valid responses.

Element 2 - Analysis of results:

Flood protection scheme:

- MDCEV behavioural choice model estimation: the taste parameters of the levels of biodiversity and recreation attributes were found to be significantly different from zero. Meanwhile, the taste parameters for the other attributes were either insignificant or did not have the expected sign.
- SWF: all combination projects had a probability of over 50% of increasing social welfare with respect to the associated classical projects and shifting the remaining budget. The large road expansion project only had a 31% probability of increasing social welfare and therefore that project should not be implemented, based on this analysis. The remaining projects all had probabilities over 50% of increasing social welfare.
- Analysis of qualitative statements on motivation: the main reasons mentioned by respondents for their choice for the combination projects related to the increase in recreational opportunities as well as improved variety in biodiversity. The methodology applied in the analysis is not mentioned.

Transport investment scheme :

- MDCEV behavioural choice model estimation: the resulting taste parameters indicated that all project specific taste parameters were significantly different from zero. Also, out of the taste parameters for the levels of specific attributes only those related to safety, namely the prevention of traffic deaths and the prevention of severe traffic injuries, were significantly different from zero.
- Analysis of SWF: out of the total of 16 projects, seven projects were found to have a probability of increasing social welfare higher than 50%. These included all four projects of the safety type, one project related to slow modes (cycling and walking), one project of the car type, and one project of the bus type. One project, of the cycling type, was found to be neutral with exactly 50% probability. The remaining eight projects were found to have a lower than 50% chance of increasing social welfare. However, the majority of probabilities were found to be close to 50% and this points to a high uncertainty for eventual policy recommendations based on these outcomes.
- Analysis of qualitative statements on motivation: two rounds of coding were executed with the first serving to identify categories and the second serving to assign each statement to a category. Subsequently the motivations mentioned by respondents were categorised further into four main categories, namely 1) fully related to traditional goals of transport planning, 2) closely related to traditional goals of transport planning, 3) related to broader goals of transport planning, and 4) other motivations.

USWM in The Hague:

- MDCEV behavioural choice model estimation: due to the low number of respondents this analysis was not possible.
- Analysis of SWF: due to the low number of respondents this analysis was not possible.
- Analysis using frequency tables: the projects green spaces along roads and permeable paving on roads were selected most often. The projects water cellar in public building or under public square, square with rainwater storage function, and construction of housing at an elevated level with respect to street level were selected least often.
- Analysis of qualitative statements on motivation: these were coded with the aim of establishing categories of motivations that were mentioned most often. Two motivations were found to be most important: the addition of green space and the effectiveness in preventing superfluous water events.

Transition in Hengstdal, Nijmegen: due to the low number of valid responses the results are not discussed further here.

Framing experiment:

- Analysis of MDCEV & SWF: the attribute levels were not varied and therefore the MDCEV analysis was not possible.

- Analysis using frequency tables: analysis of the data indicated that there were significant differences between the choices made by respondents who were provided information that was framed differently.
- Analysis of qualitative statements on motivation: the participants were not asked to motivate their project selection.

Element 3 - Policy advice:

the flood protection scheme and transport investment scheme PVEs resulted in policy advice, based on the quantitative and qualitative results, to the Ministry and the Transport Authority of Amsterdam, respectively. The USWM PVE resulted in policy advice based on the qualitative statements to decision-makers on USWM. The transition PVE did not yield sufficient responses to provide policy advice to the Nijmegen municipality. The framing experiment considered a generic city and did not have the aim of providing advice. A detailed discussion of the determination of policy advice resulting from the PVE surveys is not deemed to be of considerable interest in this review. Therefore, the reader is referred to the applicable publications.

C

Promotion

In the promotion process the channels as listed below were used and an example of a promotional poster is shown in figure C.1.

- Direct WhatsApp messages to the researcher's personal and professional network:
  - Friends.
  - Fellow students at the faculty of Technology, Policy, and Management.
  - Fellow members of the researcher's student society of D.S.V. Sint Jansbrug.
  - Neighbours.
  - Former co-workers.
- Putting up posters:
  - 43 posters at Delft University of Technology buildings.
  - 15 posters at various locations in Delft: supermarkets, three community centres, and the public library.
  - 2 posters at the Yes! Delft start-up incubator building.
- Social media posts:
  - On the researcher's personal LinkedIn page.
  - On the LinkedIn page of former members of the student society mentioned earlier.
  - On the Facebook group of former members of the student society mentioned earlier.
  - On the Facebook group of current members of the student society mentioned earlier.
  - On the Facebook group of the researcher's neighbourhood.
  - On the researcher's personal Facebook page.
- Emails to the city council groups and boards of all local political parties:
  - GL
  - D66
  - STIP
  - PvdA
  - SP
  - CU
  - Onafhankelijk Delft
  - Stadsbelangen Delft
  - CDA
  - VVD
- The municipality was also approached and asked whether they would distribute the survey, but they declined because their policy is to only distribute surveys that they set up or cooperate with.

Figure C.1: Example of a promotional poster/flyer that was used

D

Results PVE survey

This appendix presents the results of the PVE that was conducted for the variation experiment, as described in chapter 6. These results are used to formulate policy advice to the municipality of Delft.

In this analysis, the results of the two variations are taken together. Considering the limited impact that the variation had the combined results are considered to be valid. The construction of an ideal project portfolio, as was done in the large scale PVEs of the transport authority in Amsterdam and the flood protection investment scheme, is not possible in this case because the applied budgetary constraint was not based on actual policy considerations. Instead, per project the results are discussed and indications are given as to whether the project could be expected to result in societal value based on the outcome. The policy advice is accompanied by a disclaimer explaining the limited sample size, the limited degree of representation of the Delft population within the sample, and the inclusion of non-Delft residents in the sample.

First, the sample characteristics are discussed in section D. Then, selected reflections on the survey and methodology are discussed in section D. The quantitative and qualitative analysis are presented in sections D and D. Finally, the outcomes are discussed in section D.

Sample characteristics

In this section the votes and postal codes are addressed in more detail. For an overview of the other SDCs the reader is referred to the sample characteristics as presented in the previous chapter, which showed that highly educated, studying, young males were overrepresented. A great majority of the participants visit the TU Delft campus on a daily basis and travel mainly by bicycle.

Table D.1 presents the reported votes, together with an overview of the percentages of votes that each party received in the Delft municipal elections of 2018. A clear overrepresentation of GL, STIP, D66, and VVD can be observed, while the other parties are highly underrepresented. Of the 169 participants 26 reported to not have had the rights to vote at the time, corresponding to 15.4% of the sample.

Table D.2 presents the reported postal codes. The postal codes that have been reported show that the neighbourhoods of the inner city (Binnenstad), Voorhof, and Wippolder are overrepresented. This can be explained by the overrepresentation of students because these neighbourhoods have a comparatively large student population with 10.6%, 19.4%, and 39.8% of students living within Delft situated in those neighbourhoods (Gemeente Delft, 2019a). Buitenhof is another neighbourhood with a large student population with 12.7% of students within Delft living there, but this is not reflected in the reported postal codes. Residents of the neighbourhoods of Tanthof-West and Tanthof-Oost, which are directly impacted by several of the proposed projects, are represented to a limited extent in the sample.

The survey could also be completed by participants who work or study in Delft, but who do not live there. The table shows that 28 respondents reported to not live in Delft, corresponding to 16.6% of the sample.

Table D.1: PVE survey, reported votes with a comparison to the Delft 2018 municipal election results (Griffie Delft, 2018)

	Count	Distribution of sample	Distribution in election
I was not eligible to vote	26		
GL (green party)	31	24%	16%
STIP (student party)	45	35%	15%
D66 (social-liberal)	29	22%	14%
Onafhankelijk Delft (local party)	0	0%	12%
VVD (conservative-liberal)	16	12%	9%
CDA (christian)	3	2%	8%
SP (socialist)	1	1%	8%
PvdA (labour)	1	1%	7%
CU (christian)	3	2%	6%
Stadsbelangen Delft (local party)	1	1%	6%
I did not vote	3		
Prefer not to say	5		
NA	5		

Table D.2: PVE survey, reported postal codes with a comparison to the distribution of residents among Delft neighbourhoods (Gemeente Delft, 2019a)

			Sample count	Distribution of sample	Distribution of residents	Distribution of students
Within Delft	Neighbourhood	Code	137	%	%	%
	Binnenstad	2611	30	21.9%	12.0%	10.6%
	Vrijenban	2612	9	6.6%	9.4%	6.8%
	Hof van Delft	2613	16	11.7%	12.7%	6.7%
	Voordijkshoorn	2614	8	5.8%	11.9%	2.3%
	Delftse Hout	2616	0	0.0%	0.1%	0.0%
	Tanthof-West	2622	3	2.2%	7.8%	0.2%
	Tanthof-Oost	2623	3	2.2%	5.8%	1.4%
	Voorhof	2624	24	17.5%	13.2%	19.4%
	Buitenhof	2625	6	4.4%	13.3%	12.7%
	Abtswoude	2626	0	0.0%	0.0%	0.0%
	Schieweg	2627	1	0.7%	1.2%	0.0%
	Wippolder	2628	37	27.0%	12.3%	39.8%
	Ruiven	2629	0	0.0%	0.3%	0.0%
Near Delft			8			
The Hague			6			
Rotterdam			4			
Other			10			
NA			4			

Reflection on survey and methodology

Table D.3 presents the responses to seven of the eight statements. Statement 5 related to the manipulation and was discussed in detail in the previous chapter.

Statement 1, *I am convinced of my choices in this experiment*, shows that a majority of participants is convinced of their choice. Statement 2, *I received sufficient information in this research to make a choice*, shows that opinions vary from fully agree to neutral and disagree.

Statement 3, *I fully understood the information in this research*, shows that almost all participants fully understood the information. Statement 4, *I think that the information that was provided to me in this research was relevant*, shows that most participants considered the provided information relevant.

Statement 6, *I feel that this experiment was realistic*, shows that participants do not consider the experiment highly realistic as the majority chose agree/neutral.

Statement 7, *I think that the outcomes of this research can help the municipality in making deci-*

sions concerning this type of infrastructural projects, shows that the participants regard the research outcomes as useful to the municipality. Statement 8, *I think that the municipality should apply this method more often to involve citizens in policy choices*, shows that opinions vary greatly with a large group (fully) agreeing to the statement but also with a considerable group who chose neutral or (fully) disagree.

Table D.3: PVE survey, responses to selected Likert-scale statements

	Fully agree	Agree	Neutral	Disagree	Fully disagree	NA
Statement 1 - *I am convinced of my choices in this experiment.*	25	104	23	14	1	2
Statement 2 - *I received sufficient information in this research to make a choice.*	32	75	37	20	3	2
Statement 3 - *I fully understood the information in this research.*	68	74	13	9	2	3
Statement 4 - *I think that the information that was provided to me in this research was relevant.*	50	84	16	11	2	5
Statement 6 - *I feel that this experiment was realistic.*	24	70	56	16	1	2
Statement 7 - *I think that the outcomes of this research can help the municipality in making decisions concerning this type of infrastructural projects.*	39	87	24	12	4	3
Statement 8 - *I think that the municipality should apply this method more often to involve citizens in policy choices.*	37	63	38	18	9	4

Quantitative analysis

456 projects were selected in total and figure D.1 presents the counts per project. Projects 3, 5, and 6, corresponding to the Gelatine bicycle tunnel, the Faraday bridge, and the Faraday bicycle tunnel, are selected most often. Between the two parking facilities the Transferium is selected more often than the Park&Bike facility. The ramp to the A13 is selected least often, but this was the most expensive project.

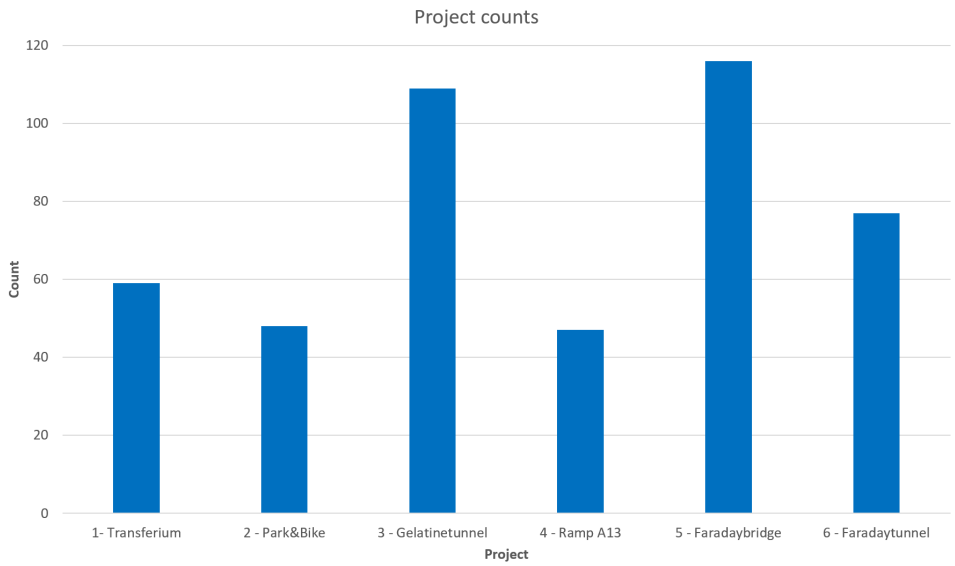


Figure D.1: PVE survey, project counts

Qualitative analysis

In total 654 statements were identified within the motivations provided by the respondents. No motivations were provided for 42 projects, corresponding to 9.2% of all selected projects. The statements

were coded using the six main categories, as presented in section 3.3. Per category several example statements are quoted in appendix M. The counts and percentages of the main categories are shown in table D.4.

Table D.4: PVE survey, counts and percentages of main motivation categories

	Count	Percentage
Traditional goals	183	28.0%
Closely related to traditional goals	122	18.7%
Broader goals	102	15.6%
Case specific	90	13.8%
Synergy of projects	81	12.4%
Other motivations	76	11.6%

Figure D.2 shows the percentages for categories that have a share of at least 5%. The traditional goal of travel time and congestion reduction is clearly the motivation mentioned most often, indicating that participants feel that travel time is highly important and that currently congestion is considered an issue. Choices based on the projected impacts and improved accessibility, closely related to traditional goals, following second and third. The motivations related to improved accessibility show that participants are concerned that Delft is divided by (natural) boundaries in the form of the river Schie and the train tracks, and that participants want to bring the various neighbourhoods closer together by facilitating more options to cross these boundaries. The goals of promoting public transport and cycling and reducing traffic-related burdens to the city centre and campus are also mentioned often, indicating that participants prefer people cycling or using public transport over using cars and that many participants consider the impacts of traffic on the city centre and campus problematic.

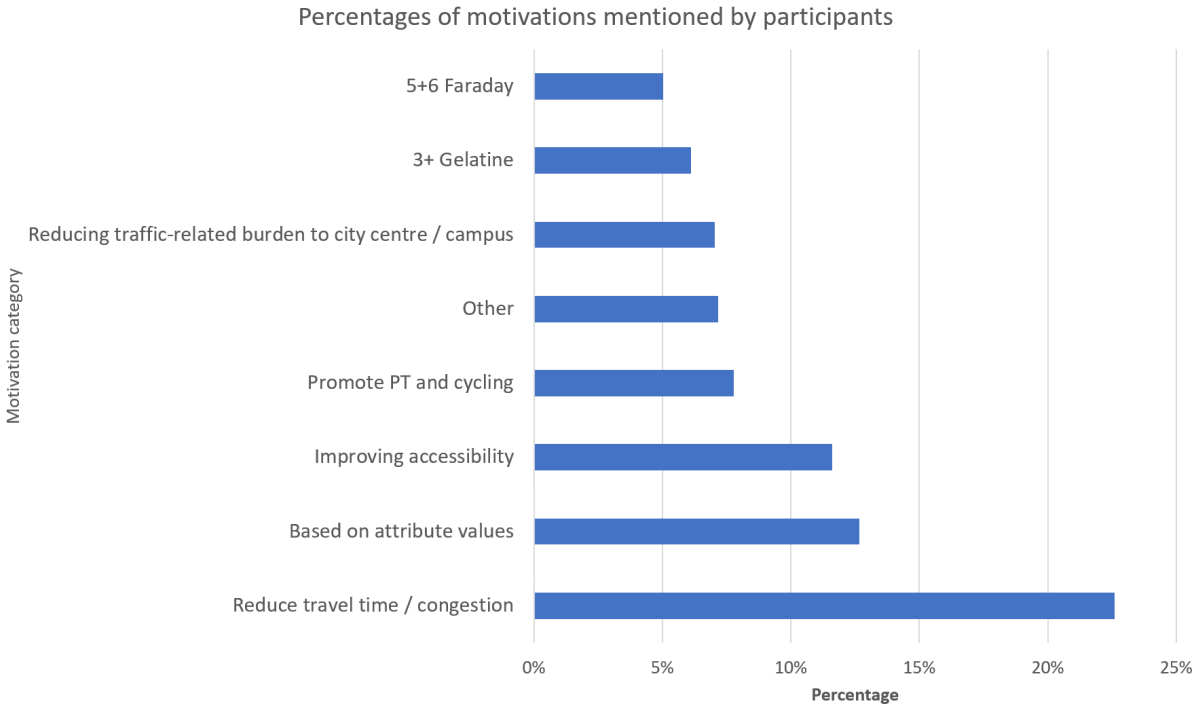


Figure D.2: PVE survey, categories of motivations with a share of 5% or higher

Table D.5 presents the counts and percentages of the main categories of motivations per project. These counts and percentages are discussed per project:

Project 1 - Transferium: this project was chosen mostly based on traditional goals and closely related to traditional goals. Within that first category falls the addition of new parking spaces and the second category focused on reducing traffic related burdens to the city centre and campus. Also, four refer-

ences were made to synergy with other projects or the new tram line.

Project 2 - Park&Bike: choices were mostly based on the closely related to traditional goal of reducing traffic related burdens to the city centre and campus. Also, the broader goals of improving health, promoting cycling and substituting the last mile of car traffic by cars were mentioned. For this project no synergy applies.
Project 3 - Gelatine bicycle tunnel: the motivations mentioned for this project related to the traditional goal of reducing travel time and the broader goal of promoting cycling. And a large share of motivations mentioned the synergy with the Gelatine bicycle bridge that will be constructed, indicating that participants do not consider the connection to be complete without this tunnel. For the combination of Gelatine tunnel and bridge many participants mentioned the problematic traffic situations that existed on the surrounding roads where cyclists and cars meet as well as the overburdened existing bridges. For this project some participants mentioned that it could improve safety, which also indicates that the current situation is problematic.
Project 4 - Ramp A13: the largest share of motivations related to traditional goals of travel time reduction, but participants were also swayed by the large projected impacts that were projected for this project. Broader goals and synergy hardly apply to this project.
Project 5 - Faraday bridge: motivations for this project are distributed over traditional goals, closely related to traditional goals, and the attribute values. Within these, reduction in travel time, improving accessibility of neighbourhoods and the campus, and the projected impacts were mentioned often. The broader goals of promoting cycling and equity considerations were also mentioned repeatedly. The synergy between this project and the Faraday bicycle tunnel was also mentioned .
Project 6 - Faraday bicycle tunnel: the motivations for this project are distributed across different categories, with the broader goal of promoting cycling and the synergy between this project and the Faraday bridge mentioned most often.

Table D.5: PVE survey, main categories of motivations per project

	Project 1		**Project 2**		**Project 3**		**Project 4**		**Project 5**		**Project 6**	
Traditional goals	23	27%	11	17%	54	34%	26	40%	48	28%	21	19%
Closely related to traditional goals	23	27%	17	27%	20	13%	7	11%	38	22%	17	15%
Broader goals	8	10%	12	19%	25	16%	2	3%	30	17%	25	22%
Case specific	8	10%	6	10%	9	6%	18	28%	34	20%	15	13%
Synergy of projects	4	5%	0	0%	40	25%	1	2%	13	8%	23	21%
Other motivations	18	21%	17	27%	10	6%	11	17%	9	5%	11	10%

Conclusions

The results of the PVE survey show that the Gelatine and Faraday projects were selected much more often than the other projects. Within these, the Faraday bridge is the most popular project, closely followed by the Gelatine bicycle tunnel.

The provided motivations show that the Faraday bridge was chosen mainly because of the reduction in travel time, to improve the accessibility of the neighbourhoods in the south-west corner of Delft, and based on the projected impacts.

The Gelatine tunnel was mostly chosen because of the synergy with the planned Gelatine bridge and reductions in travel time and congestion that participants expect from this project. Participants mentioned current issues with congestion, overburdened existing bridges and crossings, and safety concerns.

The Faraday tunnel was the third favourite project and in the underlying motivations no clear pattern could be distinguished.

The relatively low and comparable frequencies with which the two parking projects were selected indicate that neither project is particularly popular. But, when the counts of these two projects are combined they rank third with a count of 107. This does indicate that participants consider parking facilities with some sort of connection to the city centre and campus a good idea. The motivations mentioned for both projects show that extra parking spaces are considered necessary by a share of

the population and that another main motivation is the reduction of traffic related burdens to the city centre and campus, which appears to be perceived as an issue.

Finally, a new ramp for highway A13 at the Technopolis was chosen with the lowest count. However, it was also by far the most expensive project and therefore the final share is unexpectedly high. The main motivations that were mentioned concerned the travel time and congestion reduction as well as the high projected impacts.

Considering that investment in the Gelatine bridge has already been planned and based on the outcomes of the survey it is recommended that the Gelatine bicycle tunnel is constructed. Also, the Faraday bridge was perceived positively by so many participants that it is recommended to be considered for construction as well. The Faraday tunnel was chosen often as well, but when considering the combined count of the parking projects Transferium and Park&Bike a parking facility on or near the Technopolis area with the combination of an easy transfer to the tram as well as rental bicycles, such a project might deserve preference. On their own these parking projects should not be realised, based on these outcomes. Finally, a new ramp for the A13 is perceived unexpectedly positively, especially when considering the sample characteristics. Based on these outcomes it is recommended to study this project in more detail to determine whether it would indeed yield the travel time and congestion reductions that were used in this project. Based on the results none of the projects can be discarded outright.

E

Attribute levels

Sources for attribute levels

- 2005 - Local transport plan of the municipality of Delft *LVVP* (Gemeente Delft: Wijk- en Stadszaken, 2005b)
  - Expected cost of project 3 Gelatine bicycle tunnel is €3.0 million.
  - Expected cost of project 5 Faraday bridge is €2.0 million.
  - Expected cost of project 6 Faraday bicycle tunnel is €3.4 million.
  - Expected number of cyclists for project 3 Gelatine bicycle tunnel is 1,000.
  - Expected number of cyclists for project 5 Faraday bridge is 2,600.
  - Expected number of cyclists for project 6 Faraday tunnel is 4,400.
- 2011 - Masterplan Technological Innovation Campus (Gemeente Delft: Centrale Staf, 2011)
  - Expected cost of project 4 ramp A13 is €20.0 million.
- 2016 - Conceptual regional investment programme Rotterdam-The Hague Metropolitan Region *MRDH* (Gemeente Delft: Bestuur, 2016b)
  - Expected cost of project 4 ramp A13 is €20.0 million.
- 2018 - Administrative agreements Delft municipality – Province of South Holland (Gemeente Delft & Provincie Zuid-Holland, 2018)
  - Expected cost of project 5 Faraday bridge is between €8 million and €13 million.
- 2018 – Province of South Holland traffic intensities of provincial roads (Staat van Zuid-Holland, 2019)
  - Number of vehicles measured on a working day on the N470/Kruithuisweg between the Schoemakerstraat and the A13 connection west is 51,261 (both directions combined).
  - Number of vehicles measured on a working day on the N470/Kruithuisweg between the Schieweg and the Schoemakerstraat is 48,160 (both directions combined).
- For the change in travel times for cyclists between the various areas mentioned in the attributes estimates were made using Google Maps.

The original expected cost of €3.0 million in 2005 for the Gelatine bridge have risen to €16.0 million currently. Also, the expected cost of project 5 Faraday bridge have risen from €2.0 million to €8.0-13.0 million. Therefore, the cost for the tunnels are assumed to also have risen considerably.

Attribute level variation for variation experiment

For the variation experiment the attribute levels were varied over 15 treatment combinations. The minimum and maximum levels that were applied are shown in table E.1. These were loaded into a Matlab script that continually generated 15 treatment combinations and computed the correlation between the attribute levels of the 15 combinations. This was an iterative process in which whenever a combination was found with a lower correlation that combination was saved. Eventually, after 1,386,886 iterations the process was stopped and the final combination, which was found after 755,072 iterations, was applied. The original Matlab script, which was adapted for the number of projects and attributes for this research, was used for the treatment combination generation of the flood protection PVE survey (Hernández, personal communication December 2nd 2019).

Table E.1: Variation experiment: minimum and maximum cost & attribute levels

		Cost		A - Change in travel time for car users at peak times around the Campus		B - Change in travel time for cyclists between Tanthof and Campus		C - Change in travel time for cyclists between Voorhof and Campus		D - Daily number of direct users on a bicycle		E - Daily number of direct users in a car	
		[Million €]		[Minutes]		[Minutes]		[Minutes]		[# of direct users on bicycles]		[# of direct users with a car]	
		min	max	min	max	min	max	min	max	min	max	min	max
Project 1	Transferium Technopolis	10	15	-2	-6	1	-1	1	-1	0	0	500	1500
Project 2	Park and bike at several locations	10	15	-2	-4	1	0	1	0	500	1000	500	1500
Project 3	Gelatine bicycle tunnel under train tracks	10	15	0	-2	0	-2	-2	-6	1000	2000	0	0
Project 4	New ramp A13 for Technopolis	20	30	-4	-6	1	-2	1	-2	0	0	15000	25000
Project 5	Faraday bridge over the Schie river	10	15	-4	-6	-2	-6	0	-2	3000	4500	5000	10000
Project 6	Faraday bicycle tunnel under train tracks	10	15	0	-3	-2	-6	0	-2	4000	5000	0	0

F

Follow-up questions

This appendix first presents the follow-up questions for the process tracing study both in English and Dutch. Subsequently, the changes applied to the variation experiment are given.

English

We ask you several questions:
Do you agree with the following statements? [1]

1. I am convinced of my choices in this experiment.
2. I felt fully informed on the options in this experiment.
3. I feel that this experiment was realistic.
4. I think that the outcomes of this experiment can help the government in making decisions concerning this type of infrastructural projects.
5. I think that it would be good for the government to aim for involving citizens in decision-making processes concerning transport projects through surveys such as this one.

I visit the campus of the TU Delft with this frequency:

- Several times a day
- Once a day
- Several times a week
- Several times a month
- Several times a year
- (Almost) never

Dutch

We stellen u nog enkele vragen:
Bent u het eens met de volgende uitspraken?[2]

1. Ik ben overtuigd van mijn keuzes in dit experiment.
2. Ik ben volledig geïnformeerd over de opties in dit experiment.
3. Ik vind dat dit een realistisch experiment is.
4. Ik denk dat de uitkomsten van dit experiment de overheid zouden kunnen helpen in hun besluitvorming over dit soort infrastructurele projecten.
5. Ik denk dat het goed zou zijn als de overheid mij vaker om mijn mening zou vragen over dit soort infrastructurele projecten via onderzoeken als deze.

Ik bezoek de campus van de TU Delft met deze frequentie:

- Meerdere keren per dag
- Een keer per dag
- Meerdere keren per week
- Meerdere keren per maand
- Meerdere keren per jaar
- (Bijna) nooit

[1] Likert-scale: Fully disagree, disagree, neutral, agree, fully agree
[2] Likert-scale: Helemaal mee oneens, mee oneens, neutraal, mee eens, helemaal mee eens

English

This is the travel mode that I use most on a regular working day (based on covered distance):

- Bike
- Car
- Bus, tram or metro
- Train
- Walking
- Other

In the latest Delft municipal elections of 2018 I voted for this party:

- GL (GroenLinks)
- STIP (Studenten Techniek in Politiek)
- D66 (Democraten 66)
- Onafhankelijk Delft
- VVD (Volkspartij voor Vrijheid en Democratie)
- CDA (Christen-Democratisch Appèl)
- SP (Socialistische Partij)
- PvdA (Partij voor de Arbeid)
- CU (ChristenUnie)
- Stadsbelangen Delft
- I was not eligible to vote in the Delft municipal elections
- I did not vote
- Prefer not to say

These are the four digits of my postal code:

- ...

My gender:

- Female
- Male
- Prefer not to say

Dutch

Dit is het vervoersmiddel dat ik op een gemiddelde werkdag het meest gebruik (gebaseerd op afgelegde afstand):

- Fiets
- Auto
- Bus, tram of metro
- Trein
- Lopend
- Anders

Bij de afgelopen Delftse gemeenteraadsverkiezingen in 2018 heb ik op deze partij gestemd:

- GL (GroenLinks)
- STIP (Studenten Techniek in Politiek)
- D66 (Democraten 66)
- Onafhankelijk Delft
- VVD (Volkspartij voor Vrijheid en Democratie)
- CDA (Christen-Democratisch Appèl)
- SP (Socialistische Partij)
- PvdA (Partij voor de Arbeid)
- CU (ChristenUnie)
- Stadsbelangen Delft
- Ik had geen stemrecht binnen de gemeente Delft
- Ik heb niet gestemd
- Dit zeg ik liever niet

Dit zijn de vier cijfers van mijn postcode:

- ...

Mijn geslacht:

- Vrouw
- Man
- Zeg ik liever niet

English

My age:

- 18 – 25 years
- 26 – 35 years
- 36 – 45 years
- 46 – 55 years
- 56 – 65 years
- 65+ years
- Prefer not to say

The highest level of education that I followed or follow is:

- Lower education (basisschool)
- Middle education (middelbare school)
- Vocational education (MBO)
- Higher education (HBO, WO)
- Prefer not to say

My current situation is best described as:

- I work more than 32 hours per week
- I work between 16 and 32 hours per week
- I work less than 16 hours per week
- Currently I have no job, but I am searching for one
- Currently I have no job and I am not searching for one
- I am studying
- I am retired
- I have been declared unfit for work
- Other
- Prefer not to say

If you want to participate in the prize draw and want to have a chance of winning one of the four prizes of €25,- you can enter your email address here:

- ...

We are busy improving this method of research. Do you have any suggestions as a result of your experience today?

- ...

Dutch

Mijn leeftijd:

- 18 – 25 jaar
- 26 – 35 jaar
- 36 – 45 jaar
- 46 – 55 jaar
- 56 – 65 jaar
- 65+ jaar
- Zeg ik liever niet

Het hoogste opleidingsniveau dat ik heb gevolgd of nu volg is:

- Basisonderwijs (basisschool)
- Middelbaar onderwijs (middelbare school)
- Middelbaar beroepsonderwijs (MBO)
- Hoger onderwijs (HBO, WO)
- Zeg ik liever niet

Mijn huidige situatie wordt het best beschreven als:

- Ik werk meer dan 32 uur per week
- Ik werk tussen de 16 en 32 uur per week
- ik werk minder dan 16 uur per week
- Ik heb op dit moment geen baan, maar ik ben op zoek
- Ik heb op dit moment geen baan en ik ben ook niet op zoek
- Ik studeer
- Ik ben gepensioneerd
- Ik ben arbeidsongeschikt verklaard
- Anders
- Zeg ik liever niet

Als u mee wilt doen met de trekking en kans wilt maken op één van de vier prijzen van €25,- kunt u hier uw emailadres achterlaten:

- ...

Wij zijn bezig deze methode van onderzoek beter te maken. Heeft u nog suggesties naar aanleiding van uw ervaring vandaag?

- ...

Changes applied to the variation experiment

English

Do you agree with the following statements?

1. I am convinced of my choices in this experiment. *[no changes]*
2. I received sufficient information in this research to make a choice.
3. I fully understood the information in this research.
4. I think that the information that was provided to me in this research was relevant.
5. I used the information on travel time and the number of direct users while making my decision.
6. I feel that this experiment was realistic. *[no changes]*

7. I think that the outcomes of this research can help the municipality in making decisions concerning this type of infrastructural projects.
8. I think that the municipality should apply this method more often to involve citizens in policy choices.

This information I found most important: *[added]*
This information I found least important: *[added]*

- The cost per project
- Change in travel time for car users at peak times around the Campus.
- Change in travel time for cyclists between Tanthof and Campus.
- Change in travel time for cyclists between Voorhof and Campus.
- Daily number of direct users on a bicycle.
- Daily number of direct users in a car.

I visit the campus of the TU Delft with this frequency: *[Change in options]*

- Daily
- Weekly
- Monthly
- Yearly
- (Almost) never

Dutch
Bent u het eens met de volgende uitspraken?

1. Ik ben overtuigd van mijn keuzes in dit experiment.
2. Ik kreeg in dit onderzoek voldoende informatie om een keuze te maken.
3. Ik begreep de informatie in dit onderzoek volledig.
4. Ik denk dat de informatie die mij gegeven werd in dit onderzoek relevant was.
5. Ik heb de informatie over reistijd en aantal directe gebruikers gebruikt bij het maken van mijn beslissing.
6. Ik vind dat dit een realistisch experiment is.
7. Ik denk dat de uitkomsten van dit experiment de overheid zouden kunnen helpen in hun besluitvorming over dit soort infrastructurele projecten.
8. Ik vind dat de gemeente deze methode zou moeten inzetten om bewoners te betrekken bij beleidskeuzes.

Deze informatie vond ik het meest belangrijk:
Deze informatie vond ik het minst belangrijk:

- De kosten per project.
- Verandering reistijd voor automobilisten op piekmomenten rondom de Campus.
- Verandering reistijd voor fietsers tussen Tanthof en de Campus.
- Verandering reistijd voor fietser tussen Voorhof en de Campus.
- Dagelijks aantal directe gebruikers op de fiets.
- Dagelijks aantal directe gebruikers in de auto.

Ik bezoek de campus van de TU Delft met deze frequentie: *[Verandering keuzes]*

- Dagelijks
- Wekelijks
- Maandelijks
- Jaarlijks
- (Bijna) nooit

English

This is the travel mode that I use most on a regular working day (based on covered distance): *[No change]*

In the latest Delft municipal elections of 2018 I voted for this party: *[Option of being non-eligible to vote moved to first position]*

My gender: *[No change]*

My age: *[No change]*

The highest level of education that I follow or followed is: *[Changed order to stress that the current education is leading]*

My current situation is best described as: *[No change]*

These are the four digits of my postal code: *[Placed at bottom of questionnaire]*

If you want to participate in the prize draw and want to have a chance of winning one of the four prizes of €25,- you can enter your email address here: *[No change]*

We are busy improving this method of research. Do you have any suggestions as a result of your experience today? *[Changed wording]*

Dutch

Dit is het vervoersmiddel dat ik op een gemiddelde werkdag het meest gebruik (gebaseerd op afgelegde afstand): *[Geen verandering]*

Bij de afgelopen Delftse gemeenteraadsverkiezingen in 2018 heb ik op deze partij gestemd: *[Optie van niet stemgerechtigd zijn naar eerste positie]*

Mijn geslacht: *[Geen verandering]*

Mijn leeftijd: *[Geen verandering]*

Het hoogste opleidingsniveau dat ik nu volg of heb gevolgd is: *[Veranderde volgorde om te benadrukken dat huidige opleiding leidend is]*

Mijn huidige situatie wordt het best beschreven als: *[Geen verandering]*

Dit zijn de vier cijfers van mijn postcode: *[Onderaan de vragenlijst geplaatst]*

Als u mee wilt doen met de trekking en kans wilt maken op één van de vier prijzen van €25,- kunt u hier uw emailadres achterlaten: *[Geen verandering]*

Wij zijn bezig deze methode van onderzoek beter te maken. Heeft u nog suggesties naar aanleiding van uw ervaring vandaag? *[Verandering in verwoording]*

G

Survey content process tracing study

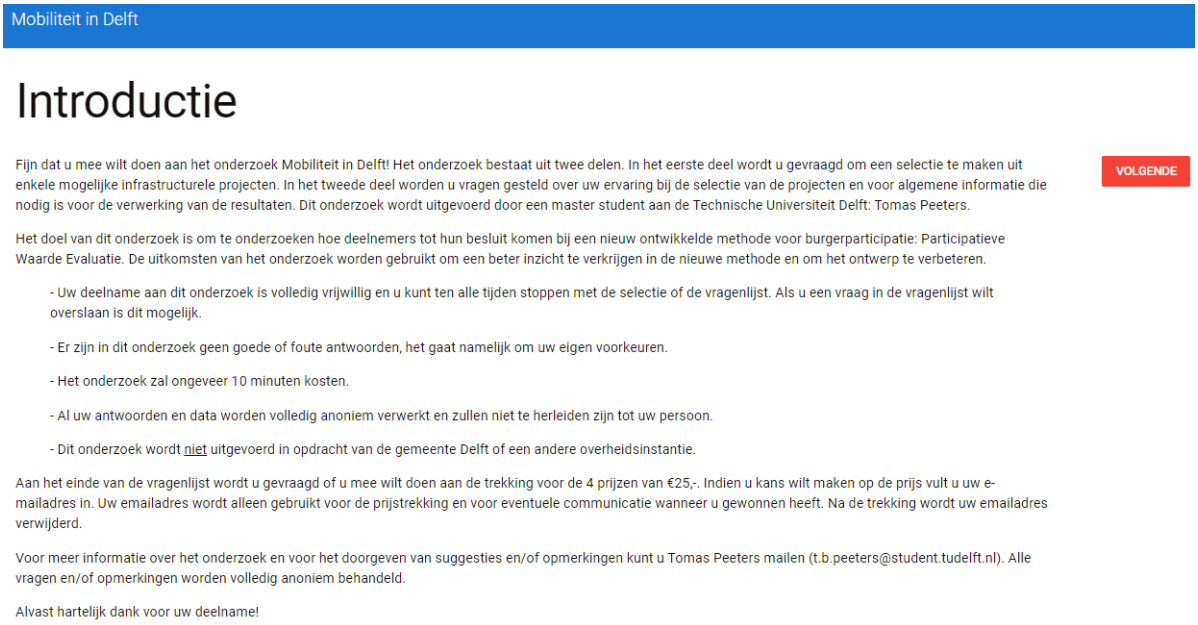


Figure G.1: Process tracing study: screenshot of landing page

Mobiliteit in Delft

Informatie

Dit experiment gaat over de bereikbaarheid van de universiteitscampus van de TU Delft en de directe omgeving. Het aantal studenten en medewerkers aan de universiteit is flink gestegen in de afgelopen jaren en dagelijks komen er 27.000 mensen naar dit gebied. Al deze bezoekers hebben een grote invloed op het verkeer op de campus en de wegen eromheen. Hierdoor hebben ook bewoners en bezoekers van bijvoorbeeld de wijken Tanthof, Voorhof, Wippolder en de binnenstad last van vertragingen tijdens de spits.

Op dit moment liggen er plannen om het gebied Schieoevers-Noord te ontwikkelen als woon-, werk- en recreatiegebied. En ook zal het Technopolis bedrijventerrein verder uitgebreid worden. Dit zal zorgen voor nog meer verkeer en vertragingen.

Ook is het op dit moment lastig om vanuit de wijken Tanthof en Voorhof naar de universiteitscampus te komen omdat er weinig plekken zijn om het spoor en de rivier de Schie over te steken.

Daarom zijn er plannen om de bereikbaarheid te verbeteren. Maar er is niet genoeg geld om al deze projectplannen uit te voeren. Daarom moeten er keuzes gemaakt worden. Wij vragen u in dit onderzoek om die keuze te maken en het beschikbare geld uit te geven aan de projecten die u het belangrijkst vindt.

- De tijdslijn voor de voorgestelde plannen is 5 – 10 jaar.

- Alle bedragen die genoemd worden zijn in miljoenen euro's.

- Wanneer u niet al het beschikbare geld uitgeeft wordt het geld dat over is doorgeschoven naar het budget van de periode erna.

TERUG VOLGENDE

Figure G.2: Process tracing study: screenshot of information page 1/2

Mobiliteit in Delft

Informatie

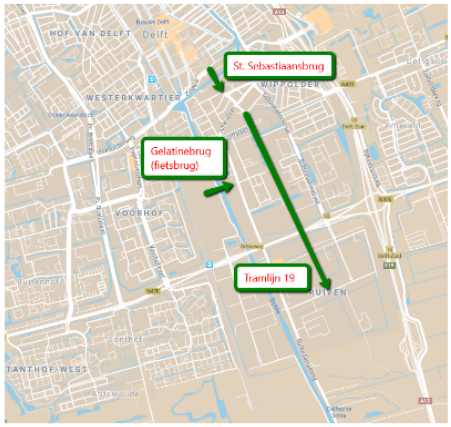
Belangrijk:

- Er wordt volgend jaar (2020) een fietsbrug aangelegd over de rivier de Schie ter hoogte van de Praxis en Lijm&Cultuur. Bij het selecteren van de projecten kunt u aannemen dat deze brug er al ligt.

- De Sint Sebastiaansbrug wordt op dit moment opnieuw gebouwd. Bij het selecteren van de projecten kunt u aannemen dat deze brug klaar is.

- Tramlijn 19 zal gaan rijden vanuit Leidschendam via Delft Station naar de universiteitscampus en het Technopolis. Bij het selecteren van de projecten kunt u aannemen dat deze tram rijdt.

In onderstaande kaart zijn deze drie projecten aangegeven:



TERUG VOLGENDE

Figure G.3: Process tracing study: screenshot of information page 2/2

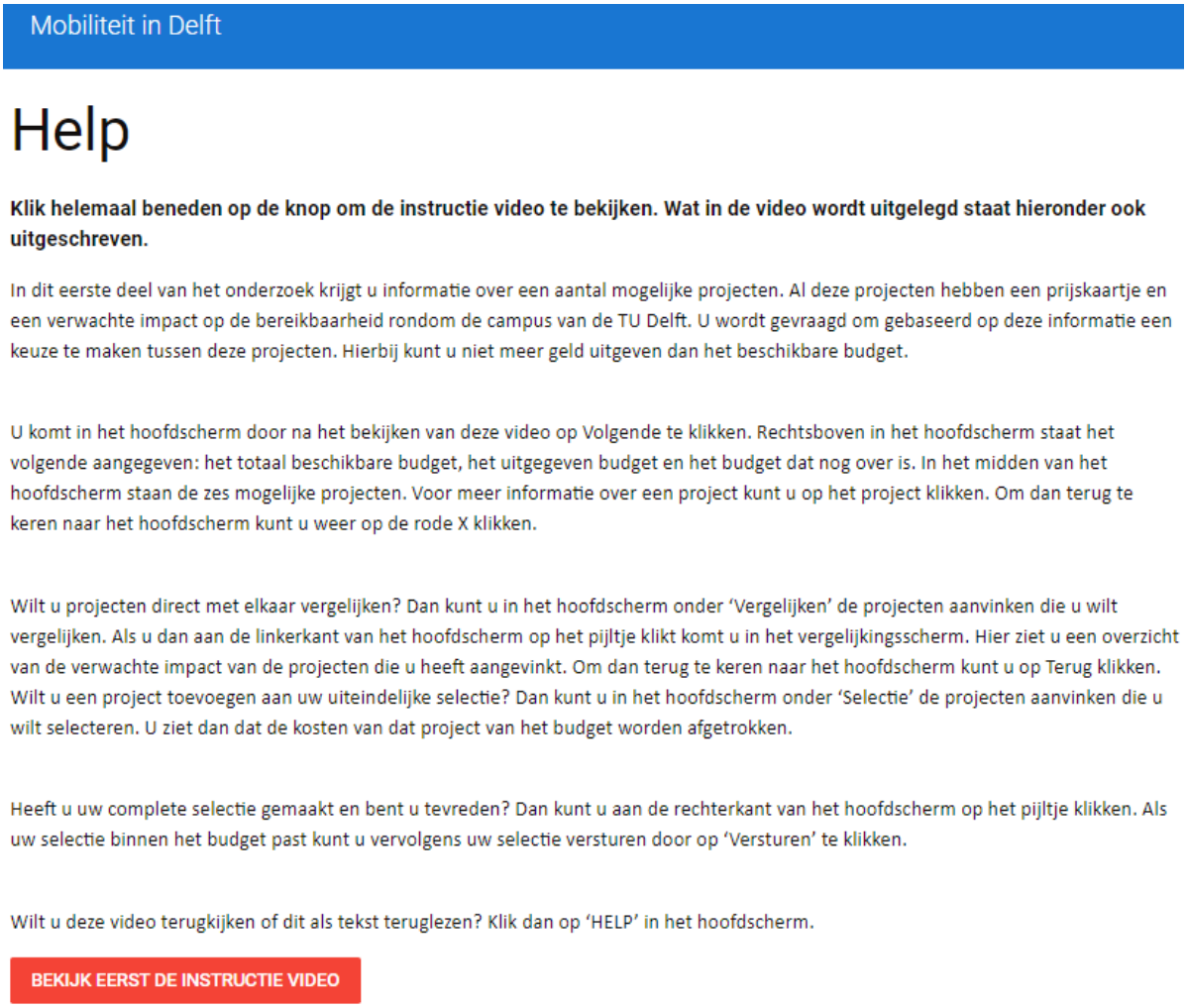


Figure G.4: Process tracing study: screenshot of help page

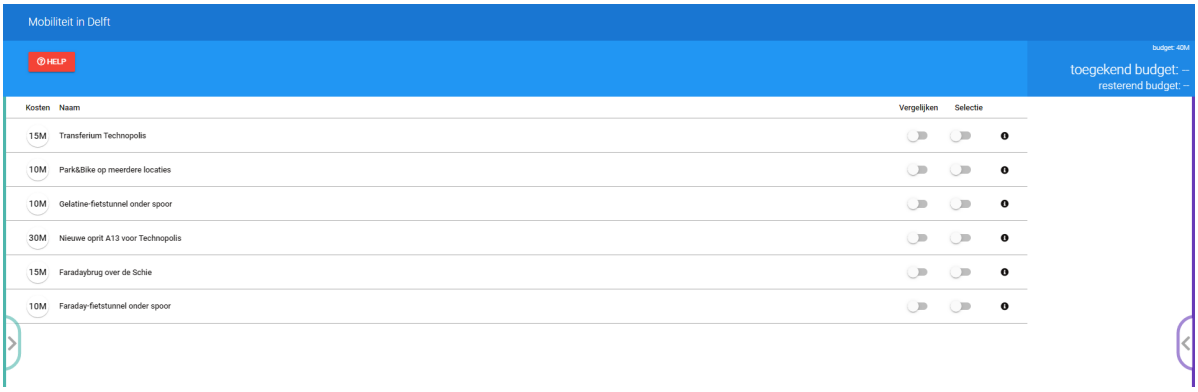


Figure G.5: Process tracing study: screenshot of main page

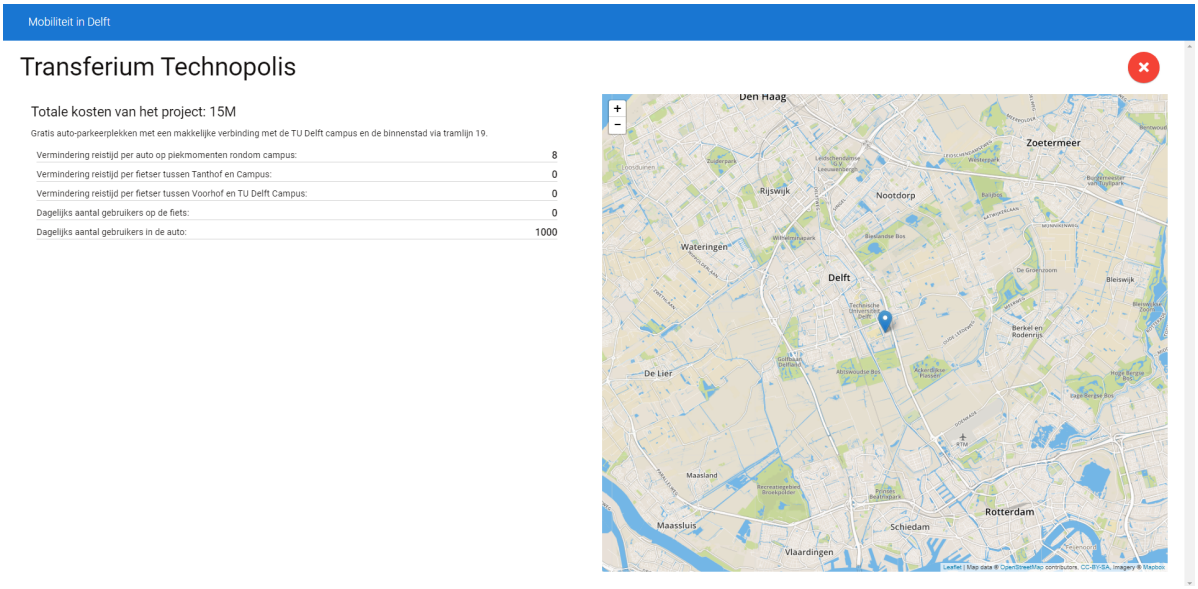


Figure G.6: Process tracing study: screenshot of project page for project 1

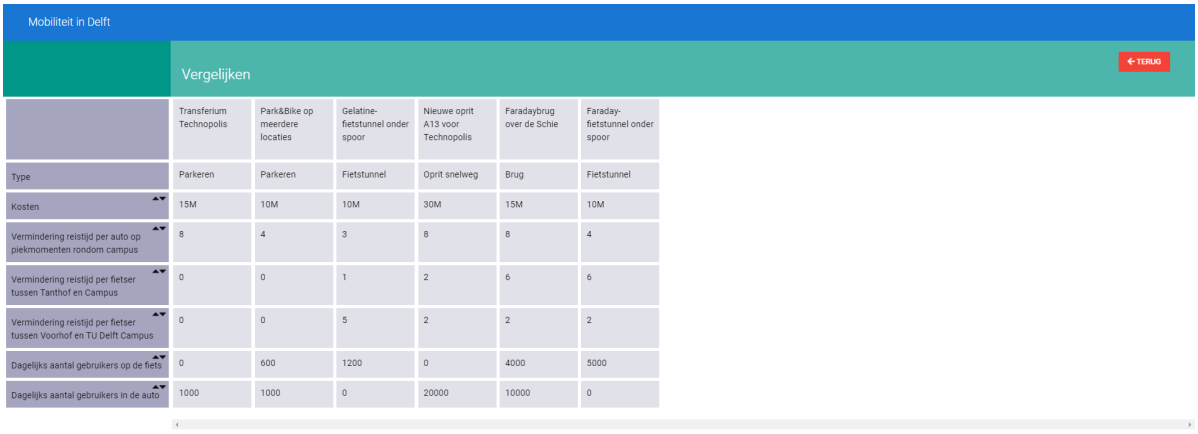


Figure G.7: Process tracing study: screenshot of comparison page

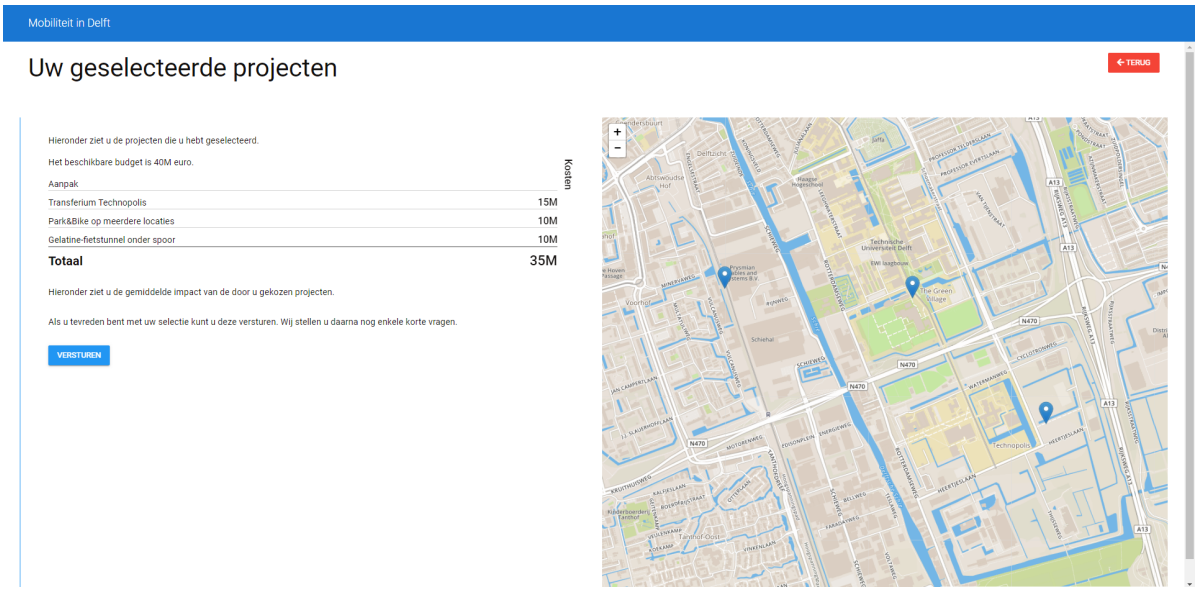


Figure G.8: Process tracing study: screenshot of confirmation page

H

Survey content variation experiment

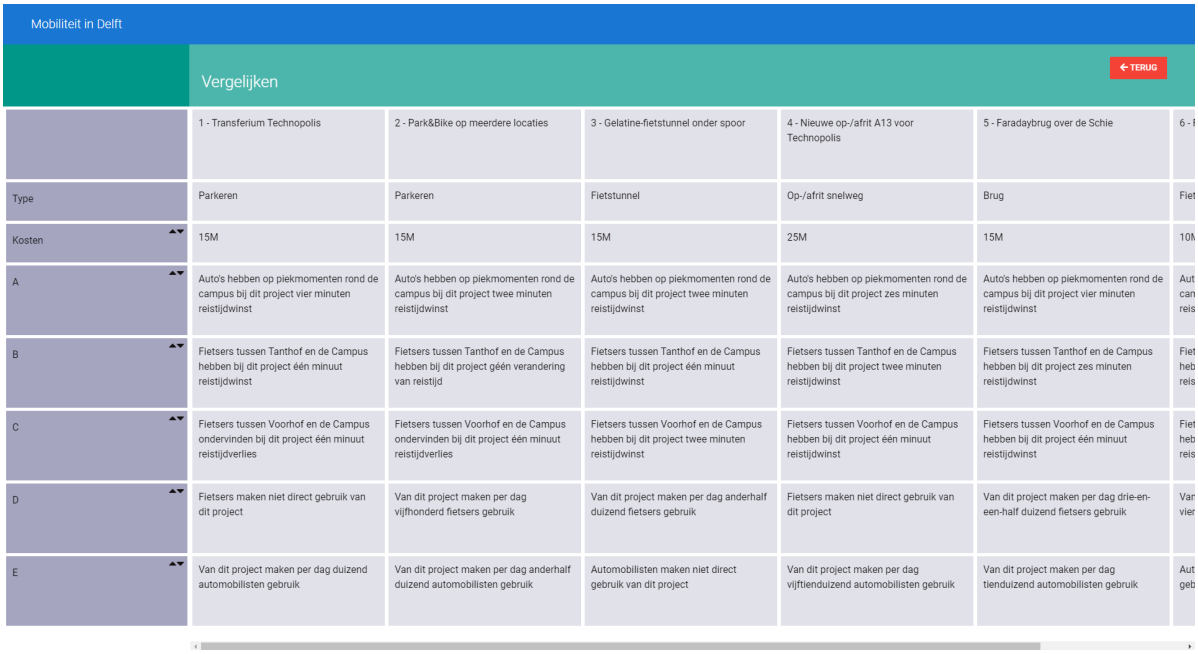
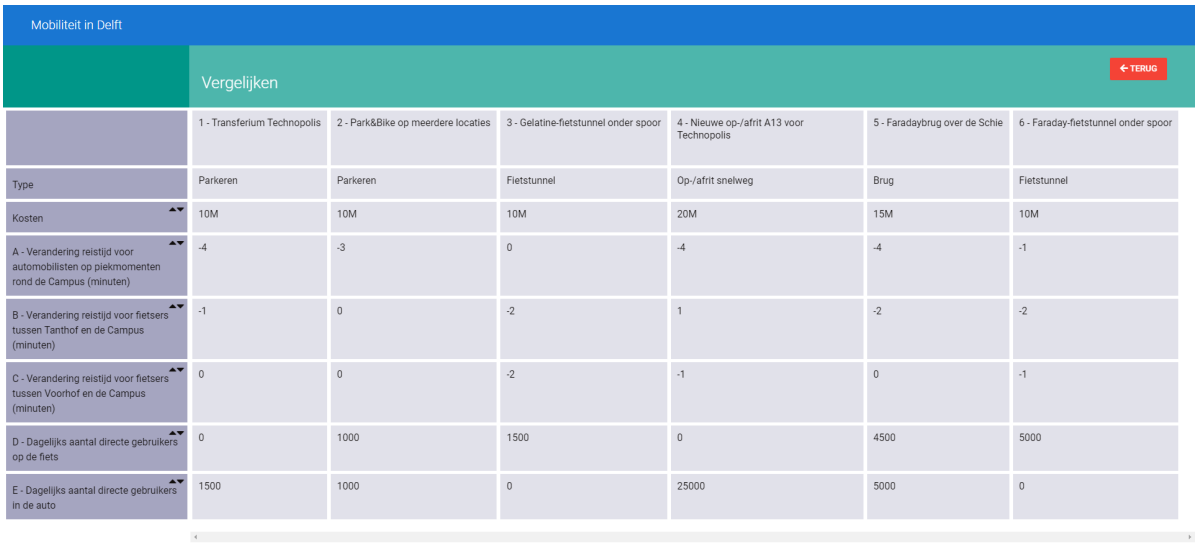


Figure H.1: Variation experiment: narrative variant comparison page



	1 - Transferium Technopolis	2 - Park&Bike op meerdere locaties	3 - Gelatine-fietstunnel onder spoor	4 - Nieuwe op-/afrit A13 voor Technopolis	5 - Faradaybrug over de Schie	6 - Faraday-fietstunnel onder spoor
Type	Parkeren	Parkeren	Fietstunnel	Op-/afrit snelweg	Brug	Fietstunnel
Kosten	10M	10M	10M	20M	15M	10M
A - Verandering reistijd voor automobilisten op piekmomenten rond de Campus (minuten)	-4	-3	0	-4	-4	-1
B - Verandering reistijd voor fietsers tussen Tanthof en de Campus (minuten)	-1	0	-2	1	-2	-2
C - Verandering reistijd voor fietsers tussen Voorhof en de Campus (minuten)	0	0	-2	-1	0	-1
D - Dagelijks aantal directe gebruikers op de fiets	0	1000	1500	0	4500	5000
E - Dagelijks aantal directe gebruikers in de auto	1500	1000	0	25000	5000	0

Figure H.2: Variation experiment: quantitative variant comparison page

Survey page texts

Landing page

Variation experiment

English

Great that you want to participate in the research Mobility in Delft! First of all: this research has been designed for a large screen and it is not suitable for execution on a phone. You are kindly requested to execute this research on a laptop or personal computer. In addition to this the research is aimed at people who live, work and/or study in Delft, if you do not fall within this group unfortunately you cannot participate in this research.

This research consists of two parts. In the first part we ask you to make a selection out of several possible infrastructural projects. In the second part we ask you several questions regarding your experience while selecting the projects and for general information that is necessary for processing the results.

In this research we apply a newly developed method of citizen participation: Participatory Value Evaluation. With your project selection and those of other participants we can establish the value of the various projects. We will communicate the final results to the municipality of Delft. This research is performed by a master student of the Delft University of Technology: Tomas Peeters. For further information on the research and for communicating suggestions and/or remarks you can send an email to Tomas Peeters (t.b.peeters@student.tudelft.nl).

- Your participation in this research is entirely voluntary and you are able to stop the project selection or the questionnaire at any time. If you wish to skip a question in the questionnaire this is possible.
- In this research there are no good or wrong answers as it concerns your own preferences.
- The research will take about 10 minutes.
- All your answers and data are processed anonymously and these cannot be traced to you personally.
- This research is not executed on behalf of the municipality of Delft or any other governmental body.

We hand out 4 prizes of €25,- to participants of this research. If you want to have the chance of winning a prize you can enter you email address at the end of the questionnaire. We only use your email address for the prize draw and for communication in case you have won. After the draw we delete your email address from the system. Thank you for your participation in advance!

Dutch

Fijn dat u mee wilt doen aan het onderzoek Mobiliteit in Delft! Allereerst: dit onderzoek is ontworpen voor een groot scherm en is niet geschikt om op een telefoon uit te voeren. U wordt vriendelijk verzocht

dit onderzoek op **een laptop of computer** uit te voeren. Daarnaast is het onderzoek gericht op **personen die wonen, werken en/of studeren in Delft**, als u niet binnen deze groep valt kunt u helaas niet meedoen aan dit onderzoek.

Dit onderzoek bestaat uit twee delen. In het eerste deel vragen wij u om een selectie te maken uit enkele mogelijke infrastructurele projecten. In het tweede deel stellen wij u enkele vragen over uw ervaring bij de selectie van de projecten en voor algemene informatie die nodig is voor de verwerking van de resultaten.

In dit onderzoek passen wij een nieuw ontwikkelde methode voor burgerparticipatie toe: Participatieve Waarde Evaluatie. Met uw projectselectie en die van andere deelnemers kunnen wij de waarde van de verschillende projecten vaststellen. Deze uiteindelijke resultaten communiceren wij aan de gemeente Delft. Dit onderzoek wordt uitgevoerd door een master student aan de Technische Universiteit Delft: Tomas Peeters. Voor meer informatie over het onderzoek en voor het doorgeven van suggesties en/of opmerkingen kunt u een mail sturen naar t.b.peeters@student.tudelft.nl.

- Uw deelname aan dit onderzoek is volledig vrijwillig en u kunt ten alle tijden stoppen met de selectie of de vragenlijst. Als u een vraag in de vragenlijst wilt overslaan is dit mogelijk.
- Er zijn in dit onderzoek geen goede of foute antwoorden, het gaat namelijk om uw eigen voorkeuren.
- Het onderzoek zal ongeveer 10 minuten kosten.
- Al uw antwoorden en data worden volledig anoniem verwerkt en zullen niet te herleiden zijn tot uw persoon.
- Dit onderzoek wordt niet uitgevoerd in opdracht van de gemeente Delft of een andere overheidsinstantie.

Wij verloten 4 prijzen van €25,- onder de deelnemers aan dit onderzoek. Als u kans wilt maken op een prijs kunt u aan het einde van de vragenlijst uw e-mailadres invullen. Wij gebruiken uw emailadres alleen voor de prijstrekking en voor communicatie wanneer u gewonnen heeft. Na de trekking verwijderen wij uw emailadres uit ons systeem. Alvast hartelijk dank voor uw deelname!

Information page

Variation experiment

English

This research concerns the accessibility on and around the campus of the TU Delft. The number of students and employees at the university have risen greatly in the last couple of years and on a daily basis 27.000 people visit the area. All these visitors have a significant impact on traffic on and around the campus, which causes a number of problems:

- Around peak traffic hours there is so much car traffic that there are large delays on roads such as the Kruithuisweg/N470, the Schoemakerstraat and the link to the highway A13.
- The large amounts of cyclists cause delays on cycling lanes as well as for other traffic at points where they meet
- The cycling routes from the neighbourhoods of Tanthof and Voorhof to the campus are overburdened because there are limited opportunities to cross the train tracks and the river the Schie
- Also residents and visitors of other areas in Delft such as the neighbourhoods Tanthof, Voorhof, Wippolder and the inner city experience delays at peak traffic hours
- Currently, there are plans to develop the Schieoevers area as a living, working and recreational area. Also, the Technopolis industrial estate which is located south of the campus will be expanded further. This will lead to even more traffic and delays.

Therefore, there are plans to improve accessibility. However, there are not sufficient funds to execute all these project plans. Therefore, choices will have to be made. We ask you in this research to make that choice and to spend the available funds on the projects that you find most important.

- The timeline for the proposed projects is 5 – 10 years.

- All amounts of money that are mentioned are in millions of euros.
- If you do not spend all the available funds the funds that are left will be transferred to the budget of the next period.

[Page 2]

- This year the construction will start for a bicycle bridge over the river Schie at Schieoevers-Noord, near the Praxis and Lijm&Cultuur (https://www.delftsepost.nl/reader/47650/948183/nieuwe-fietsbrug-over-schie). When considering the projects you can assume that this bridge is already completed.
- The Sint Sebastiaans bridge is currently being reconstructed. When considering the projects you can assume that this bridge is already completed.
- Tram line 19 will run between Leidschendam through Delft Station to the campus and Technopolis. When considering the projects you can assume that this tram is already running.

In the map below these three projects are indicated:

[Map with projects]

Dutch

Dit onderzoek gaat over de bereikbaarheid op en rondom de campus van de TU Delft. Het aantal studenten en medewerkers aan de universiteit is flink gestegen in de afgelopen jaren en dagelijks komen er 27.000 mensen naar dit gebied. Al deze bezoekers hebben een grote invloed op het verkeer op en rondom de campus, wat zorgt voor verschillende problemen:

- Rond de spits is er zoveel autoverkeer dat er grote vertragingen zijn op wegen zoals de Kruithuisweg/N470, de Schoemakerstraat en de aansluiting op de snelweg A13.
- De grote aantallen fietsers zorgen voor vertragingen op fietspaden én voor ander verkeer op punten waar ze elkaar kruisen.
- De fietsroutes vanuit de wijken Tanthof en Voorhof naar de campus zijn overbelast omdat er weinig plekken zijn om het spoor en de rivier de Schie over te steken.
- Ook bewoners en bezoekers van andere gebieden in Delft zoals de wijken Tanthof, Voorhof, Wippolder en de Binnenstad hebben last van vertragingen tijdens de spits.
- Op dit moment liggen er plannen om het gebied Schieoevers-Noord te ontwikkelen als woon-, werk- en recreatiegebied. En ook zal het Technopolis bedrijventerrein dat ten zuiden van de campus ligt verder uitgebreid worden. Dit zal zorgen voor nog meer verkeer en vertragingen.

Daarom zijn er plannen om de bereikbaarheid te verbeteren. Maar er is niet genoeg geld om al deze projectplannen uit te voeren. Daarom moeten er keuzes gemaakt worden. Wij vragen u in dit onderzoek om die keuze te maken en het beschikbare geld uit te geven aan de projecten die u het belangrijkst vindt.

- De tijdslijn voor de voorgestelde plannen is 5 – 10 jaar.
- Alle bedragen die genoemd worden zijn in miljoenen euro.
- Wanneer u niet al het beschikbare geld uitgeeft wordt het geld dat over is doorgeschoven naar het budget van de periode erna.

[Pagina 2]

- Er wordt dit jaar begonnen met de aanleg van een fietsbrug over de rivier de Schie bij Schieoevers-Noord, ter hoogte van de Praxis en Lijm&Cultuur (zie https://www.delftsepost.nl/reader/47650/948183/nieuwe-fietsbrug-over-schie). Bij uw beoordeling van de projecten kunt u aannemen dat deze brug er al ligt.
- De Sint Sebastiaansbrug wordt op dit moment opnieuw gebouwd. Bij uw beoordeling van de projecten kunt u aannemen dat deze brug klaar is.
- Tramlijn 19 zal rijden vanuit Leidschendam via Delft Station naar de campus en het Technopolis. Bij uw beoordeling van de projecten kunt u aannemen dat deze tram rijdt.

Onderstaande kaart laat deze drie projecten zien die u als voltooid kunt beschouwen:

[Kaart met projecten]

Help text

Variation experiment

English

Click on the button all the way below to watch the instruction video. What is explained in the video is also written directly below.

In this first part of the research you are presented with information on several possible projects. All these projects have a certain cost and expected impacts on the accessibility around the campus of the TU Delft. You are asked to make a choice between these projects, based on this information. You cannot spend more money than is available.

You will arrive in the main screen by clicking on the red X. In the top right corner in the main screen the following is shown: the total available budget, the spent budget and the budget that still remains.

In the centre of the main screen the six possible projects are shown. To see more information about a project you can click on the 'i'. To then return to the main screen you can click on the red X.

Do you want to compare projects directly? Then in the main screen toggle the projects that you want to compare under 'Vergelijken' . If you then click on the arrow at the left of the screen you arrive in the comparison screen. Here you see an overview of the expected impacts of the projects that you toggled. To then return to the main screen you can click on Terug.

Do you want to add a project to your final selection? Then you can toggle projects that you want to select under 'Selectie'. You will see that the costs of that project are deducted from the budget.

Did you make your complete selection and are you satisfied? Then you can click on the arrow at the right side of the main screen. If your selection fits within the budget you can send your selection by clicking 'Versturen'.

Do you want to see this video again or read it again as text? Then click on 'HELP' in the main screen.

[Video in which above text is read out loud while the steps are followed in the online tool]

Dutch

Klik helemaal beneden op de knop om de instructie video te bekijken. Wat in de video wordt uitgelegd staat hieronder ook uitgeschreven.

In dit eerste deel van het onderzoek krijgt u informatie over een aantal mogelijke projecten. Al deze projecten hebben een prijskaartje en een verwachte impact op de bereikbaarheid rondom de campus van de TU Delft. U wordt gevraagd om gebaseerd op deze informatie een keuze te maken tussen deze projecten. Hierbij kunt u niet meer geld uitgeven dan het beschikbare budget.

U komt in het hoofdscherm door op de rode X te klikken. Rechtsboven in het hoofdscherm staat het volgende aangegeven: het totaal beschikbare budget, het uitgegeven budget en het budget dat nog over is.

In het midden van het hoofdscherm staan de zes mogelijke projecten. Voor meer informatie over een project kunt u op de 'i' klikken. Om dan terug te keren naar het hoofdscherm kunt u weer op de rode X klikken.

Wilt u projecten direct met elkaar vergelijken? Dan kunt u in het hoofdscherm onder 'Vergelijken' de projecten aanvinken die u wilt vergelijken. Als u dan aan de linkerkant van het hoofdscherm op het pijltje klikt komt u in het vergelijkingsscherm. Hier ziet u een overzicht van de verwachte impact van de projecten die u heeft aangevinkt. Om dan terug te keren naar het hoofdscherm kunt u op Terug klikken.

Wilt u een project toevoegen aan uw uiteindelijke selectie? Dan kunt u in het hoofdscherm onder ‘Selectie’ de projecten aanvinken die u wilt selecteren. U ziet dan dat de kosten van dat project van het budget worden afgetrokken.

Heeft u uw complete selectie gemaakt en bent u tevreden? Dan kunt u aan de rechterkant van het hoofdscherm op het pijltje klikken. Als uw selectie binnen het budget past kunt u vervolgens uw selectie versturen door op ‘Versturen’ te klikken.

Wilt u de video terugkijken of dit als tekst teruglezen? Klik dan op ‘HELP’ in het hoofdscherm.

[Video waarin bovenstaande text wordt uitgesproken en terwijl de stappen worden doorlopen in de online tool]

Debriefing page

Variation experiment

English

Thank you very much!

Thank you for your participation in the research “Mobility in Delft”. Your selection and answers to the questionnaire have been saved in the system.

As indicated in the introduction this research is part of broader research into an innovative method of citizen participation. In this research the way in which information is presented varies. You received information in the form of numbers. In another version the information is presented in full sentences. *You received information in the form of full sentences. In another version the information is presented purely in numbers.* The results of this research help to gain insight in how participants process the presented information within this innovative method.

For this research a large group of participants is needed and if you know others who would like to participate, then please share the link to this research with them: https://www.onderzoek.live/delft

If you have provided your email address you are entered into the draw for one of the prizes of €25,-. The winners will get be contacted personally no later than February 28th. Your email address will only be used for the prize draw and for communications in case you have won a prize. After the draw your email address will be removed from the system.

For further information on the research and for providing suggestions and/or remarks you can send an email to Tomas Peeters (t.b.peeters@student.tudelft.nl). All questions and/or remarks will be treated anonymously.

You can now close this screen.

Again: this research is not executed on behalf of the municipality of Delft or any other government body.

Dutch

Heel erg bedankt!

Bedankt voor uw deelname aan het onderzoek Mobiliteit in Delft. Uw projectselectie en antwoorden op de vragen zijn opgeslagen in het systeem.

Zoals aangegeven in de introductie bestuderen wij in dit onderzoek een innovatieve methode voor burgerparticipatie. In dit onderzoek varieert de wijze waarop de informatie gepresenteerd wordt. U

heeft informatie gekregen in de vorm van getallen en bij een andere versie wordt informatie in de vorm van volle zinnen gepresenteerd. *U heeft informatie gekregen in de vorm van volle zinnen en bij een andere versie wordt informatie puur in getallen gepresenteerd.* De uitkomsten van dit onderzoek helpen om inzicht te krijgen in hoe deelnemers de gepresenteerde informatie verwerken bij deze innovatieve methode.

Voor dit onderzoek is een grote groep deelnemers nodig en mocht u anderen kennen die het leuk zouden vinden om aan dit onderzoek mee te doen dan kunt u de link naar het onderzoek met ze delen: https://www.onderzoek.live/delft

Als u uw emailadres heeft ingevoerd doet u mee met de trekking voor een van de vier prijzen van €25,-. De winnaar krijgt uiterlijk 28 februari persoonlijk bericht. Uw emailadres wordt alleen gebruikt voor de prijstrekking en voor eventuele communicatie wanneer u gewonnen heeft. Na de trekking wordt uw emailadres uit ons systeem verwijderd.

Voor meer informatie over het onderzoek en voor het doorgeven van suggesties en/of opmerkingen kunt u Tomas Peeters mailen (t.b.peeters@student.tudelft.nl).

U kunt het scherm nu afsluiten.

Nogmaals: dit onderzoek wordt **niet** uitgevoerd in opdracht van de gemeente Delft of een andere overheidsinstantie.

J

Results process tracing study

Table J.1: Process tracing study, overview of reported socio-demographic characteristics

Gender		**Education**	
Male	6	Higher	10
Female	4		
Age		**Current situation**	
18-25	4	Studying	4
26-35	4	Working 32+	5
65+	2	Working 16-	1
Postal code			
2611 (inner city)	8		
2628 (Wippolder)	2		

Table J.2: Process tracing study, overview of votes and responses to case specific questions

Vote		**Most used travel mode**	
No voting rights	2	Bicycle	7
GL (green party)	6	Train	1
VVD (conservative-liberal)	1	Bus, tram or metro	1
D66 (social-liberal)	1	Walking	1
Frequency of visits TU Delft			
Multiple times per day	3		
Once per day	1		
Multiple times per week	1		
Multiple times per year	3		
(Almost) never	2		

Table J.3: Process tracing study, responses to Likert-scale statements

	Fully agree	**Agree**	**Neutral**	**Disagree**	**Fully disagree**
Statement 1 - *I am convinced of my choices in this research.*	3	6	1	0	0
Statement 2 - *I felt fully informed on the options in this research.*	2	2	2	4	0
Statement 3 - *I feel that this research was realistic.*	0	8	2	0	0
Statement 4 - *I think that the outcomes of this research could help the government in making decisions concerning infrastructural projects such as these.*	0	4	6	0	0
Statement 5 - *I think that it would be good if the government would ask me for my opinion more often on these kind of infrastructural projects through surveys such as this one.*	2	7	1	0	0

Table J.4: Process tracing study, project selections per participant

Project/ Participant	Project 1	Project 2	Project 3	Project 4	Project 5	Project 6	Total selected
A	Selected	-	-	-	Selected	Selected	3
B	-	-	Selected	-	Selected	Selected	3
C	-	-	-	-	Selected	Selected	2
D	Selected	Selected	-	-	Selected	-	3
E	Selected	Selected	-	-	Selected	-	3
F	-	-	Selected	-	Selected	Selected	3
G	-	Selected	Selected	-	-	Selected	3
H	-	-	Selected	-	Selected	Selected	3
I	Selected	-	-	-	Selected	Selected	3
J	-	-	Selected	-	Selected	Selected	3
Cumulative	**4**	**3**	**5**	**0**	**9**	**8**	**29**

The statements recorded in the verbal protocol were coded in two rounds in which firstly the main categories and categories were established and secondly the statements were assigned to these (main) categories. The identified main categories were the following: (1) *information processing* indicates what form of information was consulted or processed by participants, (2) *strategy formulation* indicates the utterances related to decision-making strategy, (3) *motivation statement* indicates the reasons participants mentioned for (not) selecting projects, (4) *general reflection* indicates statements of reflection and reasoning, (5) *reflection on PVE* indicates comments and uncertainties related to the survey's methodology or content, and (6) *other* indicates the utterances that could not be classified according to the preceding categories. The statement counts within these main categories and their subcategories are discussed below.

Other interactions

Sorting option on the comparison page: only one participant made use of this by sorting the projects based on cost (J).

Help video: all participants watched the help video, which was mandatory in this study.

Help text: two participant made use of the help button and the help text that was provided. Of those, one participant did so at two instances, namely to know how to select projects and continue, but also in an attempt to revisit the pages with information. The information the participant wanted to consult regarded what would be done with the budget that was not spent.

Attribute unit tool tip: this was seen by six participants, missed by four participants.

Table J.5: Verbal protocol, counts of main categories

Participant ID/ Main category	A	B	C	D	E	F	G	H	I	J	Total
Information processing	49%	59%	57%	43%	52%	63%	68%	64%	60%	58%	58%
Strategy formulation	9%	4%	3%	3%	8%	1%	0%	5%	4%	3%	4%
Motivation statement	18%	18%	9%	30%	25%	28%	13%	18%	18%	8%	18%
General reflection	7%	5%	3%	7%	1%	1%	0%	0%	7%	2%	3%
Reflection on PVE	0%	0%	16%	0%	0%	6%	6%	0%	3%	6%	4%
Other	18%	13%	12%	18%	14%	1%	13%	13%	8%	22%	13%
Total count	45	112	90	61	77	89	62	94	146	130	906

Table J.6: Verbal protocol, counts within the main category of strategy formulation

Participant ID/ Category	A	B	C	D	E	F	G	H	I	J	Total
Review projects one-by-one	2	0	1	1	3	0	0	1	1	1	10
Compare all projects	0	2	2	0	0	1	0	0	0	1	6
Compare a selection of projects	2	1	0	1	2	0	0	3	5	0	13
Focus on a group of users	0	1	0	0	0	0	0	1	0	0	2
First impression	0	0	0	0	1	0	0	0	0	0	1
Perform calculations	0	1	0	0	0	0	0	0	0	2	3
Total	4	5	3	2	6	1	0	5	5	4	35

Match of written & verbal motivations

The degree to which the written motivations corresponded to the motivations mentioned while completing the survey was high. However, personal benefits specifically were mentioned by three participants during the selection and these were only reflected in the written motivations of one, and not explicitly.

This is an indication that the motivations provided by participants in PVE surveys indeed reflect the thought processes that they applied while making their selection. But, there is an indication that the degree in which participants report motivations related to personal benefit might be limited. This might be due to a desire to provide socially desirable motivations.

Table J.7: Action log, list of actions

1	Open survey	9	Zoom in or pan map	17	Send selection
2	Continue to page 2	10	Study attribute unit tool tips	18	Confirm selection
3	Continue to page 3	11	Compare all projects	19	Consult information motivation screen
4	Start	12	Compare a selection of projects	20	Proceed to questionnaire
5	Read help page	13	Select project	21	Complete
6	Watch help video	14	Deselect project	22	Use external programmes
7	Study main page	15	Visit help page	23	Order comparison page based on cost
8	Visit project page	16	Proceed to confirmation page	24	Return to main screen

K

Shortened verbal protocols

Participant A

This participant took 6:14 minutes to make a selection of projects 1, 5, and 6. This participant's first step was to review each project page one-by-one. In this process the participant said of each plan: this might be useful. Project 3 was selected directly after reviewing its page, based on personal experience of a long wait for bicycles. The synergy of the two Faraday projects was acknowledged. After the initial review of the project pages the participant chose to compare projects 3, 5 , and 6, and based on the information in the comparison screen the choice was made to deselect project 3 and select projects 5, and 6. Then the participants mentioned that €15 million of budget was left and a comparison was made of the parking projects 1 and 2. The motivation for this was to reduce the number of cars in the city centre by providing free parking. Based on the attribute values project 1 was chosen.

Motivations mentioned during selection:
1 - Transferium: after selecting projects 5 and 6, €15 million was left to spend and this project was selected after comparing attribute values to project 2. Also intended to have less cars in the city centre.
2 - Park&Bike: discarded after comparison of attribute values to project 1.
3 - Gelatine bicycle tunnel: initially selected after viewing project page because of personal experience with waiting, but then discarded after comparing attribute values to projects 5 and 6.
4 - Ramp A13: discarded without explanation.
5 - Faraday bridge: selected together with project 6 after comparing attribute values to project 3.
6 - Faraday bicycle tunnel: selected together with project 5 after comparing attribute values to project 3.

Written motivation:
1 - Transferium: *This seems useful because then cars will drive less through the centre. People can park their cars relatively closely (and for free) and then continue on foot or with the tram to the city centre.*
5 - Faraday bridge: *I think that it is useful to better connect the neighbourhoods to the south west of the Schie to the Campus. Because the train tracks and the Schie work as a barrier in that neighbourhood. I compared the Faraday bridge to the Gelatine bridge and out of those two this seemed to me the option with the most advantages.*
6 - Faraday bicyle tunnel: *This tunnel is useful because it is in line with the bridge and through this the travel time is reduced.*

The motivations mentioned in the process and those provided in the written motivation mostly correspond, apart from the barrier aspect of the river and train tracks which was only mentioned in the written motivation.

Table K.1: Verbal protocol, shortened protocol of participant A

Statement	Category	Action	Project
First I will read the projects	Strategy		
I do not know the area of Delft well yet, I think, so I'll have to check the maps	Reflection		
Yes, this is mostly important for the cars	Reflection		1
Well, I find this quite a good plan, actually	Motivation		2
Yes, that is quite a good plan I think	Motivation		3
There it is always a long wait with bicycles	Reflection		3
I'm going to toggle this one	Other	Select	3
That might be useful as well	Motivation		4
I think it is useful to make the tunnel if you also make the bridge	Motivation		5, 6
Now I'll compare these three with each other	Strategy	Compare	3, 5, 6
Well, then actually I think, when I look at this, that the Faraday bridge is perhaps a better plan, and tunnel	Motivation	Select	5, 6
		Deselect	3
And then I have still 15 million left	Motivation		
To have less cars in the city centre if there are free parking spots	Motivation		1, 2
Now I'll compare these two and then I'll choose one of them I think	Strategy	Compare	1, 2
Then I'll choose the Transferium one	Motivation	Select	1
Yes, that's it, okay, send	Other	Send	

Participant B

This participant took 11:58 minutes to make a selection of projects 3, 5, and 6. This participant's first step was to reflect on the problem by reasoning that cars are currently experiencing more delays than cyclists, and therefore the choice was made to focus on projects for cars. Thus, first the participant compared the car projects 1, 2, and 4 and subsequently the bicycle projects 3, 5, and 6. The participant found the Faraday projects 5 and 6 to have a good cost/benefit ratio. Then a comparison was made of all projects and the participant made computations by summing the minutes of travel time savings. These were both Faraday projects 5 and 6, and the ramp project 4. Selecting all these project was not possible due to the budget constraint so project 4 was discarded and 5 and 6 were kept. At this point the participant formulated the aim to promote cycling and public transport instead of car use. But, it was acknowledged that some people have no choice and that projects 1 and 2 are good to facilitate those people and offer them a last mile transport by public transport, bicycle or foot. A comparison of the attributes however showed that project 3 resulted in benefits for both cyclists and car users while promoting bicycle use. Finally, a summation of bicycle users and car users of the three projects 3, 5, and 6 was made and it was concluded that the cyclist projects were chosen as they turned out to benefit car users as well.

Motivations mentioned during selection:
1 - Transferium: discarded after comparison of attribute values to project 3.
2 - Park&Bike: discarded after comparison of attribute values to project 3.
3 - Gelatine bicycle tunnel: selected because of attribute values when compared to projects 1 and 2 and because it has benefits for both car users and cyclists. The selection was a result of the desire to spend the entire budget.
4 - Ramp A13: initially determined to be one of the three best projects based on summation of TTS, but discarded because it did not fit in the budget.
5 - Faraday bridge: selected because one of the three best projects based on summation of TTS.
6 - Faraday bicycle tunnel: selected because one of the three best projects based on summation of TTS.

Written motivation: the same motivation was provided for all three projects 3, 5, and 6: *It should be promoted to come by bicycle or public transport to the TU Delft. Improving the bicycle routes turns*

out to also benefit those who come by car. And the options that mostly benefit cyclists are also rather cheap compared to asphalt. That is why I choose these three options.

The motivations mentioned in the process and those provided in the written motivation correspond. This participant included the exact same motivation for each project is he/she considered a portfolio instead of standalone projects.

Table K.2: Verbal protocol, shortened protocol of participant B

Statement	Category	Action	Project
[study main page]			
Most students go to the university by bicycle and long queues of cyclists form in front of a bridge that is open, or in front of traffic lights that are red, if there are any	Reflection		
I think cyclists are not the real problem, maybe you have to cycle a bit around from some places, but I think that the real delays are not for the cyclists. I think that those are more for the cars	Reflection		
Now I find that people should take public transport within urban areas	Motivation		
Let's first focus on the cars, I think that the issue is with them	Strategy	Compare	1, 2, 4
Then the bicycle things	Strategy	Compare	3, 5, 6
Well, this is not very expensive and it does result in a lot of time saved for both car users as well as cyclists	Motivation		5
Those Faraday bridge and tunnel are a good one anyway because they are useful for all parties	Motivation		5, 6
And they are quite cheap	Motivation		5, 6
Now I'll compare everything to each other	Strategy	Compare	all
If I then sum the total minutes of time savings	Strategy		
[summing minutes of time savings]	Other		all
Let's see, do I have enough budget to choose the best three?	Motivation	Select	4
Faraday bridge and tunnel, and the new ramp	Motivation	Select	5
Then we have 15 million left	Other	Select	6
And then the new ramp.. But that one is 30 million	Information	Deselect	4
Then we'll return to comparing	Strategy	Compare	all
What do we actually want to stimulate? So we want that people will come there by bicycle. We want that people come there by public transport	Motivation		
If we lay down more asphalt and give cars, car users, what they want, then the incentive to come with the car doesn't disappear	Motivation		
Except that more asphalt means more traffic jams in practice, and due to that it sucks still, so I am not convinced of more asphalt	Motivation		
A Transferium or a park&bike are nice ideas, because it can of course be that you have to come from a place with bad public transport and then it is very nice to come to a specific place with a car	Motivation		1, 2
And subsequently can cycle for a bit or go by foot	Motivation		1, 2
But I see that the impact of that.. Yes, the Transferium one could be a good one	Motivation		1, 2
But only 1000 people a day make use of that	Information		1, 2
If we take the Gelatine tunnel under the train tracks for a moment, that one is good for reducing cars and good for the cyclists	Information		3
So that is actually interesting, that if you help the cyclists you also help the car users, so then the knife cuts at both sides	Motivation		3
And with that, by constructing better bicycle routes, now I don't know if those bicycle routes are actually bad, but that you through that promote going to the university by bicycle, or make it more appealing	Motivation		3
And that, with that, the people who have to come by car anyway and who cannot come by bicycle or public transport also benefit	Motivation		3
So if I look at this I can help a lot of cyclists and 10.000 car users as well	Motivation		3, 5, 6
We'll choose the measures that at first instance seem beneficial to the cyclists, but also have a lot of effect for car users	Motivation	Select	3

Participant C

This participant took 13:15 minutes to make a selection of projects 5 and 6. The first step this participant took was to compare all projects and review the attribute values. Then, the participant reviewed the project pages one-by-one. The participant indicated that project 1 would only be useful for people at Technopolis, that for project 2 it was doubtful whether people would agree to paying for a rental bicycle, that project 3 was in line with Gelatine bridge, that trees would be cut for project 4, and that projects 5 and 6 had synergy. Subsequently, the participant went back to comparing all projects and reviewed the attribute values in more detail, focusing on cost-benefit ratios. A comment was made regarding the inclusion of only travel time and costs being taken into account, and not other aspects such as nuisance, impact on traffic patterns, and environmental impacts. Finally, the participant concluded that the Faraday project 5 and 6 had the best cost-benefit ratio, based on the attribute values, but that for the other projects too little information was available to make a good decision.

Motivations mentioned during selection:
1 - Transferium: not selected because too little information was available and the impacts were doubted.
2 - Park&Bike: not selected because too little information was available and the impacts were doubted.
3 - Gelatine bicycle tunnel: not selected because too little information was available. Initially the synergy with the Gelatine bridge was acknowledged, but subsequently forgotten.
4 - Ramp A13: not selected because too little information was available and the impacts were doubted.
5 - Faraday bridge: selected based on cost-benefit ratio after comparison of all projects and because it had synergy with project 6.
6 - Faraday bicycle tunnel: selected based on cost-benefit ratio after comparison of all projects and because it had synergy with project 5.

Written motivation:
5 - Faraday bridge: *This project has an impact on many travellers for a relatively low price. Also it matches nicely with the Faraday tunnel.*
6 - Faraday tunnel: *This project has a lot of impact also, a good match with the other project.*

The motivations mentioned in the process and those provided in the written motivation correspond.

Table K.3: Verbal protocol, shortened protocol of participant C [part 1]

Statement	Category	Action	Project
I think that it is smart to just compare all of them	Strategy		
Do you get more information when you click one? I clicked the upper one and I see some information. I think that there the same information is shown during the comparison	PVE		1
So now I will compare all at the same time	Other	Compare	all
I do not know if those are minutes or hours, that is what I miss. I actually think that they are minutes, because that would be most logical	PVE		
That is nice, I find it funny that the bicycle tunnel also results in a decrease in travel time per car while no cars make use of that tunnel, but probably there will be less bicycles on the roads	PVE		
Now I'll look at them one by one so I can perhaps find out a bit more	Strategy		
This seems to me to be primarily for the Technopolis, so for people who work at the university it is already to far to walk	Reflection		1
Yes, free car parking spaces with rental bikes. Rental bikes implies that they cost money, then I immediately think: will people want to pay money to take a rental bike for the last part of the journey? While you are already going by car	Motivation		2
Under the train tracks, ah yes, that is of course in line with that bicycle bridge that will be there from Lijm&Cultuur to the Praxis [Gelatine tunnel]	Motivation		3
Someone wants to cut down a forest to make a ramp	Motivation		4
I am noticing that a number of projects are logical to build together, and then that is especially the Faraday bridge and tunnel because they are in line with each other. And then if you choose one of those then the effect will become a lot bigger if you do both instead of only one	Motivation		5, 6
Then I see an 'i' that I can click, but then I get the same information	PVE		
I think that I'll again look at the comparison to get a clear picture of what the big impact is, and then I'll eventually have to make a decision	Strategy	Compare	all
What I see is that the ramp is of course the most expensive, but also it does have the largest impact on the cars. Namely, 20000 cars make use of it and they also have a significant reduction in travel time at peak times around the campus, which is of course good	Motivation		4
However, you also have the Faraday bridge and that will help only half the cars, but also 4000 cyclists with it and simultaneously at half the price. And the impact of it is actually just as big for cars around the campus	Motivation		5
The way that I see it here means that all cars have an 8 minute reduction in travel time, not just the 10000 cars, I think, but I am not sure of course	PVE		
The Faraday tunnel also has a large effect on cyclists and also even an impact on a lot of cars. If I look at the number then the Faraday projects are both quite appealing. Costs together are 25 million, impact 19000 travellers, and I think that that is the most bang-for-buck	Motivation		5, 6
I find it a pity that actually only travel time is taken into account, and costs, even though more could be taken into account. Such as: nuisance to people living nearby, other spots might become a lot busier with traffic and that can take up a lot of nuisance	PVE		
The Park&Bike locations can perhaps be better for the environment, especially to reduce the emissions a bit	Motivation		4

[Continued on next page]

Table K.4: Verbal protocol, shortened protocol of participant C [part 2]

Statement	Category	Action	Project
This I find interesting to take into account, but I cannot make a conclusion on this. And I wonder whether I should consider my own experience, for example that at peak times the Kruithuisweg is always clogged up	PVE		
And I think that the new ramp on and off the highway, I assume that that is included. Haha, that would be funny if that is not included, that means that it only would have an effect for half the time	PVE		4
		Select	5
		Select	6
But, then I wonder: are those other projects worth the expense to include? And then I am mostly comparing to the other two projects [Faraday projects] that cost the same as one of the other projects, but they have at least or almost ten times as much impact as these and for that I would say that it is almost not worth it	Motivation	Compare	1, 2, 3
I think that it would be more clear if I would have more information about the projects themselves, now there is only one sentence actually. But, what I am missing is the current problem situation, where does it really go wrong?	PVE		
I think that I'll take the conclusion for the other four projects, well three actually because the ramp I cannot afford if I choose the other two, I have too little information to make a well thought-through decision and therefore I wouldn't dare to do so	PVE		2
Those Transferiums they have in many other large cities and they did that for a reason. Such a Transferium you wouldn't use to go to the university because of the relative short distance. But that would almost only be to benefit the city centre and the busy traffic towards the city centre, which goes along the university of course. However, you will make it more busy around the Kruithuisweg and the highway, I wonder whether that indeed results in that much more time savings	PVE		1
I find it funny that with the free parking spaces the daily users on a bicycle is 600, I assume that they will not park their bicycle there and take rental bicycles. But I don't know	PVE		2
What strikes me is that.. Maybe that they are only impacted by.. No, it does get a bit busier on the bicycle. That's funny, that the reduction in travel time cannot be negative, because it could be that because there are more bicycles that it will get more busy and that it will take a minute longer	PVE		2
I stay with the conclusion that I have too little information to solve this or to have a useful opinion on it and therefore I do not select them	PVE		

Participant D

This participant took 6:23 minutes to make a selection of project 1, 2, and 5. As a first step the participant reviewed the project pages one-by-one. The participant indicated that project 1 had broader impacts, such as on diverting cars away from the city centre and providing spaces for visitors to park, which the participant considered a personal benefit. Project 2 was less desirable than project 1 because of the bicycle aspect, which would be uncomfortable in bad weather. Project 3 was discarded because of a bad cost-benefit ratio based on the attribute values. Project 4 was discarded based on an analysis of the current traffic situation and of it being very expensive. The participant considered project 5 desirable because of limited options to cross the river, the attribute values, and because of equity considerations. Finally, project 6 was discarded, as it seems due to bad experiences of Delft with project involving train tracks[1]. Then the participant indicated that the choice was made, based on impacts to the city centre, the car problem, and the bicycle problem as well as equity considerations. For verification the participant made a comparison of the chosen projects and concluded that the choice was good.

Motivations mentioned during selection:
1 - Transferium: selected immediately after viewing project page with personal benefit and car-free city centre motivations.
2 - Park&Bike: selected because of the same reasons as project 1.
3 - Gelatine bicycle tunnel: discarded based on a bad cost-benefit ratio.
4 - Ramp A13: discarded based on an analysis of the current traffic situation and high cost.
5 - Faraday bridge: selected based on current limited options to cross the river, the attribute values, and because of equity considerations.
6 - Faraday bicycle tunnel: discarded because of bad experiences of Delft with project involving train tracks.

Written motivation:
1 - Transferium: *A city centre with limited access for cars [autoluwe binnenstad] is nice. For visitors as well as students as well as residents. This covers the expensive parking.*
2 - Park&Bike: *Same argument as for the Transferium, but with the choice to go for a car [should be bicycle, probably]. Also for resolving problem of the lack of bicycles. Free parking.*
5 - Faraday bridge: *For residents and students/visitors this offers more possibilities for mobilising to and from the city centre.*

The motivations mentioned in the process and those provided in the written motivation correspond.

[1] The municipality of Delft was almost bankrupted due to cost overruns of projects related to putting the train tracks and station, which split Delft in two, under the ground.

Table K.5: Verbal protocol, shortened protocol of participant D

Statement	Category	Action	Project
First I want to know the information: what, where, and why?	Strategy		
In any case, what is not taken into account here, is that the car-free city centre is something that I am really a proponent of and that now offers a perspective	Motivation		1
Next to that I am paying hundreds of euro's per year for car, for visitor parking	Motivation		1
This touches more aspects than what it says here, what I find interesting. What I see benefits on different aspects, both for the students and the city itself	Motivation	Select	1
Cheap car parking places with rental bicycles, also a good idea, but I am less sensitive to this. If the weather is really bad I'll have to let my guests park the car somewhere and then they have to come here by bicycle	Motivation		2
Reduction peak times, reduction in travel time, yes, I find that it results in limited benefits compared to the money that it costs	Motivation		3
Yes, a new ramp, that is interesting. Currently you have of course three sides that you can go to when the bridge [Sint Sebastiaansbrug] is open again in the future, so a fourth possibility can reduce it indeed, the chaos in traffic. But I find it already quite limited, also in the peak times I find it limited still, how much it is a nuisance and how much you are gridlocked	Motivation		4
And then my budget is gone, that doesn't help either	Motivation		4
I do not know how many students are actually there and I do not know the area very well because I avoid it a bit. But it does impact the university area. Otherwise you would think that students are innovative enough to find a good bicycle route. However, the options across the Schie are of course quite limited	Motivation		5
It does reduce a lot	Motivation		5
I would almost choose that one out of solidarity	Motivation		5
Well, to be perfectly frank, if it says something about train tracks in Delft the hairs in my neck rise. If that is one of those intense projects that turns out to be difficult and cost money, so that 10 million will probably be 30 million	Motivation		6
No	Motivation		6
I have been able to make my choice	Other	Select	5
		Select	2
With that we impact the city centre, the car problem, the bicycle problem	Motivation		
Next to that, in my view, you offer everyone a solution: the residents of the city centre, but also students	Motivation		
I can compare them for the fun of it, always funny, it's possible	Strategy	Compare	1, 2, 5
Well, you reduce a number of things. You get cyclists as well as cars, I am perfectly satisfied with my choice	Motivation		
Yes, for me it is important that there is a solution for everyone	Motivation		
I shouldn't save money, right, that's a waste. That will go to crazy things	Motivation		

Participant E

This participant took 8:55 minutes to make a selection of projects 1, 2, and 5. The first step of this participant was to review the project pages one-by-one. Projects 1 and 3 to 6 were not commented on, but the participant immediately indicated that project 2 was a favourite and that in general he/she went for the first choice. Then, the participant again reviewed the projects one-by-one and indicated that project 1, 4, and 5 were desirable. The participant commented that, if going for the first choice, projects 1, 2, and 5 were favourite. The participant made comparison of these three projects and concluded that these fitted the budget perfectly. For the Faraday bridge project 5 the participant indicated that different groups of people benefit and that the attributes values were favourable. Project 1 and 2 were chosen because of environmental concerns and the ability for people to use bicycles or public transport.

The participant then reviewed the project pages of the remaining three projects to indicate why those were not chosen. Project 3 was discarded because of relatively bad attribute values, project 4 because of being a car focused project and a doubt of whether it would solve the problems. Finally, projects 5 and 6 were compared and the attribute values of, the already selected, project 5 were better.

Motivations mentioned during selection:
1 - Transferium: selected based on first instinct and to promote substitution of cars with public transport for the last leg.
2 - Park&Bike: selected based on first instinct and to promote substitution of cars with bicycles for the last leg because of environmental concerns.
3 - Gelatine bicycle tunnel: discarded based on first instinct and subsequently discarded based on attribute values.
4 - Ramp A13: discarded based on first instinct and subsequently the effectiveness was doubted and it was discarded as being a car focused project.
5 - Faraday bridge: selected based on first instinct and because of attribute values as well as equity considerations for residents/students and cars/cyclists.
6 - Faraday bicycle tunnel: discarded based on first instinct and in a subsequent comparison with project 6 the attribute values were low.

Written motivation:
1 - Transferium: *I am in favour of environment focused solutions with which I am in favour of use of public transport, especially in high population density areas such as Delft.*
2 - Park&Bike: *I am in favour of environment focused solutions with which I am in favour of use of bicycles, especially in high population density areas such as Delft.*
5 - Faraday bridge: *The bridge reaches more people than the tunnel, due to which this is my choice.*

The motivations mentioned in the process and those provided in the written motivation correspond.

Table K.6: Verbal protocol, shortened protocol of participant E [part 1]

Statement	Category	Action	Project
First I'll read all of them	Strategy		
Rental bikes, well, I am positive about that already	Motivation		2
Okay, now quickly go through it, let's see	Strategy		
I was fan of Park&Bike already. I am a feelings person so I generally go for my first choice anyway	Strategy	Select	2
The reason that I am a fan of that is that I am in favour of less cars, so I find a parking space with a rental bike for the last leg a good idea	Motivation		2
And then we'll compare some things	Strategy		1
This I find a good idea as well	Motivation	Select	1
I find it difficult to think about this because those are places where I actually do not go that often myself. But I also do not visit the university that often anymore, because that is what happens when you live in the city centre and don't study anymore	Reflection		3
I think that a new ramp can be useful, next to only for the students also for other residents of delft	Motivation		4
The bridge I also find a good one	Motivation		5
If I would go for first instinct I would go for the Transferium, the park&bike and the Faraday bridge	Motivation	Select	5
But I will compare these for a moment	Strategy	Compare	1, 2, 5
Then I have a perfect fit for the costs as I can see on my screen	Motivation		1, 2, 5
Reduction in travel time, yes that I find a bit less important to be honest, for cars at least	Motivation		
Yes, I will go for the three choices that I just mentioned because the Faraday bridge across the Schie is important for a lot of people and not just the students, even though I understand that it is mainly about the students and the people who work there	Motivation		5
But, I see that there are a lot of users on bicycles and in cars, in that direction and I think that it can result in a lot of travel time savings	Motivation		5
But, I think that next to that it would be beneficial to the residents as well	Motivation		5
I choose the Park&Bike because I am favour of environment reduction things	Motivation		2
So I find it very wise to park your car somewhere and continue on a bicycle, or with public transport	Motivation		1, 2
But I do agree with the plan to go with the tram because they are obviously busy connecting that tram	Motivation		1 & tram
I will also look at the other options to indicate why I do not choose them	Other		
Yes, what I see here is reduction in travel time for cars while the number of daily users of the cars is not really applicable. And there is some reduction for cyclists, but that is also just one or five minutes	Motivation		3
And it is, relatively speaking, if I look at the other projects, about less cyclists. Especially with the bridge that we just discussed	Motivation		3

[Continued on next page]

Table K.7: Verbal protocol, shortened protocol of participant E [part 2]

Statement	Category	Action	Project
Let's see what I click here, a new ramp. I think that this would benefit a lot of people, but it is again a car thing. So I think that for the people of the university not really.. Because I assume that technical people, just as myself, are a bit more busy with environment reduction. So going by bicycle, because they know the technical background a bit more than other people. But I do think that a ramp can be built there, but I wonder whether it will solve the issue, because I see here that it has mostly car users and no bicycle users	Motivation		4
Those I can compare to each other, since we're doing research	Strategy	Compare	5, 6
Yes, the tunnel I would not choose because it impacts less people than the bridge. Because with that you get 5000 people on bicycles instead of the 14000 bicycle and car users with the bridge. So then, if I had to choose one of the two, I would go for the bridge	Motivation		5, 6
So I'll go for these three choices. Yes, I am hitting, just as I had calculated, exactly 40	Motivation	Send	

Participant F

This participant took 12:31 minutes to make a selection of projects 3, 5, and 6. This participant's first step was to review the project pages one-by-one. During this the participant mainly made references to the (lack of) personal benefits that would ensue from each project, which came down to a preference for cycling-oriented projects. The synergies of both the Gelatine projects and the Faraday projects were acknowledged.

As a second step, the participant made a comparison of all projects. Project 4 was discarded because the cause of the problem and therefore the solution was taken into doubt. Faraday projects 5 and 6 were regarded positively due to the cost-benefit ratio and promoting cycling to the university. For project 3 the cost-benefit ratio was considered relatively low and the attribute values were doubted. However, its ability to reduce the division between parts of the city was regarded positively. Project 2 was discarded because the participant doubted the added value, partly due to the Mobike bike sharing system and existing parking facilities. Project 1 was discarded for being located illogically. Finally, the participant indicated that the bicycle options were in line with his/her wishes and because the underlying problems were not doubted.

Motivations mentioned during selection:
1 - Transferium: discarded for being located illogically and because of no personal benefit.
2 - Park&Bike: discarded because the participant doubted the added value, partly due to the Mobike bike sharing system and existing parking facilities. Also because of no personal benefit.
3 - Gelatine bicycle tunnel: selected based on personal benefits, despite an initial indication that the cost-benefit ratio was low in a comparison between all projects. Also selected because of the synergy with the Gelatine bridge.
4 - Ramp A13: discarded because the cause of the problem and therefore the solution was taken into doubt.
5 - Faraday bridge: selected based on personal benefits and a high cost-benefit ratio compared to the other projects. Selected together with project 6 due to synergy considerations.
6 - Faraday bicycle tunnel: selected based on personal benefits and a high cost-benefit ratio compared to the other projects. Selected together with project 5 due to synergy considerations.

Written motivation:
3 - Gelatine bicycle tunnel: *There is quite a large procession of cyclists from the west side of Delft towards the campus. I think with the Gelatine bridge a better access to this bridge is desirable to make use of this extra capacity.*
5 - Faraday bridge: *If I look at the numbers there seems to be a clear desire to move from Tanthof*

to Technopolis. Next to that, Tanthof is quite badly accessible as people can only access or leave the neighbourhood via the Kruithuisweg, which is true for both car users and cyclists. That is why I think that a better connection to the Technopolis is desired. This means that both the Faraday bridge and tunnel are needed, because otherwise you do not have the straight connection.
6 - Faraday bicycle tunnel: [same as for project 5]

The written motivations do not contain the personal benefits that were mentioned several times in the process. Also, the initial doubt with respect to project 3 is not mentioned. This participant included the exact same motivation for project 6 as for project 5.

Table K.8: Verbal protocol, shortened protocol of participant F [part 1]

Statement	Category	Action	Project
This does not sound very appealing to me, because I live next to the campus and more cars around the campus is actually not really desired	Motivation		1
This is also again mainly intended for people who do not live close to the campus, so for me that is again a bit less appealing. I would anyway.. I have a parking spot here in front of the house and I wouldn't move around here by car anyway. For me the things on the bicycle are of course more logical	Motivation		2
What is the Gelatine bridge? Ah, that is the new bridge that they are building, okay	Motivation		3
It would make it much easier for me to reach the Hoven [Voorhof] and to move around the university	Motivation		3
It also makes other bridges much less busy	Motivation		3
That it also make it easier to get from Voorhof to the university, because now you always have to go to that weird swing bridge or to the Kruithuisweg	Motivation		3
And it is relatively cheap with respect to the other options	Motivation		3
And for me especially the bicycle movements count much more than car movements because I am here already and I do not have to get here by car	Motivation		3
Why does that make the travel time for a cyclist go down? I don't fully get that	PVE		4
Plus: is the ramp to the university really the issue?	Reflection		4
And it is relatively expensive	Motivation		4
Ah, that is the bridge that connects the industrial area of the Makro to what happens at the south side of the Kruithuisweg. Will that be really used that much and is that really an issue?	PVE		5
It will make it much easier to get from Tanthof to the south side of the campus.	Motivation		5
But still there is no tunnel under the train tracks so you actually, if you live in Tanthof, have to go over the Kruithuisweg to reach the south side of the campus, the Technopolis. Ah, that tunnel under the train tracks is surely part of it	Motivation		5
Yes, okay, so actually if you choose the bridge you would want to include the bicycle tunnel because otherwise the bridge doesn't make that much sense.	Motivation		6
Now, if I look at..	Strategy		
If I want to compare, where do I click? On the arrow? Ah, here	PVE	Compare	all
But, it is mostly the Kruithuisweg that is gridlocked, not the A13 I think. [discussion of origin of the issue] So I don't think that that A13 ramp is such a useful addition	PVE		4
I think that both the Faraday bicycle tunnel and bridge, if you choose one you have to choose the other, otherwise they are not effective.	Motivation		5, 6
But with that, you do help 9000 cyclists and 10000 car users in one go, and it is still cheaper than the new ramp	Motivation		5, 6
And you promote going to the university on a bicycle	Motivation		5, 6
The Gelatine bicycle tunnel I find expensive for how much impact it has, if only 1200 cyclists make use of it per day and you look at what impact the Faraday bicycle tunnel has	Motivation		3
Then I wonder whether those number are fully correct, as a first	PVE		3
As a second, yes, I find that impact quite low actually. Perhaps that is because there is another tunnel next to it, due to which not that many people make use of it	Motivation		3

[Continued on next page]

Table K.9: Verbal protocol, shortened protocol of participant F [part 2]

Statement	Category	Action	Project
It does make that the train tracks are much less a dividing line in the city, so from that perspective that is an advantage	Motivation		3
I find Park&Bike also very nice, but I wonder whether it adds a lot if you have all those Mobikes [bike sharing system] in the city currently	Motivation		2
And especially because when you look at the campus then there are a number of dedicated parking facilities that are actually not very far from the places where you need to go	Motivation		2
Of course then the idea is that you actually make a kind of Transferium where everybody travels to one side of the campus and from takes a bicycle from there. But I wonder whether eventually many people will do that , so whether it isn't a waste of money with respect to those parking places already being there and people who will probably take the gamble to go there	Motivation		
I think that the Transferium is an idea anyway, because it does make it very easy to take the tram as well, so you bring the car much closer to making a step with public transport afterwards	Motivation		1
But for that it must be easily accessible, and if you look at where, if it is on the Technopolis, then that is kind of illogical. Because first you come from the Kruithuisweg and you have to be somewhere close to Architecture and then you actually go the wrong way	Motivation		1
So I think that in this instance I will go for the bicycle options because these are also best aligned with my wishes	Motivation	Select	3
Because a large part of the people who want to reach the campus, apart from the workers, comes by bicycle and you clearly see queues form on the access roads towards the campus on moments that lectures begin	Motivation	Select	5
		Select	6

Participant G

This participant took 6:01 minutes to make a selection of projects 2, 3, and 6. Firstly, the participant reviewed the project titles on the main page. Secondly, the participant reviewed the project pages one-by-one. Projects 1 and 4 were discarded because they facilitated car traffic. Projects 2, 5, and 6 were commented on positively, with 5 and 6 mentioning the motivation of unlocking the Tanthof neighbourhood. The participant concluded that these three were best because they promote cycling. However, still €10 million was left and this was troubling the participant.

Motivations mentioned during selection:
1 - Transferium: discarded immediately because it facilitates car traffic.
2 - Park&Bike: selected because of intention of promoting cycling.
3 - Gelatine bicycle tunnel: selected because of intention of promoting cycling.
4 - Ramp A13: discarded immediately because it facilitates car traffic.
5 - Faraday bridge: discarded as project 6 was favoured, seemingly because project 6 is a tunnel purely for cyclists.
6 - Faraday bicycle tunnel: selected because of intention of promoting cycling and to improve accessibility of the Tanthof neighbourhood.

Written motivation:
2 - Park&Bike: *I want to have the car and bicycle traffic connect to each other and I want a clear place where cars and bicycles are located so they do not drift through Delft.*
3 - Gelatine bicycle tunnel: *To unlock Voorhof, and perhaps due to that more students will live in Voorhof and it will mix nicer/better with the other residents.*
6 - Faraday bicycle tunnel: *For this the same applies, Tanthof is, in my opinion, especially a neighbourhood for families. It the connection between Tanthof en de Campus is better unlocked the mix between various residents is made easier. This will also decrease the pressure in the city centre from student housing.*

The motivations mentioned in the process and those provided in the written motivation correspond.

Table K.10: Verbal protocol, shortened protocol of participant G

Statement	Category	Action	Project
So these are the projects, but now suddenly there are three more. You mentioned the three that are there, the bicycle tunnel.. Oh no, then that was.. These are all three, six others, aren't they?	PVE		
I don't know where to place everything, but does that matter? Ah, here, information	PVE		1
That I wouldn't do, more car traffic	Motivation		1
This seems like a good one, park&bike	Motivation		2
[accessed page of Gelatine tunnel without commenting]			3
Then we are again facilitating that car traffic, that is a tough one	Motivation		4
Quite a good one, to unlock Tanthof	Motivation		5
So then I now have two, three, and five	Other		
Connects the neighbourhood of Tanthof, ah, that is also a good one. Yes, I like that one also	Motivation		6
Let's see, how do I proceed? [reads help page]	PVE	Help	
Two	Other	Select	2
Three	Other	Select	3
The Faraday bridge over the Schie? Or the bicycle tunnel under the train tracks? I'll choose that bicycle tunnel	Other	Select	6
Cycling traffic I want to..	Motivation		
I have ten million left	Motivation		
Let's see what happens with that. [reads help page]	PVE	Help	
Yes, I am satisfied but I have money left	Motivation	Send	

Participant H

This participant took 7:11 minutes to make a selection of projects 3, 5, and 6. Firstly, the participant reviewed the project titles on the main page. Secondly, the participant reviewed project pages 1 up to 4 one-by-one with only commenting on the synergy between project 3 and the Gelatine bridge. Then the participant adopted the strategy to focus on bicycle users and reviewed project pages 2 up to 6. Project 2 and 3 were considered useful and put into the selection. Project 4, the new ramp, was discarded because it was not considered necessary. Project 6 was initially discarded because cyclists from the Tanthof neighbourhood could go through the Gelatine tunnel and bridge.

The participant noted that money was left to spend, so project 1 was selected. Then, a comparison was made of projects 1, 2, and 3. Subsequently, the participant searched for the high attribute value of car users (20,000 for project 4) that he/she had seen and based on the encountered attribute values of car users (10,000 versus 1,000) project 5 was selected and project 1 was deselected. Then the participant compared the currently selected projects 2, 3, and 5. However, upon revisiting the project page of project 2 the participant commented that free parking spaces are not necessary and the project was again deselected. The Faraday tunnel project 6 was then chosen based on the number of cyclists. Finally, the selected projects 3, 5, and 6 were compared and the participant concluded that the selection was final as it helped a lot of cyclists and also some car users. The participant also indicated a wish for spending the remaining €5 million.

Motivations mentioned during selection:

1 - Transferium: initially selected after budget was left after the first review of project pages, but subsequently discarded because of the limited number of users.

2 - Park&Bike: initially selected directly after reviewing the project page, but subsequently discarded because the participant did not consider free parking spaces to be necessary.

3 - Gelatine bicycle tunnel: selected directly after reviewing the project page.

4 - Ramp A13: discarded immediately because the participant considered it unnecessary.

5 - Faraday bridge: selected based on the attribute values.

6 - Faraday bicycle tunnel: initially discarded because cyclists from the Tanthof neighbourhood could

go through the Gelatine tunnel and bridge. Finally selected based on the number of cyclists.

Written motivation:
3 - Gelatine bicycle tunnel: *Positive effect for cyclists on the west side of the city.*
5 - Faraday bridge: *Large benefit for car users and cyclists.*
6 - Faraday bicycle tunnel: *A lot of benefit for cyclists.*

The motivations mentioned in the process and those provided in the written motivation correspond.

Table K.11: Verbal protocol, shortened protocol of participant H

Statement	Category	Action	Project
[study main page]			
Let's see, what is a Transferium Technopolis?	Strategy		1
Gelatine bicycle tunnel under the train tracks. They will build a bridge there, but then there also needs to be something underneath the train tracks	Motivation		3
Well, I'll go more for the cyclists than for cars	Strategy		
That might be useful, let's put that in the selection	Motivation	Select	2
That might be useful, but does that need to be under the the train tracks? Yes, then the boys from the Voorhof and the van Hasseltlaan can cross the train tracks with the bicycle	Motivation	Select	3
New ramp, well, not necessary I think	Motivation		4
Yes, well, they can cycle a bit around via the Gelatine bicycle tunnel and the Gelatine bridge, so I do not find that very necessary	Motivation		6
Now I have money left, so perhaps then yes..	Motivation		
Well, then I'll go for a Transferium Technopolis	Motivation	Select	1
If I compare these	Strategy	Compare	1, 2, 3
Now I just saw somewhere that there were 20,000 [car users]. Let's see, where was that again?	Information		4
10,000 users in the car, so that is a nice result if I choose the bridge over the Schie	Motivation		5
With the Transferium, that is only 1,000 [car] users, so I'll not choose the Transferium	Motivation	Deselect	1
And then I'll choose the Faraday bridge	Other	Select	5
And if I compare those also	Strategy	Compare	2, 3, 5
Look, that has a nice impact, 4,000 [cyclists], that is a nice result	Motivation		5
Yes, I think free car parking spaces, that is not necessary at all	Motivation	Deselect	2
5,000 cyclists, that is quite a nice result	Motivation	Select	6
Let's compare for a moment	Strategy	Compare	3, 5, 6
10,000 [car users], yes, that looks nice	Motivation		5
That I'll do that, the Gelatine bicycle tunnel under the train tracks, and that Faraday bridge and a bicycle tunnel under the train tracks. Then that just becomes a very good connection	Motivation		3, 5, 6
Yes, and then I would very much like to spend 5 million on something, but I can't	Motivation		3, 5, 6
That gives a nice result,	Motivation		3, 5, 6
many cyclists helped and also quite a bit of car users	Motivation		3, 5, 6

Participant I

This participant took 12:14 minutes to make a selection of projects 1, 5, and 6. This participant's first step was to review the project pages one-by-one. Several comments were made on the participant's limited knowledge with regards to parking being an issue and not knowing the area near Technopolis and Tanthof. The participant regarded the attribute values of projects 4 and 5 positively, and indicated that project 3 seemed useful. The project pages of projects 1 and 2 were viewed again and project 1 was selected.

Then, the participant discovered the comparison option and compared firstly projects 1 and 2, and then 3 and 5. For 1 and 2 the participant compared attributed values and concluded, again, that project 1 had a better cost-benefit ratio. For project 3 the participant acknowledged the synergy with the Gelatine bridge, but in the comparison with project 5 the attribute values were in favour of project 5. Therefore, he/she selected project 5.

Then the participant observed that €10 million was left and viewed the project costs, noting that project 4 did not fit with the remaining budget. That project page was again visited and because of it being expensive and the participant not owning a car it was discarded, despite impacting a lot of people. The participant again made a comparison, this time of projects 2, 3, and 6. Based on that former comparison project 6 was selected in favour of project 3, thereby fully spending the budget.

Subsequently, another comparison was made of the selected projects 1, 5, and 6 as well as project 4. Again, the high number of users for the ramp project 4 was acknowledged, but contrasted with the participant not having a car and doubting the impact. Then, the participant identified a synergy between projects 1 and 4, as people who use the ramp can then park at the Transferium. However, this was not possible with the budget. So, the participant made a comparison of the Transferium project 1 with the cheaper Park&Bike project 2 and concluding that it was not possible to have the combination with the tunnel (unclear which one). However, the participant still lingered on the synergy between ramp project 4 and Park&Bike project 2. Finally, the conclusion was made that project 4 was too expensive and that people should come by bicycle or train.

Motivations mentioned during selection:

1 - Transferium: selected in a comparison between projects 1 and 2 based on this project not contributing to bicycle issues and because of the more favourable cost-benefit ratio. Also selected because of the intention to stimulate public transport use.

2 - Park&Bike: discarded because of expected bicycle issues.

3 - Gelatine bicycle tunnel: initially considered because of synergy effects with Gelatine bridge, but discarded after comparison with project 5 based on attribute values. Later it was also mentioned that people in Voorhof already live close to the university.

4 - Ramp A13: discarded, despite being considered due to the attribute values and discarded multiple times due to no personal benefit and high cost. Also the synergy between this project and projects 1 or 2 were considered.

5 - Faraday bridge: selected in a comparison between projects 3 and 5 based on attribute values. Also selected because of the intention to stimulate bicycle use.

6 - Faraday bicycle tunnel: selected in a comparison between projects 2, 3, and 6 based on attribute values and to fully spend the budget. Also selected because of the intention to stimulate bicycle use.

Written motivation:

1 - Transferium: *Parking is not only an issue with the bicycle but also with the car. Therefore, it is nice to go with public transport from the parking spot to work or study. Otherwise you are simply shifting the problem. Next to that there is not a lot of space on the campus to place spaces for both bicycles and cars. Therefore I do not choose the ramp because now there is a fine connection between the station and the campus with the tram line.*

5 - Faraday bridge: *It is useful for people who live in Tanthof to go to work with a bicycle quickly. Combined with the tunnel under the train tracks the travel time is drastically reduced. This stimulates people to go by bicycle.*

6 - Faraday bicycle tunnel: *To double the effect and to promote cycling I choose the combination of the tunnel and bridge.*

The motivations mentioned in the process and those provided in the written motivation correspond. The participant included the reason for not choosing project 4.

Table K.12: Verbal protocol, shortened protocol of participant I [part 1]

Statement	Category	Action	Project
The first, okay	Strategy		1
I didn't know parking was such an issue. Yes, that's funny, then there will be more bicycles, is that an issue again	Reflection		2
With the bicycle, cycling a bit. Wouldn't everyone in the city centre dump their car there and cycle the last bit	Reflection		2
Yes, that is useful	Motivation		3
I new actually a renewed one? Or really an extra one, next to it, two lanes or something?	PVE		4
Yes, I don't know, I don't live there. Also, I do not have the idea that it reduces the busy traffic	Reflection		4
Yes, 8 minutes and 2,000 [20,000] people, that is quite a lot	Motivation		4
Are these really existing plans?	PVE		4
It is expensive, but it is used a lot, 8 minutes around the campus, travel time for cyclists 6 minutes, that is also a lot	Motivation		5
Only I don't know how many people live in Tanthof	Reflection		5
The maps are very far zoomed out when you open them	PVE		
I don't know, I am not such a fan of the parking thing, but maybe that Transferium? Oh no, that is that parking thing. Yes, two parking things, that is the same	Motivation		
Would people really take a rental bicycle?	Reflection		2
I just don't really see that there is enough space on the campus, more there near the company area	Reflection		1
Was the other one also with bicycles?	Reflection		1
Yes, then you'll get issues with bicycles, so I am more in favour of this one	Motivation	Select	1
Oh, you can compare them	PVE		
Then I'll do that	Strategy	Compare	1, 2
5 million more and double travel time savings for half the people, yes, I like that	Motivation		1, 2
Yes, that is quite weird. Weird that they build a bicycle bridge there near the Praxis while there is nothing there. Yes, near the Praxis there is nothing there, then you have to bicycle around anyway to get to that bridge in the first place [Gelatine bridge]. Then it is useful that there is a tunnel there	Motivation		3
We'll have a look	Strategy	Compare	3, 5
One of those two I think is a fine idea. It is also clear that that bridge yields much more, however I am also a fan of that tunnel. Practically I would go for the bridge, if so many people benefit from it	Motivation		3, 5
		Select	5
So then I can choose.. Yes, not the ramp. Does it yield that much? 20,000? Yes, but I have no car	Motivation		4
Hmm, I don't see it.. Too expensive	Motivation		4

[Continued on next page]

Table K.13: Verbal protocol, shortened protocol of participant I [part 2]

Statement	Category	Action	Project
We can compare 10 million options, there, go	Strategy	Compare	2, 3, 6
So in principle the Faraday bicycle tunnel yields the most. This is as much, this is a bit less	Motivation		2, 3, 6
Where is Voorhof? Is that next to? Yes, those people already live close by	Motivation		3
Click on that, then I am out of money	Motivation	Select	6
If I now compare these, the tunnel with this and that or that ramp, let's see what yield the most	Strategy	Compare	1, 4, 5, 6
Well, it is the highest number of people	Motivation		1, 4, 5, 6
But I have no car	Motivation		1, 4, 5, 6
I don't see the issue that much, and I also wonder whether it will really yield that much. Will it not become very busy in Tanthof with cars?	Motivation		1, 4, 5, 6
If you then drive your car directly to beneath the campus, if that is possible. Oh, that is quite useful with the parking garage, but that is not possible with the costs	Motivation		1, 4
Let's see, if I compare these two	Strategy	Compare	1, 2
Parking, yes, both on the campus	Information		1, 2
Yes, that is quite beneficial, but that is not possible with the tunnel	Motivation		2
No, I think I'll go for bicycle stimulation	Motivation		
But two of those tunnels is also weird. But yes, perhaps the connection is chill when you have both	Motivation		
I don't know, I am thinking whether people come from Delft or whether people live far away. Because, apparently many people come from far away, so then that ramp is nice	Motivation		4
But then you would have to do it with the park&bike, you want to dump your car somewhere. Otherwise everybody comes with the car and then that doesn't make sense anyway	Motivation		2, 4
So then, now you should there.. Yes, it doesn't make that much of a difference, up there you cannot either	Motivation		2, 4
Yes, it is a very expensive one	Motivation		4
Come with the bicycle, or the train	Motivation		
And then the bridge over the Schie and under the train tracks so you can cycle in one go	Motivation		5, 6

Participant J

This participant took 21:05 minutes to make a selection of projects 3, 5, and 6. Firstly, this participant made a review of the project pages one-by-one. The participant focused on the attribute values and voiced some confusion about what they meant, what the underlying problems were, and what was considered most important (not necessarily by whom, but objectively, it seemed).

Secondly, the participant compared all projects. The synergy of the Faraday projects 5 and 6 was acknowledged, but due to this not being indicated in the attribute values the participant wondered whether to take this into account. The participant decided to make multiplications of travel time savings and the number of users in order to get an objective measure. This was done by using a calculator and making notes on a screenshot of the comparison page. However, half way the calculations the participant realised that the number of direct users were 0 for some projects, even though travel time savings were indicated. The participant realised that the travel time savings were more of an overall net value. However, the participant noted that he/she lacked knowledge of the amount of cyclists and car users that would be impacted and searched for this information, which was not provided.

Subsequently, the participant again decided to make calculations, but based on a summation of travel time savings with weighting factors of 1 for both cyclists (from Tanthof and from Voorhof) and 2 for car users. These weighting factors were an assumption with regards to an objective measure, not necessarily personal preference. The outcome would then be divided by cost to obtain a benefit-cost ratio. This resulted in the Faraday projects 5 and 6 being most desirable.

Then, because €15 million was left and two out of three possible projects cost €10 million the participant decided to multiply the obtained values by 2/3 for those €10 million projects (projects 2 and 3). This indicates that spending the entire budget was considered desirable. Finally, this resulted in Gelatine bicycle tunnel project 3 being most desirable. However, in the final process the participant was a bit confused and not very sure of the outcomes of the calculations, indicating: *”Am I sure? No, I am not sure, but I am not going to calculate it again.”*

Motivations mentioned during selection:
1 - Transferium: discarded based on calculations using TTS and cost.
2 - Park&Bike: discarded based on calculations using TTS and cost.
3 - Gelatine bicycle tunnel: selected based on calculations using TTS and cost.
4 - Ramp A13: discarded based on calculations using TTS and cost.
5 - Faraday bridge: selected based on calculations using TTS and cost.
6 - Faraday bicycle tunnel: selected based on calculations using TTS and cost.

Written motivation:
3 - Gelatine bicycle tunnel: *This gave, according to my calculations, the most travel time reductions possible for the 15 million that was left (despite it costing only 10 million).*
5 - Faraday bridge: *This had, according to my calculations, the most travel time savings per euro.*
6 - Faraday bicycle tunnel: [same as for project 5]

The motivations mentioned in the process and those provided in the written motivation correspond.

Table K.14: Verbal protocol, shortened protocol of participant J [part 1]

Statement	Category	Action	Project
Okay, then I think first I'll read them or something	Strategy		1
I am missing my orientation, I am always very bad with this	Reflection		
Yes, reduction in travel time per cyclist, that should then be negative because you get more bicycle travel time, netto or something, I think	PVE		
I still find it difficult what all numbers mean. And I do not really have an overview of what is most important, that is what I am missing a bit, I think. So, what problems are biggest. Is the travel time for cyclists more important than for cars? Or the other way around? What problem is biggest?	PVE		
Ah okay, then I don't have to go all the way over there, that is quite logical	Motivation		5
Okay, but I think that then that is not necessary if that bridge is there? It is located a bit differently, or not?	PVE		6
Okay, well, I'll compare all of them at the same time	Strategy	Compare	all
Wow, uhm, we have the bridge over the Schie and a tunnel under the train tracks, both near the Faraday. So I guess that those work best if they are in line with each other?	Motivation		5, 6
But it doesn't indicate that it works even better if you choose both of them. So I do not know if I have to take that into account. Uhm, yes..	PVE		5, 6
Yes, I can multiply the number of minutes in travel time reduction with the number of cars and do the same for cyclists. Then I have something that is objective. Yes, I'll do that	Strategy		
Can I just open the calculator? Yes, I'll do that	Other	External	
[calculations of travel time savings multiplied with number of users]	Information		
Yes, I find it difficult, and I am taking way too long	Other		
Yes, now I am in doubt, because the number of users doesn't say anything. If those users are using but it doesn't matter, what does it give. And that travel time is, I think, more of a sort of netto number. So then I have to make a guess as to how many cyclists are in the area and then that is actually the most important, I think	PVE		
But then I have to start all over again	Other		
There is not somewhere some extra information on the problem, right? With how many cyclists, how many cyclists there are? How many cars there are?	PVE	Help	
Okay, I think that I'll make a decision. What am I going to base that on?	Other	Compare	all
Yes, I think that I'll assume that I find cyclists and cars both equally important. So then, travel time per cyclist between Tanthof and the campus and between Voorhof and the campus, so then I would say..	Motivation		
Uhm, cars I'll give a weight of 2, and then to both cyclists I give a weight of 1, there. And then I'll just multiply that with each other. And then I have this, then divide by the cost of course. So then we have here	Strategy		
[calculations of travel time savings multiplied with the weight and division by costs]	Information		
And then I have assumed that I find the car equally important as the cyclists, but then I'll take the cyclists between Tanthof and Voorhof together as one	Motivation		
And then I have a score per project. And then the Faraday bicycle tunnel and the Faraday bridge are the most important	Motivation		5, 6
Then I am at 25 million	Information		5, 6

[Continued on next page]

Table K.15: Verbal protocol, shortened protocol of participant J [part 2]

Statement	Category	Action	Project
And then the Gelatine bicycle tunnel can also be added	Other		III
And then I have 5 million left, I think	Information	Select	5
		Select	6
Let's see, yes, then I have 15 million left, then I have to find the best value for that as well	Motivation	External	
[calculations times 2/3 for 10 million cost]	Information		
Yes, then the bicycle tunnel is simply the best, yes, then the bicycle tunnel is added	Motivation		3
The Faraday bicycle tunnel, or did I have that one already? Ah no, that is no 1, I erased the six, never mind	Other		6
Okay, so the choice goes between.. Oh man, I really have no overview anymore	Other		
The park&bike, the Gelatine bicycle tunnel and the Transferium, that is what the choice is between	Other		1, 2, 3
And then if I multiply the Gelatine bicycle tunnel times 2/3 than it is still 0.8 so than that is the best	Motivation		3
So then I'll do that, the Gelatine. Okay, I think it is correct	Other	Select	3
The Faraday bridge over the Schie, that is a score of 1.6	Motivation		5
The Faraday tunnel, that is also a score of 1.6	Motivation		6
And the Gelatine that adds 0.9	Motivation		3
Yes okay, that it	Other		
Then I say: send. Right?	Other	Proceed	
Oh yes, that is correct	Other	Return	
		Proceed	
Okay, send	Other	Send	
Am I sure? No, I am not sure, but I am not going to calculate it again	Other	Confirm	

Variation experiment: outcomes

Figure L.1 shows the counts of the 15 treatment combinations within both variants and the variants combined. The counts per variant range from 2 to 9 and when combined they range from 7 to 14.

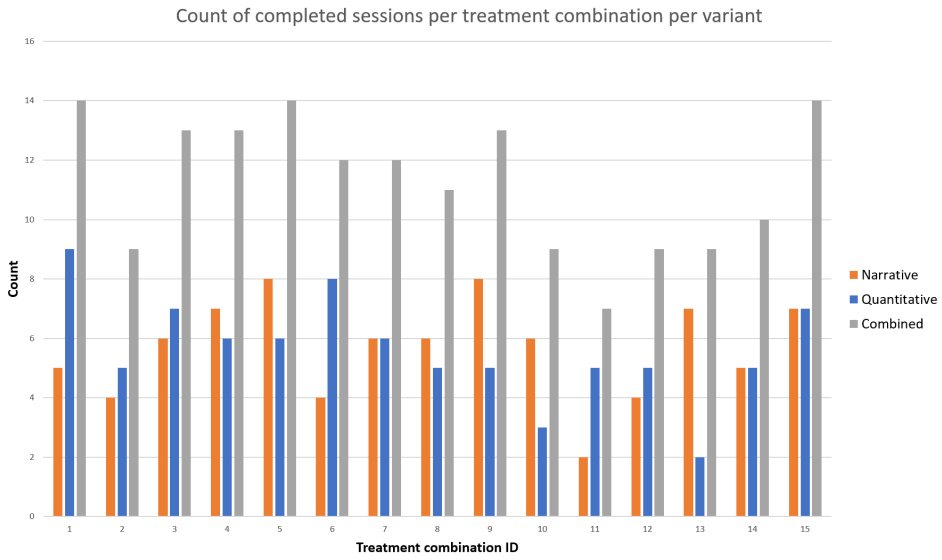


Figure L.1: Variation experiment, completed number of treatment combinations per variant

Table L.1 presents the first estimation results for the MNL choice model. In that estimation the parameters were included that related to the budget and to both bicycle travel times separately.

Table L.1: Variation experiment, resulting MNL choice model for the first estimation. Indicated with one asterisk and two asterisks are the parameters that are significantly different from zero at confidence levels of 90% (t-value 1.645 or higher) and 95% (t-value 1.96 or higher), respectively.

		Narrative		**Quantitative**	
N	Observations		85		84
Parameter	Project/attribute	Estimate	t-value	Estimate	t-value
0-LL		-266.5		-252.7	
Final-LL		-231.8		-216.4	
ρ^2		0.130		0.144	
PSC_1 (fixed)	1 - Transferium	0.00	-	0.00	-
PSC_2	2 - ParkBike	-0.834**	-2.172	-0.200	-0.510
PSC_3	3 - Gelatine tunnel	-0.383	-0.577	1.385**	2.004
PSC_4	4 - Ramp A13	0.503	0.494	3.079**	2.784
PSC_5	5 - Faraday bridge	-1.448	-1.228	0.872	0.693
PSC_6	6 - Faraday tunnel	-3.398**	-2.527	-0.251	-0.185
β_{X_A}	A - Change in travel time car	0.355	0.771	-1.154**	-2.355
β_{X_B}	B - Change in travel time bicycles Voorhof	0.091	0.167	-0.475	-0.885
β_{X_C}	C - Change in travel time bicycles Tanthof	-0.252	-0.379	-0.041	-0.058
β_{X_D}	D - Number of direct bicycle users	3.584**	2.593	1.181	0.858
β_{X_E}	E - Number of direct car users	-0.186	-0.152	-2.391*	-1.770
α_B	Not allocating budget	-5.586**	-4.592	-1.852	-1.438

M

Quotes from motivations [Dutch]

This appendix presents quotes representative of the categories identified and applied in the qualitative analysis of the PVE survey applied in this research.

Traditional goals

Improve safety

"Is direct voor een grote groep een verbetering en veiliger" [Variation: narrative] [Project 3: Gelatine bicycle tunnel]

"Deze verbinding is op dit moment gevaarlijk." [Variation: quantitative] [Project 3: Gelatine bicycle tunnel]

Reduce travel time / congestion

"Betere doorstroom, meer tijdswinst" [Variation: quantitative] [Project 4: Ramp A13]

"Fietsers hopen zich op op bepaalde plekken om naar de TU te komen. Een extra verbinding helpt." [Variation: quantitative] [Project 3: Gelatine bicycle tunnel]

"Dat omrijden gaat veelal via de kruithuisweg, die in de spitstijden al behoorlijk stilstaat. Een extra route over de schie om inwoners binnen Delft te verplaatsen is daarvoor nodig." [Variation: narrative] [Project 5: Faraday bridge]

"Meer auto's met bestemming TU wijk sneller op bestemming, ontlasting afrit Delft centrum en Delft zuid, afhankelijk van aanrij- en vertrekrichting." [Variation: narrative] [Project 4: Ramp A13]

Personal benefits / self-interest

"De parkeerplekken zouden voor mij een goede optie zijn als ik met de auto kom. Het klinkt als een hele goede keuze door de afstand vanaf de snelweg tot de parkeerplekken en de mogelijkheid om de tram te gebruiken om naar je eindbestemming te komen." [Variation: narrative] [Project 1: Transferium]

Increase number of parking spaces

"Volgens mij is parkeren in Technopolis op dit moment best lastig, en ik denk dat het goed voor de ontwikkeling is om hier gratis parkeerplekken te plaatsen." [Variation: narrative] [Project 1: Transferium]

"Parkeren is niet alleen met de fiets een probleem maar ook met de auto. Vandaar dat het handig is om met het OV vanuit de parkeerplaats naar het werk of de studie te gaan. Anders verschuif probleem gewoon. Daarnaast is er niet heel veel ruimte op de campus om plekken voor zowel fietsen als auto's te zetten." [Process tracing study] [Project 1: Transferium]

Closely related to the traditional goals of transport planning

Improving accessibility

"Oost-west verbindingen zijn cruciaal voor Delft." [Variation: quantitative] [Project 3: Gelatine tunnel]

"Onderdeel van een betere route voor Tanthof. Zo is tanthof beter aangesloten, want het is al zo ver weg." [Variation: quantitative] [Project 5 & 6: Faraday bridge and tunnel]

"De schie vorm een strakke scheiding tussen verschillende delen van Delft. Dit zorgt voor veel omfietsen en omrijden." [Variation: narrative] [Project 5: Faraday bridge]

Reducing traffic-related burden to city centre / campus

"Lost grotendeels het autoprobleem aan de oostkant van de TU op, huurfietsen voor het laatste deel zorgen dat iedereen zich over de campus kan verspreiden." [Variation: narrative] [Project 2: Park&Bike]

"Ik denk dat het een verbetering van de campus én de binnenstad oplevert als mensen hun auto verder weg laten staan." [Variation: quantitative] [Project 1: Transferium]

"Dat verkeer naar de binnenstad niet belemmerd wordt door het verkeer wat naar de campus gaat." [Variation: quantitative] [Project 4: Ramp A13]

Broader goals

Improve health and environment

"De toegankelijkheid vanaf de A13 is op dit moment niet optimaal en zorgt voor veel onnodig omrijden, dit is slecht voor het milieu." [Variation: narrative] [Project 4: Ramp A13]

"Daarnaast is fietsen gezond en iets typisch Nederlands, wat ik bij de Universiteit Delft vind passen." [Variation: quantitative] [Project 2: Park&Bike]

"Ik ben pro milieu gerichte oplossingen." [Process tracing study] [Project 1 & 2: Transferium & Park&Bike]

Promote PT and cycling

"Ook deze fietstunnel helpt voor stimulatie van fietsen op en naar campus. Ik heb lang getwijfeld tussen de faraday tunnel en brug. Toch ben ik voor meer fiets stimulatie in Delft en vind ik het belangrijker dat fietsers voordeel hebben van de maatregelen." [Variation: narrative] [Project 6: Faraday tunnel]

Fietstechnisch een prikkel voor mensen in Tanthof met de fiets richting de TU te gaan." [Variation: narrative] [Project 5 Faraday bridge]

"Ik vind dat het gebruik van fietsen of OV zo veel mogelijk gestimuleerd moet worden, dus dat daar mobiliteitsgeld naartoe zou moeten gaan." [Variation: quantitative] [Project 2: Park & Bike]

Reduce car traffic through substitution of modes

"Stimuleren van het parkeren van auto's buiten het centrum en de reis vervolgen op de fiets." [Variation: quantitative] [Project 2: Park & Bike]

"Stimuleert multimodaal vervoer. [Variation: narrative] [Project 1 & 2: Transferium & Park & Bike]

Improve attractiveness of area

"Maakt delft-zuid aantrekkelijker om te wonen als student, en bied dus meer kansen voor aannemers om totale wooncapaciteit van delft uit te breiden." [Variation: narrative] [Project 5: Faraday bridge]

"Om de groeit te stimuleren van het technopolis park." [Variation: narrative] [Project 4: Ramp A13]

"Op deze manier zullen misschien ook de studentenwoningen zich minder concentreren in bepaalde wijken en zich meer verspreiden naar buitengebieden in Delft, zodat de student wat breder geïntegreerd wordt over de hele stad." [Variation: quantitative] [Project 5: Faraday bridge]

Equity considerations

"Deze is als compensatie voor de automobilisten." [Variation: narrative] [Project 1: Transferium]

"De brug dient zowel ter ondersteuning voor de fietsers en de auto's." [Variation: quantitative] [Project 5: Faraday bridge]

Case specific

Based on attribute values

"Het feit dat 25.000 auto's hier gebruik van gaan maken en er een significant verschil is in reistijd voor hen, maar daardoor ook een voordeligere reistijd voor fietsers vanuit de Tanthof en Voorhof lijkt me reden genoeg om deze investering te legitimeren." [Variation: narrative] [Project 4: Ramp A13]

Desire to fully spend the budget

"Dit project paste not binnen het budget" [Variation: narrative] [Project 1: Transferium]

"Eerlijk gezegd waren nummer 4 en 5 mijn favorieten, en had ik nog 10M over om uit te geven. Daarvan leek dit mij de beste optie." [Variation: quantitative] [Project 1: Transferium]

"Het liefst had ik de gelatine tunnel en een nieuwe afrit gekozen, maar heb geen 5 miljoen liggen." [Variation: quantitative] [Project 6: Faraday tunnel]

Synergy of projects

1+2 Trans+P&B

"handig in combinatie met de park&bike" [Variation: quantitative] [Project 1: Transferium]

1+4 Trans+A13

"En als je met die nieuwe op-/afrit nieuwe automobilisten aantrekt, moeten zij ook kunnen parkeren." [Variation: narrative] [Project 1: Transferium]

"Het transferium is door de gekozen op/afrit goed bereikbaar." [Variation: quantitative] [Project 1: Transferium]

1+5 Trans+FB

"Ook combineert dit goed met de Faradaybrug over de Schie." [Variation: narrative] [Project 1: Transferium]

2+4 P&B+A13

"In combinatie met goede parkeervoorzieningen van waaruit men lopend, met OV of met de fiets (zie andere maatregel) zich kan verplaatsen over de campus lijkt me dit een mooie manier om een aanzienlijke verbetering te realiseren." [Variation: narrative] [Project 4: Ramp A13]

3+ Gelatine

"De bijbehorende brug wordt gebouwd, dus deze fietstunnel is ook nodig." [Variation: narrative] [Project 3: Gelatine tunnel]

"Na realisatie van de Gelatinebrug is deze tunnel prioriteit #1 wat mij betreft, zodat fietsers direct doorkunnen en er optimaal gebruik van de brug gemaakt kan worden." [Variation: narrative] [Project 3: Gelatine tunnel]

"Deze fietstunnel lijkt me erg nuttig, aangenomen dat de Gelatinebrug over de Schie er al ligt." [Variation: quantitative] [Project 3: Gelatine tunnel]

4+5 A13-Faraday

"Om optimaal gebruik te maken van de nieuwe op-/afrit A13 voor Technopolis is een goede doorstroming naar de rest van Delft net zo belangrijk. Vandaar een brug over de schie." [Variation: narrative] [Project 5: Faraday bridge]

5+6 Faraday

"De Schie brug heeft alleen zin als er ook een spoorovergang is." [Variation: narrative] [Project 6: Faraday tunnel]

"De Faraday-fietstunnel sluit aan bij het project Faradaybrug dat ik ook gekozen heb." [Variation: quantitative] [Project 6: Faraday tunnel]

"Dit betekent ook dat zowel de Faraday brug als Tunnel benodigd zijn omdat je anders niet de doorgaande verbinding hebt." [Process tracing study] [Project 5: Faraday bridge]

Other motivations

Negative aspect

"De reistijd zal voor automobilisten toenemen maar het is een hele toekomstgerichte oplossing." [Variation: quantitative] [Project 1: Transferium]

"Los van het feit dat ik denk dat 15 miljoen voor dit project echt veel te veel is als ik ervanuit moet gaan dat de tram al rijdt, vind ik dit wel een goed project om te realiseren." [Variation: narrative] [Project 1: Transferium]

"Nadeel is dat de Tunnel op die locatie niet goed aansluit op een doorlopende (fiets)weg. Daar mag ook aan gewerkt worden, zodat fietsers niet teveel door de wijk te hoeven kronkelen." [Variation: narrative] [Project 3: Gelatine tunnel]

Negative aspect other project

"Andere projecten zijn onnodig en zijn een vorm van kapitaalvernietiging." [Variation: narrative] [Aimed at all projects other than 4 & 5: Faraday bridge & tunnel]

"Het opsplitsen (park en ride) van een route gaat denk ik niet veel helpen, mensen hebben daar toch geen zin in en veel tijd zou het niet schelen denk ik." [Variation: quantitative] [Aimed at project 1 and 2: Transferium & Park&Bike]

"Mijn voorkeur ging eerst uit naar alternatieven die fietsen stimuleren, maar bedacht me toen dat in de huidige situatie vooral het autoverkeer een probleem is en dat de fietsalternatieven geen fietsverkeer stimuleren bij forenzen buiten delft." [Variation: quantitative] [Aimed at projects 3 and 6: Gelatine tunnel & Faraday tunnel]

N

Remarks

This appendix presents an overview of the remarks made by respondents. These are displayed in table N.1.

Table N.1: Variation experiment, frequencies of (main) categories of remarks made by respondents

(Main) category	**Count**
Total	221
Request for more info	47
Provide more info on projects	13
Present combined impact of projects	8
Provide visualisations	8
Provide a more elaborate problem statement	5
Include impact on traffic patterns	4
Provide sources/explanation for provided values	4
Other aspects	4
Feedback	19
Positive	10
Ambiguous attribute values	5
Negative	3
Suggestion	15
Ability to suggest projects of your own	3
Ask for most/least important drivers	3
Provide more space for comments	3
Allow motivation for portfolio	1
Ability for respondent to value projects	1
Add sorting option	1
Ask whether participants will benefit personally from projects	1
Ask for emotional value of projects	1
Ask for personal experience	1
Remarks directly related to variation	3
Presentation in sentences not necessary [narrative]	1
Include a column with units [narrative]	1
Change in travel time can be confusing [quantitative]	1
User interface / user experience	21
Include ability to review selection/info on motivation page	7
Lack of overview	3
Reduce task complexity	3
Missing: below you see the impacts on confirmation page	2
Improve the graphics	2
Wish to complete on mobile device	2
Improve usability	1
Increase font size	1
Other	12