Responsible Sensing Lab × esdit × Gemeente Amsterdam

Driving for Values

An explorative study on acceptance, acceptability and autonomy in the context of a navigation aid that promotes public values

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Management summary

This report outlines the findings of an investigation conducted by the Responsible Sensing Lab, philosophy of technology experts from the ESDiT consortium (Ethics of Socially Disruptive Technologies) and representatives from the Smart Mobility Program of the city of Amsterdam. The investigation employs a research through design approach, merging prototyping activities, empirical studies, and philosophical reflection. It aims to explore the Driving for Values concept, focusing on car drivers' experience of the value of autonomy and its relation to the notions of acceptability and acceptance. The Driving for Values system is framed as a voluntary navigation aid providing car drivers with so called "social routes", which supports the municipality in fostering a variety of public values such as livability and air quality, by managing the use of the public space. Autonomy is here conceptualized as involving two main components: i) the ability to freely choose among different options and ii) the availability of meaningful options, i.e options that enable the agent to decide and act on the basis of their own reasoned values and commitments. Acceptance is conceptualized as the willingness to use the app. Acceptability refers to the system's adherence to moral norms and principles. The goal of this investigation is to design and evaluate a variety of potential features of the Driving for Values system considering their impact on car drivers' experience of autonomy and the effects on acceptance and acceptability of the system. Seven studies with a total of approximately 65 participants (including citizens of Amsterdam, designers and researchers) were conducted. In these studies, participants engaged with different versions of the Driving for Values system and compared their features. The insights from these studies together with insights gathered from monthly workshops with experts from academia and municipality representatives are the basis of the recommendations presented below. These recommendations are intended to support the municipality of Amsterdam in further researching and designing the Driving for Values and similar systems.

Recommendations

1 Further pursue the idea of voluntary route advice promoting public values.

A. We recommend that the municipality continues to explore and develop the Driving for Values concept further. Participants, notably from Amsterdam, support the concept of a navigation system providing alternative social routes, recognizing its potential benefits. However, their acceptance and adoption hinge on the system's design, implementation, and operation. Citizens have specific criteria and suggestions for the system to be acceptable (see further recommendations).

2 Promote autonomy

A. We recommend designing the system for autonomy. Autonomy is an important moral value that both concerns car drivers and other users of the public space. Systems that respect autonomy are more likely to be accepted.

B. The system should balance the autonomy of the car drivers with the autonomy of other users of the public space. Cars may infringe on the autonomy of other traffic participants, e.g., by exposing them to involuntary traffic risks. Enlarging the autonomy of citizens therefore is an important justification and rationale for the system, and also allows some infringement of the autonomy of car drivers, but not more than required.

C. Autonomy is not about having complete freedom or as many choices as possible but about having options which facilitate meaningful choices. The design of the system should support this by providing car drivers with options and choices to:

- **I.** contribute to what they feel is most important to them. This can be in the form of enabling drivers to influence the high level public values that the system promotes across the city (valid for all drivers in the city) but also setting personal value preferences to receive routes that are in line with one's own ideals.
- **II.** choose among two social routes, one of which being shorter in duration and time.

D. Social route advice should only be provided if it generates sufficient societal benefit as otherwise, it would be an unnecessary infringement on driver's autonomy. This means that a threshold needs to be defined about what constitutes sufficient societal benefit. Moreover, for routes that meet the threshold and are advised, proof of the generated societal benefit needs to be provided. How this proof is provided, by whom and to whom also needs to be defined in the development process.

E. Design for autonomy should not come at the cost of usability, that is important for acceptance and adoption of the system. Existing navigation apps (e.g., Google Maps, Waze, City Mapper, etc.) are setting high standards for usability. Based on the feedback gathered from our participants, we recommend that the Driving for Values system should be integrated in existing navigation apps and not be developed stand alone.

Build a trustworthy and transparent system

A. We recommend investigating and defining a strategy to make drivers trust the system (the socio-technical system as a whole, including the individual routes it suggests and the processes behind it). Communicating to drivers how they contribute to the objectives is key for acceptance.

B. The beneficial "social" effects of the system and the individual routes should be made transparent and communicated to citizens and drivers.

C. Values 'used' or 'shown' in the app should make sense in the domain of car driving in Amsterdam. If the values pursued with the system are too far disconnected from this domain, they can be difficult to understand and therefore accept.

D. The introduction of such a system should be accompanied by a campaign in which people are informed about the purpose, the ideas behind it, the precise workings of the system and in which discussions with citizens are organized. The campaign should include a hotline people can call in case they have any questions, etc. The ethical, social, and environmental advantages of using the system should be carefully explained to citizens.

E. The government influencing routes should be held to higher standards than Google Maps, in terms of transparency.

Manage compliance

A. We recommend making the use of the system optional, and not prescribed by law. But the design of the system can greatly affect how many people participate (such as how you set defaults). In designing, set a desired compliance threshold. Do not aim for full participation of the population, but also guard against too low participation. Change the design if compliance levels get out of the desired 'compliance bound'.

B. The user's experiences with the system should be monitored over time and adapted and improved where necessary.

C. The municipality should think about ways of incentivizing people to not only use the system but also to choose the social route.

D. Not everybody has to contribute to every goal: The level of compliance with route advice correlates with the public value created. For example: every car that does not go past a primary school at school opening time reduces the risk of a traffic accident in which a child gets hurt. This means that not everybody has to abide by the advice, allowing people who really do not like this not to do so, thereby minimizing infringement on individual freedom.

E. The design of the system should not overly exploit the moral duty car drivers feel towards the public values that they embrace by putting them under excessive moral pressure to increase compliance.

Ensure democratic control and citizen participation

A. We recommend setting up a democratic process in which it is decided which public values will be integrated in the route advice and which not. The process should be organized close to the city council. At the same time, the process should enable citizens to contribute to the goals and design of the system so that they don't feel like the system is imposed on them by the municipality.

B. Existing platforms such as “Signalen in Amsterdam” should be leveraged to allow citizens to voice their concerns about the current traffic situation in Amsterdam, and subsequently take those concerns up in discussions with citizens. The idea behind this would be that the system would be developed bottom-up, starting with the current problems as they are perceived by the citizens. Those would be guiding the design of the system. The platform could then also be used after the system has been implemented, as a place where citizens can provide feedback and make suggestions for improvement of the system.

C. The public values for which the system optimizes should be continuously critically reviewed. Only the public values generating sufficient value should be maintained.

D. The system’s performance with regards to the public values it was designed to promote should be continuously monitored. Clear (functional and normative) performance indicators should be defined in the development of the system.

Recommendations for further research

We recommend conducting further research to investigate:

A. Extending the system to additional user groups, such as cyclists, pedestrians, etc., in order to develop a system that caters to all traffic participants, not just car drivers.

B. How citizens should be involved. This could for example focus on how to keep them involved as the system evolves and is adapted, exploring the “meaningful moment idea” in more detail or approaches such as participation through citizen interest groups or citizen representation by the city council.

C. The democratic process through which it is decided which public values are integrated into the system.

D. The perception and impact of the system on other users of the public space.

E. The transparency mechanisms used to make beneficial “social” effects of the system visible and communicate them to the citizens.

F. Whether routes and road rules provided by the system should always be optional, or if they are situated in which the system should define and communicate hard rules which could lead to fines.

G. Users’ experience of other values which are closely related to autonomy but were outside of the scope of this project. The most relevant values to investigate further are:

- **I.** Privacy. Respect for autonomy requires respect for people’s privacy.
- **II.** Democracy and participation. These are core values that need to be respected and that contribute to human moral autonomy (see recommendation 5)
- **III.** Transparency and trustworthiness. (See recommendation 6).

H. The use of incentivising mechanisms (Positive: parking points, gamification, etc. but also negative: fining people if they don’t comply) and their effects on user experience.

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1 Introduction

This report presents the findings of an investigation conducted by a transdisciplinary team consisting of members of the **Responsible Sensing Lab**, philosophy of technology experts from the ESDiT consortium (**Ethics of Socially Disruptive Technologies**) and representatives from the **Smart Mobility Program of the city of Amsterdam**. The transdisciplinary way of working involved regular meetings, both online and in-person, during which a common language was established and the group gradually arrived at common research questions and goals. The project investigates the Driving for Values system through empirical and conceptual research. The Driving for Values system is an alternative navigation app providing car drivers with so-called “social routes”. These social routes are intended to foster a variety of public values such as livability and air quality. The Driving for Values system thereby becomes a tool for the municipality to organize and regulate the public road space based on public values.

We believe that digital systems such as Driving for Values can be experienced by citizens as interfering with their choices and limiting their freedom. Such systems involve the collection of all sorts of data, raising issues of privacy and surveillance, and aim at influencing people’s choices and behavior, which raises concerns about values such as freedom, autonomy, and justice. It is therefore important to account for such values in the design process of digital systems, so that systems are designed that respect the privacy and autonomy of users and citizens as well as achieving their purposes and underlying values, such as, (traffic) safety, sustainability, and (human) well-being. Approaches like Value-Sensitive Design (Friedman & Hendry, 2019) and Design for Values (Hoven et al., 2015) can be used to systematically incorporate values of moral importance in design. The aim of such approaches is to design technologies that are both socially accepted and morally acceptable. Socially accepted means that users and other relevant stakeholders accept the technology; morally acceptable means that the system avoids or at least mitigates ethical concerns.

Designing technologies that are both socially accepted and morally acceptable requires not only incorporating values and related design requirements in the design process, but also investigating whether proposed design solutions indeed respect the values. This investigation therefore makes use of prototypes and empirical studies with citizens as well as theoretical expertise to explore the Driving for Values concept. The focus thereby lies on car drivers' experience of the value of autonomy and its relation to the notions of acceptability and acceptance. The goal of this investigation is to generate a set of recommendations for the municipality of Amsterdam that can guide the development and additional research efforts concerning the Driving for Values system.

This report is structured as follows. Chapter 2 introduces the Driving for Values system in more detail. Chapter 3 presents our conceptualizations of acceptance, acceptability and autonomy, which were used for the investigation of the Driving for Values system. Chapter 4 concisely outlines the overall research approach. Chapter 5 presents the set-up and results of the empirical studies carried out in scope of this investigation. Chapter 6 contains our recommendations to the municipality of Amsterdam. Chapter 7 concludes the report.

2 The Driving for Values system

Driving for Values is a fictional traffic management system which falls under the umbrella of “Digitale Regie Openbare Ruimte”. The system is envisioned to support the municipality in managing the use of the public space by providing users of that space with advice and possibly rules related to direction and access, speed, parking, and more. The advice and potential rules provided by the system are intended to foster a variety of values such as livability, air quality, and social cohesion. The system is envisioned to communicate to users through dynamic traffic signs and navigation interfaces.

The investigation presented in this report was inspired by the Code the Streets concept. It focuses on the idea of using so-called “social routes” to influence how car drivers navigate through the city, thereby fostering public values. (We operate under the assumption that driving is predominantly conducted by human drivers.) For example, this could include improving the safety of school children by steering car drivers around school areas during school opening and closing hours. Each social route would likely be informed by realtime information and optimized for a variety of public values, finding for example a balance between livability, safety, and environmental impact. The resulting routes are dynamic, possibly changing between one trip and the next.

The description provided above represents the base concept of the Driving for Values system as we conceptualized it for the project at hand. For the studies presented in chapter 5, slight variations of this base concept were adopted, testing additional features and characteristics.

3 Framing acceptance, acceptability and autonomy

This chapter introduces the conceptualizations of acceptance, acceptability and autonomy that were used for the investigation of the Driving for Values system. We present each of these three key areas of interest separately with references to relevant literature.

Framing acceptance

A main goal of the municipality was to gain insights into the acceptance conditions of the Driving for Values system. They were interested in questions such as: “Under what conditions are citizens likely to accept the system, and thus use it?” “What features does the system need to have in order to be accepted?” Given this goal, we looked into relevant social science literature on acceptance and decided on suitable definitions of acceptance that we then incorporated into the design of the prototypes. We moreover linked acceptance to acceptability and autonomy.

We focussed on acceptance at the level of the individual and gained inspiration from the Technology Acceptance Model (TAM) developed by Davis (1989). This model tries to explain individuals’ attitudes towards technology and enables a significant step towards a greater understanding of the reasons for accepting or rejecting technology. In its initial version, TAM presented perceived usefulness and perceived ease of use as the two most relevant characteristics that affect the intention to use technology (Davis, 1989), where perceived usefulness captures, e.g., whether users think that a technology helps them to accomplish their tasks more quickly, and perceived ease of use links to, e.g., whether users think that a technology is easy to operate, also in a skilful way. Underscoring the importance of subjective norms, Venkatesh and Davis (2000) later extended the original concept by incorporating social influence and cognitive processes. For example, the extended model TAM3 explains that even with increased experience, perceived ease of use has a significant role when interacting with IT (Venkatesh & Bala, 2008). Another key factor affecting an individual’s intention to engage with new technology is hedonic motivation (Brown & Venkatesh, 2005), that is, the experience of fun and joy when using the technology.

Further inspiration came from the book *Driver Acceptance of New Technology: Theory, Measurement and Optimization*, edited by Michael A. Regan et al. (2014), in which we found two definitions of acceptance relevant for our purposes:

1. Sum of Attitudes (relates to Attitudinal Acceptance)

"The third category sees acceptance as the sum of all attitudes, implying that other, for example more emotionally formed, attitudes are added to the more 'rational' evaluation of the usefulness of the system" (Regan et al., 2014, 13).

2. Willingness to use (relates to Behavioural Acceptance)

"Acceptance is the degree to which an individual incorporates the system in his/her driving, or, if the system is not available, intends to use it" (if such a system would hypothetically be released at some point) (Regan et al., 2014, 18). In this case, the driver accepts the system as the best option in a given situation - but that doesn't mean that they have to like it. It may simply be that the system is mandatory and they don't want to pay a fine (Regan et al., 2014).

These two definitions of acceptance influence each other: Sum of attitudes affects Willingness to use. For instance, as pointed out by Brown & Venkatesh (2005), the experience of fun and joy crucially affects individuals' intentions to use a technology. Willingness to use is moreover closely connected to perceived usefulness and perceived ease of use (Davis 1989).

We decided to focus on people's acceptance of the system at large, i.e., on their "Sum of Attitudes" towards and their "Willingness to use" the system as a whole. Yet we also looked at the acceptance of individual features of the system and individual route recommendations. We moreover took into consideration how acceptance of the system relates to characteristics of the participants, including age, socio-economic status, and cultural background. For the sake of simplicity and feasibility, we decided to disregard some other aspects of acceptance, such as stability and change (how and to what extent acceptance changes over time) and how acceptance is affected by the social environment (e.g., who else is in the car, if anyone).

Framing acceptability

We aimed not only to explore whether the Driving for Values system would be accepted by individuals, but also whether it would be morally acceptable. Following Ibo van de Poel (2016, p. 180), we take the core distinction between acceptance and acceptability to be that "acceptance is primarily a descriptive notion while acceptability is primarily a normative notion". While (social) acceptance is "an empirical fact", (moral) acceptability is "an ethical judgment" (van de Poel 2016). Acceptance and acceptability can come apart. As van de Poel has pointed out (ibid., p. 178): "Although, lack of acceptance of a technology may point at the moral unacceptability of that technology, we cannot simply conclude from non-acceptance that a technology is also morally unacceptable." In virtue of concerning the ethical quality of the technology (its acceptability from a moral or societal point of view), the concept of acceptability functions as a bridge between acceptance, which is primarily descriptive, and the moral concept of autonomy.

Framing autonomy

At the center of our study is the value of autonomy, since we assumed that whether citizens would find such a system acceptable largely depends on how that system would affect their perceived autonomy. In order to arrive at a definition of autonomy suitable for our purposes, we conducted a literature review and tried out ways of asking questions related to different aspects of autonomy in our study iterations.

In this project, we use a local concept of autonomy as opposed to a global concept. A global concept of autonomy refers to the person as a whole, while a local concept refers to specific actions or spheres of action (see Rössler 2017). People can lack autonomy in certain spheres of action, or sometimes act non-autonomously, while acting autonomously in other spheres/situations and thus being autonomous persons. We are interested in the question as to whether citizens using the Driving for Values system experience themselves as autonomous in their decisions about which route to take. Our interest in people's experience of autonomy motivated our choice to make use of speculative design in our research.

A useful source was a paper by Vugts et al. (2020, p. 108), who reviewed different understandings and dimensions of autonomy, thereby identifying three general conceptualisations of autonomy in the literature on nudging: 1) autonomy as freedom of choice, which "refers to the availability of options and the environment in which individuals have to make choices", 2) autonomy as agency, which "involves an individual's capacity to deliberate and determine what to choose", and autonomy as self-constitution, which "relates to someone's identity and self-chosen goals". Those conceptualisations fit well with Blöser et al.'s (2010, p. 240) definition of autonomy as "a person's capacity to judge, decide, and act on the basis of her own attitudes and reasoning". We also took inspiration from Beate Rössler's understanding of autonomy as containing two elements:

A. absence of impediments/obstacles
B. horizon of (in a broad sense) meaningful and desirable options

We decided to adopt a substantial theory of autonomy, which takes autonomy to depend on the desirability and moral quality of the options/actions (see Rössler 2017). Joseph Raz, e.g., holds that only if we have the right options available in a society can we act autonomously. Procedural theories, by contrast, take autonomy to depend only on how a person acts and decides.

A challenge for us was the fact that people usually do not have a clear idea of what the term "autonomy" means. We thus had to think carefully about the way we formulated our questions and try them out during our initial iterations. More about this in section 5.2.1.

4 General project approach

This project takes a research through design approach (Stappers & Giaccardi, 2017) to explore the Driving for Values system through the iterative design of prototypes and feedback rounds from users and experts. Starting off with an initial conceptualization of acceptance, acceptability, and autonomy grounded in scientific literature, five initial empirical studies (presented in detail in the following section) were conducted, in which different versions of the system were tested. These initial studies, besides delivering input relevant for the final recommendations, were crucial in setting the research scope. The studies were accompanied by regular discussions and workshops with the project team of scientific experts as well as experts of the mobility context in Amsterdam. These meetings were used to reflect on our evolving insights on the system as well as our main topics of interest, acceptance, acceptability, and autonomy, and to design the following study iteration. The insights gathered from the initial exploration, combining findings from the empirical studies and scientific expertise, were used to set up a final, more elaborate set of studies: a individual interview study and a focus group study. These are described in more detail in the following section. Ultimately, the insights gathered from all of the studies as well as during the regular workshops and discussions with a variety of experts were used by the project team to write the final set of recommendations presented in this report.

5 Studies

This chapter presents the set-up and results of the studies that were carried out in the context of this project. First, the five study iterations are introduced in section 5.1. This is followed by the two final studies shown in section 5.2, an individual interview study and a focus group study. Lastly, particularly relevant additional insights gathered from discussions within the project team and civil servants are presented in section 5.3.

5.1 Initial iterations

5.1.1 Set-up of the iterations

This section provides a short overview of the approach of the five initial study iterations that were carried out prior to the final individual interview and focus group studies. For each iteration, the goal, study set-up, location, and participants are described. Section 5.1.2 presents the results from the iterations.

Iteration 1

Goal: Gather basic insights about how people may experience different system features. The features tested included, for example:

- different goals for which the system optimize s such as improving air quality, safety for school children or improving the welfare of the local animal population;
- different interventions, such as having to take a certain route or receiving a fine, routes being presented as mere advices that one can dismiss, or receiving a monetary reward for taking a certain route;
- personalized routes informed by characteristics of the vehicle (e.g., being asked to take a certain route because one drives a large vehicle) and the driver (e.g., being asked to take a certain route because one emitted too much CO_2).

Set-up: Participants were asked to imagine themselves as drivers about to travel from A to B in Amsterdam. During the experiment, participants were presented with 15 visuals of fictional notifications (see figure 1) asking them to take a certain route or avoid specific streets. Participants commented on the pictures. The experiment ended with questions asked to the participants.

Location: Faculty of Industrial Design Engineering, TU Delft

Participants: Four individual participants; all in possession of a driver's license

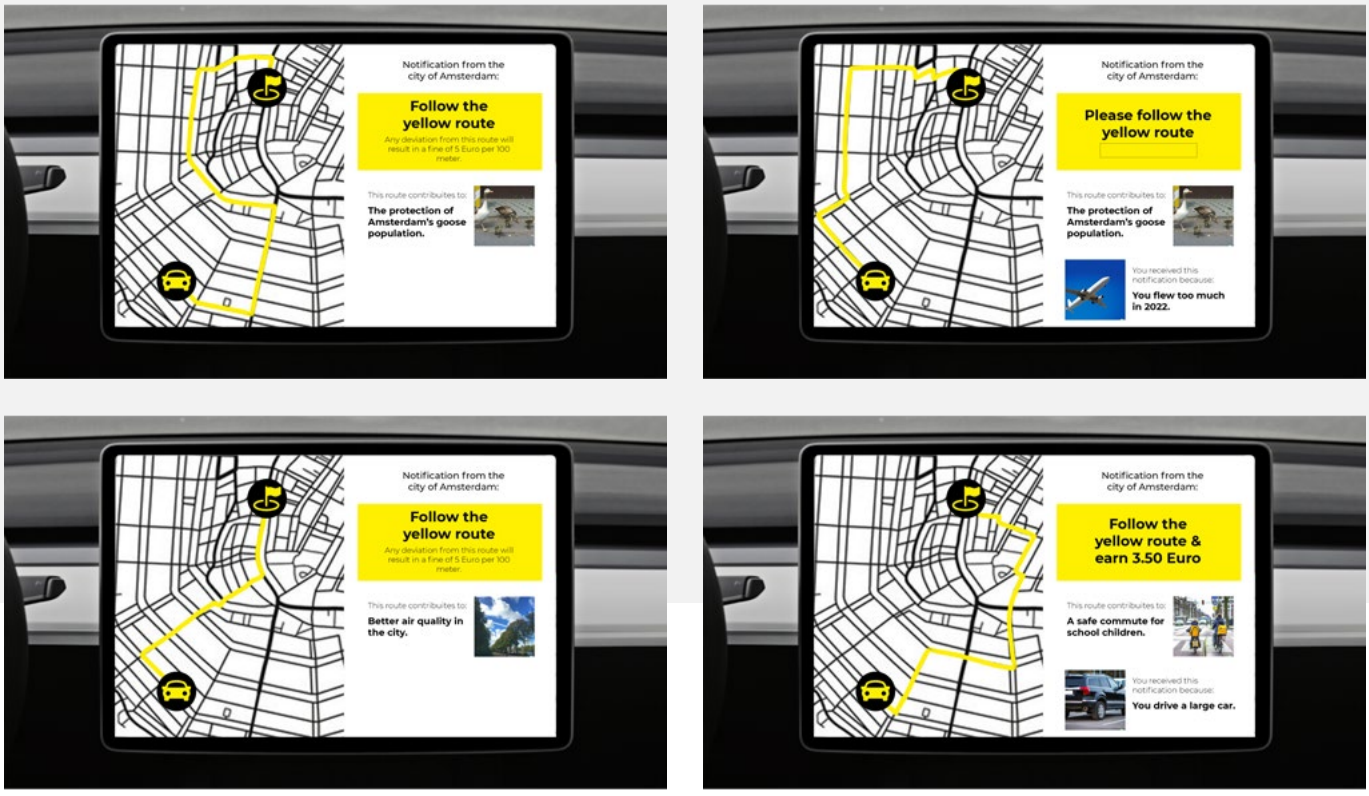

Figure 1 Four examples of notifications that participants were confronted with during iteration 1.

Iteration 2

Goal: Gather basic insights about how people may experience different system features. The features were the same as in iteration 1, with the addition of features providing participants with choice and influence on the system:

- choosing between route options that are optimized for different values;
- setting personal values and receiving route advice that is (more) in line with those values.

Set-up: Participants were asked to imagine themselves as drivers about to travel from A to B in Amsterdam. During the experiment, participants were presented with visuals of fictional notifications (same as iteration 1), asking them to take a certain route or avoid specific streets. Additionally, participants were presented with choice features, affecting the routes provided by the system (see figure 2 and 3). Participants commented on the pictures. The experiment ended with questions to the participants.

Location: Faculty of Industrial Design Engineering, TU Delft

Participants: Five individual participants; all in possession of a driver's license

Figure 2 One of the choice features presented to participants in iteration 2. Participants can choose between three route options that are optimized for different values.

Figure 3 One of the choice features presented to participants in iteration 2. This feature allows participants to adjust the dials to indicate to what extent the system should optimize for values such as Culture, Accessibility, Economy, or Climate.

Iteration 3

Goal: Gather insights about how people perceive different goals for which the system optimizes (e.g., safety for school children, promoting social cohesion in neighborhoods) and how their perception is affected by communication characteristics (e.g., notifications focused on the route's personal benefits for drivers versus a formulation focused on a route's benefits for society).

Set-up: The study was set-up as a questionnaire with a variety of multiple choice and open ended questions. Within this questionnaire, respondents were presented with a total of eleven visuals of fictional notifications. The notifications differed with regards to the goal and/or formulation (see figure 4). The same set of questions for each of them.

Location: Online

Participants: Five individual participants (family or friends of Fabian); all in possession of a driver's license

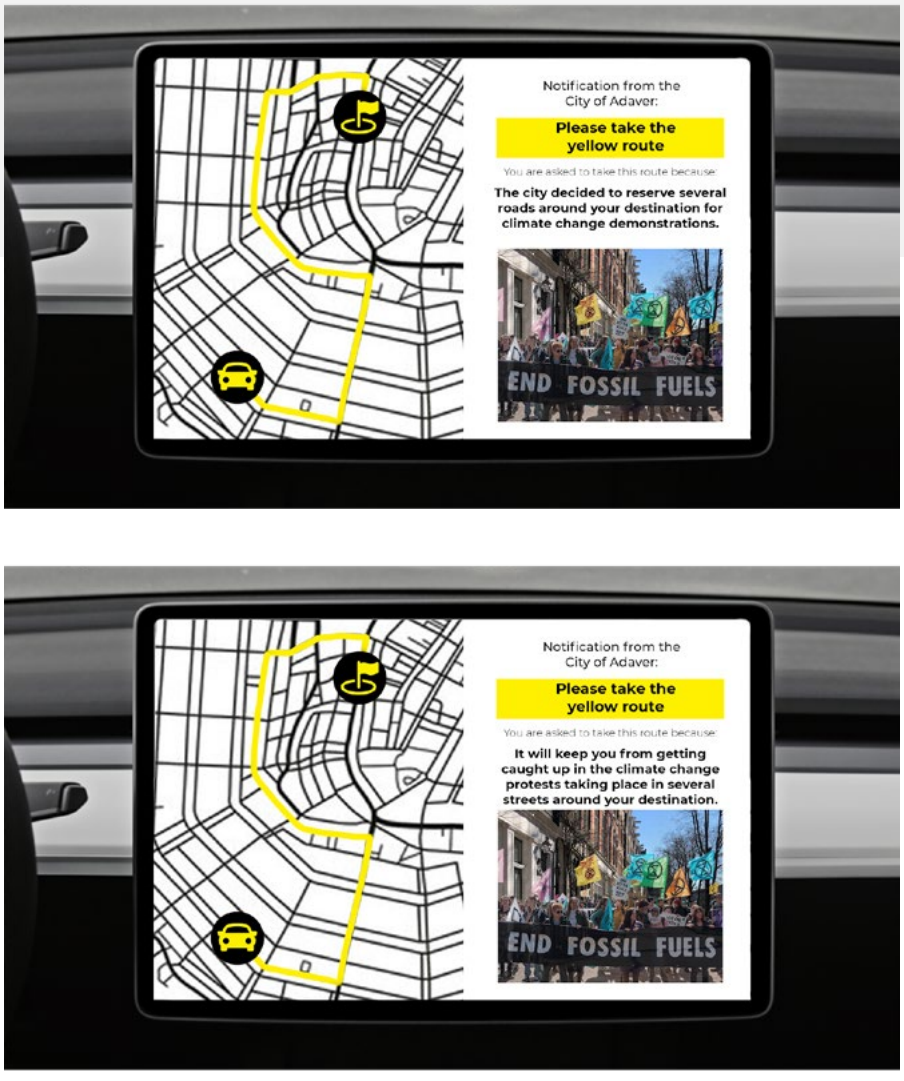

Figure 4 Example of notifications used to investigate participants' reactions to different communication characteristics. The notification on the left states that the city has reserved roads for climate change demonstrations whereas the notification on the right points out that taking this route helps one from getting caught up in climate change demonstrations.

Iteration 4

Goal: Gather insights about how people perceive different goals for which the system optimizes, differences in communication characteristics (as in iteration 3), interventions (e.g., routes are presented as advice, routes are presented as hard rules and ignoring them will result in a fine, etc.) and reasons for personal treatment (e.g., driving a large car).

Set-up: During the presentation at the Responsible Sensing Lab anniversary event, guests were first asked to show their willingness to follow a certain route contributing to a certain goal by standing up or sitting down. A few guests were invited to speak out about their choice. Later at the reception, guests were invited to react to a poster with visuals showing fictional notifications by the system (see figure 5) and were asked to react to them using emoticon stickers. Guests could also write comments on the poster and engage in a discussion with Fabian.

Location: Responsible Sensing Lab anniversary event, Pakhuis de Zwijger

Participants: Approximately 15 guests of the Responsible Sensing Lab anniversary event.

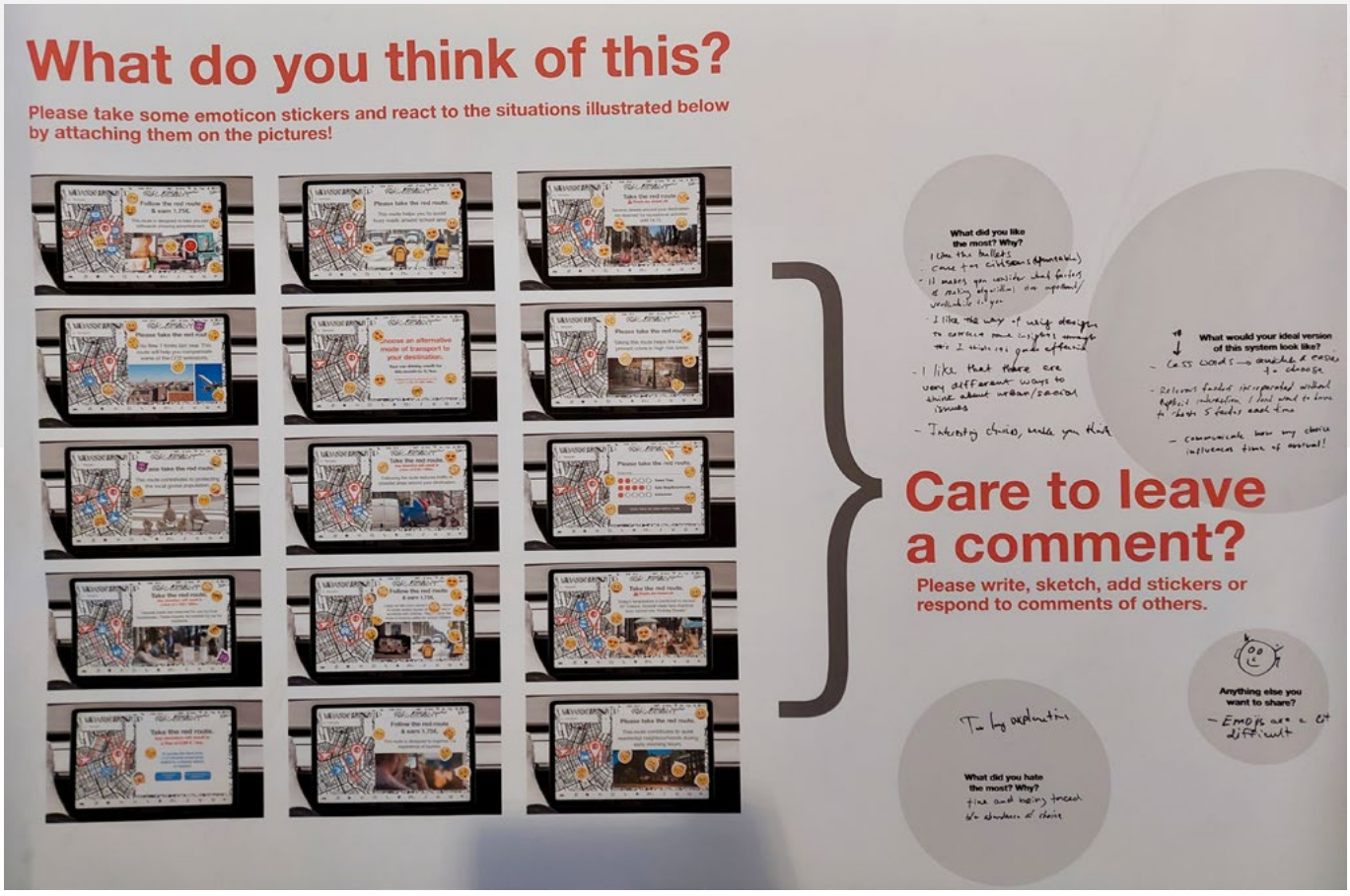

Figure 5 The poster with input from guests of the Responsible Sensing Lab anniversary.

Iteration 5

Goal: The goal for this study was twofold. First, to explore more detailed versions of the system, each with different features granting drivers different options to choose from. Second, to learn more about how to set up an experiment to gather meaningful data. This includes insights about how we can meaningfully learn about people's experience of the systems (e.g., what questions deliver interesting insights).

Set-up: The study was split up in three rounds and, in total, four different versions of the Driving for Values system were tested (see figure 6), which were realized as printout prototypes of apps:

- **System A: Base** This was the base version of the system that all other versions were compared to. In this version, participants were asked to take a route to their destination. They could click on "Find out more" to get an explanation why they were asked to take this route.
- **System B: Credits** This version is based on a credit system. The interface presented participants with their credit score and two route options: the fastest route, choosing which would cost them three credits, and the Social route, which would cost them only one credit. Similar to System A, participants could click on "Find out more" to receive more information on the Social route.
- **System C: License + Oath** For this version, participants were first asked to take a driver's license exam played out with toy cars. Then they would receive a fictional driver's license, on which they could specify which public values they cared for by choosing a minimum of three points from a list of eight ideals. Subsequently they were asked to use the app, which functioned similarly to system A, with the only difference being that if participants clicked on "Find out more", they received additional information on how the personalized route presented to them fitted with the societal goals they chose on their license.
- **System D: Subscribe** In this version of the system, participants could choose to subscribe to different parties (e.g., Google, Extinction Rebellion, Shell, etc.) in the app interface. By subscribing to them, they would authorize these parties to send them route advice. Participants could click on an example profile where they were presented with more information, such as a statement by the profile owner, the ideals that this profile aims to contribute to and some statistics of their route advice, such as "Routes by this profile take on average 15% longer than the quickest route option".

In each round, one of the more radical system design versions (B, C, D) was compared with the base version (A). Questions asked to the participants were kept the same during all rounds. Furthermore, the goal for which the system optimizes (promoting safety in Amsterdam) and intervention (routes were presented as advice) were the same across all prototypes. The iteration involved basic role play, revolving around bringing a large gift to a friend's birthday party in Amsterdam.

Location: IDE faculty, TU Delft

Participants: 12 individual participants, four for each round. Six out of 12 participants had drivers licenses; the remaining six didn't have a driver's license or did not drive. Participants were design students, mechanical engineering students & professional designers/researchers.

System versions tested:

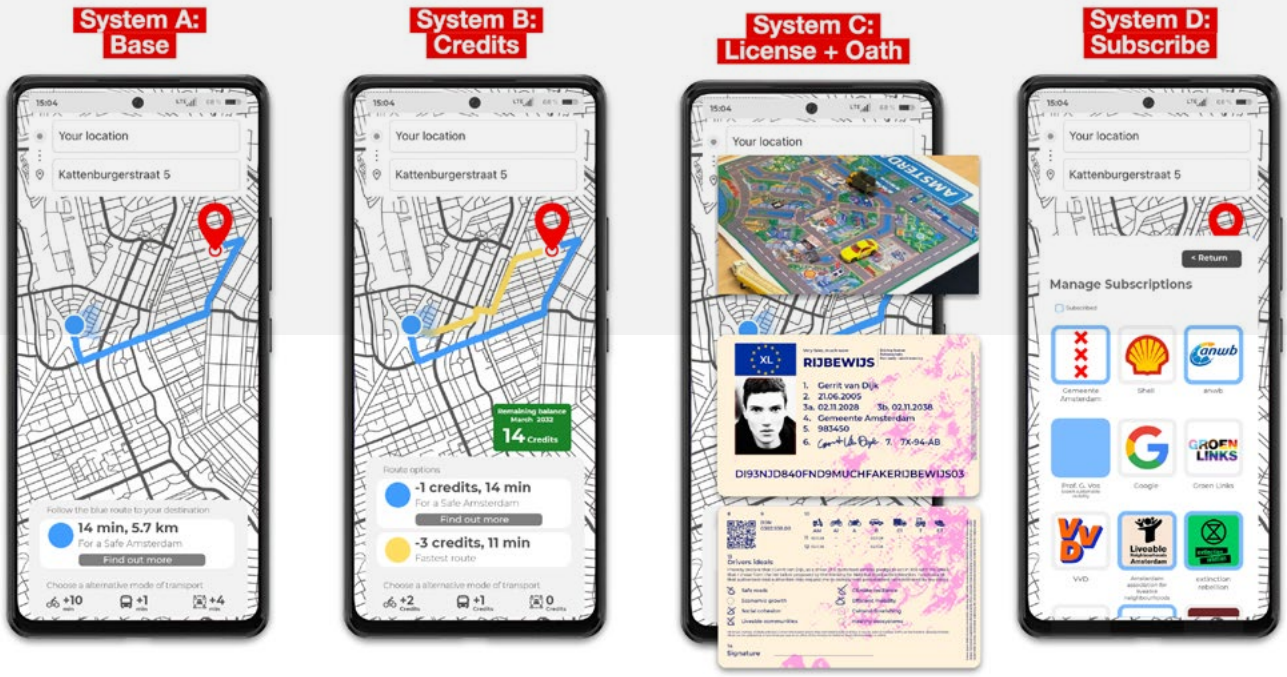

Figure 6 Example screens of the four system versions tested in iteration 5. From left to right: System A: Base, System B: Credits, System C: License + Oath, System D: Subscribe

5.1.2 Results of the iterations

This section presents the main results from the five initial iterations carried out. These results informed the set-up for the individual interview study and the focus group study as well as the final recommendations, together with other insights gathered in this project.

Participants recognized that the system affects their sense of autonomy
Almost all participants of iteration 1 and 2 indicated that they felt like the systems shown to them affected their sense of autonomy when asked to choose from the overview presented in figure 7. This overview of 13 fundamental human needs was chosen for this first and second iteration because participants can easily relate to it, as previous studies have shown. Although needs are not the same as values, the two are closely related. The participants comments often revolved around ideas related to personal freedom, being in control vs being steered, competence (e.g., "I'm perfectly capable of driving around some geese!" or "I know what I'm doing, I know the road.") and surveillance (e.g., "This feels very big brother"). Participants' comments further indicate that the control features present in iteration 2 increase their sense of autonomy.

Other "values" affected by the system: ease & morality
Most participants of iteration 1 and 2 commented that, next to autonomy, the system affects their sense of ease (i.e., easy to use, hasslefree), morality and impact (i.e., the system may offer an opportunity for people to feel morally good).

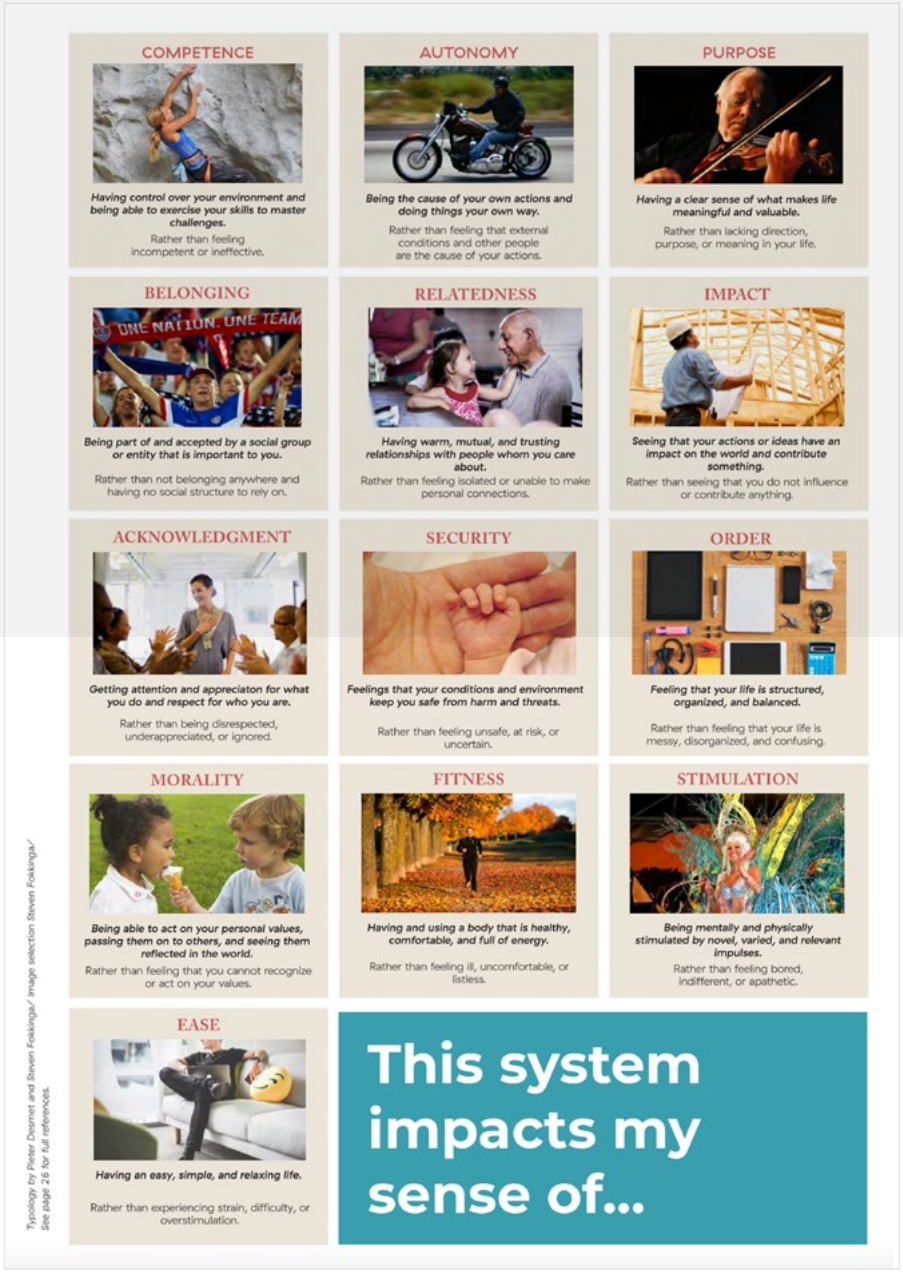

Figure 7 Overview of the 13 fundamental human needs (Desmet & Fokkinga, 2020).

Many factors affect people's acceptance
The iterations showed that people's acceptance of the system is influenced by a variety of factors. The factors most commonly named by participants are:

- personal situation, e.g., being relaxed versus in a hurry, one's emotional state, who is in the vehicle, etc. (Example comments from participants: "If there is anything more important at the moment I will override the advise.");
- perceived impact of route on self, e.g., negative impacts such as increased travel time, but also positive impacts, such as more quiet roads at night, etc.;
- understanding of and opinion about the public values, e.g., improving safety for school kids, air pollution, animal welfare, etc. (Example comments from participants: "If I believe in a use case it is acceptable.", "There is a goose problem in my neighborhood.");
- relationship with who asks to take route, e.g., their relationship with the municipality;
- personal perspective on intervention, e.g., having little money may have people look differently at the risk of getting fined;
- reasons for personal treatment, e.g., driving a large vehicle or having emitted too much CO_2 last year.

Some participants further mentioned that while they may find single route advice provided by the system acceptable, it can still cause negative emotions that can affect long term acceptance of route advice and the system as a whole.

The iterations also showed that features allowing drivers to make meaningful choices and how the system communicates also play important roles in the acceptance of the system and routes provided by the system, which we explore in the following sections.

Choice features and their effect on acceptance and the experience of autonomy
Iteration 1 indicated that advising drivers to take a route that contributes to a goal they don't care for and negatively impacts their short term desires (e.g., longer traveling time) results in non-compliance ("If I don't care for something, I won't follow a route unless I have to."). Forcing people to take a route that contributes to a goal they don't care for and negatively impacts their short term desires results in annoyance.

Participants' comments from iteration 2 and 5 indicate that choice features, giving drivers some level of control of the route advice they are provided with, have the potential to positively affect autonomy and acceptance. However, participants also voiced clear preferences between the different choice features.

In iteration 2, the participants' preferences were split equally across the two choice options. Some participants preferred having route options to choose from while others claimed that they didn't want to face a choice of three routes every time they drive stating that they "just want to get into the car and drive". These participants generally preferred setting the system according to their own personal values.

‘I have to keep my credits in mind or the system will prevent me from taking the car next weekend’

In iteration 5, system C (License + Oath) was most positively received by the participants. Most participants commented that this system version felt less manipulative and provided an increased sense of control compared to the base system, system A. One participant commented: “C is less manipulative than A because in A you are guided by the morals of who makes the app whereas in C I can use my own morals.” Participants’ feedback on system B (Credits) was mixed. Some participants commented that system B offered an increased feeling of control and the ability to make deliberate choices. Others found that system B feels more manipulative and unpleasant: “I feel more controlled, I’m not my own boss anymore.” Furthermore, they complained that system B would make traveling a hassle, requiring lots of thinking power: “I have to keep my credits in mind or the system will prevent me from taking the car next weekend.” System D (Subscribe) was received rather negatively. While all participants agreed that system D offers more control compared to system A, they also agreed that the system seemed cumbersome and unnecessarily complex because the settings are too indirect.

Generally speaking, most participants appeared to share the conviction that the system should in some way or another allow them to take the fastest route. A few participants also voiced the desire to be able to override the system in case of emergency.

‘C is less manipulative than A because in A you are guided by the morals of who makes the app whereas in C I can use my own morals’

Communication strategies and their effect on acceptance and the experience of autonomy

Iteration 3 indicates that route advice formulated with a focus on personal benefits (e.g., not getting caught up in a road full of climate protesters) can positively affect acceptance of a route advice compared to more neutral route advice (e.g., there are climate protests taking place). Furthermore, the representation of the route on the map, e.g., as looking long and cumbersome or straightforward, can also affect acceptance of the route.

Participants' comments from iteration 2 and 4 indicate that communication strategies confronting people with their "moral duty" (see figure 8) may lead more drivers to follow the route advice. However, this can also cause stress and irritation and drivers are "put on the spot", having to decide between their moral ideals and their short term interest in getting to their destination as fast as possible (see figure 9).

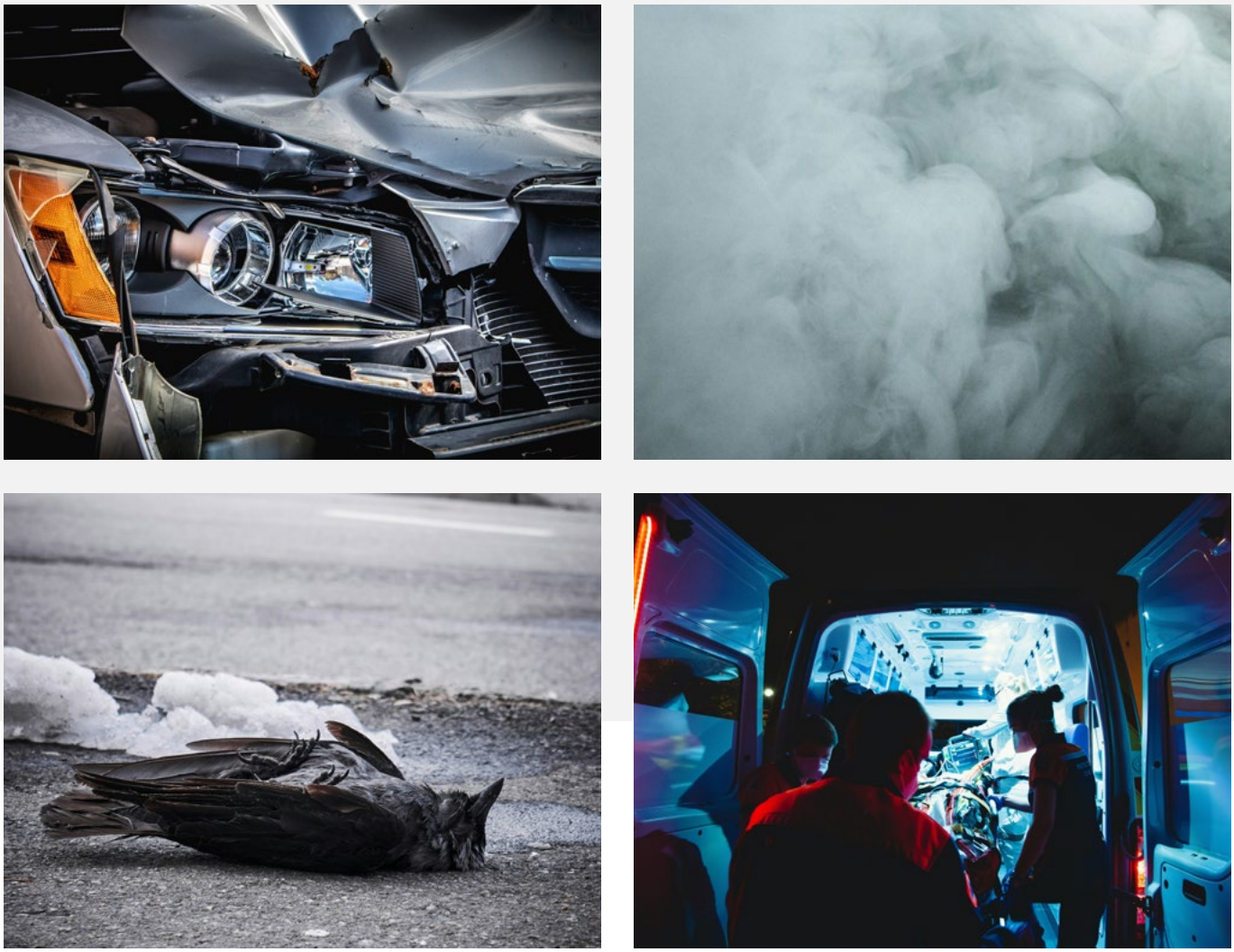

Figure 8 Similar to the pictures and warning text on cigarette packages, including gruesome images as the ones presented in this figure in the navigation advice may confront drivers with their "moral duty" when navigating through the city.

Figure 9 Snapshot of a route advice making use of insinuating images together with participants' reactions (emoticon stickers) from iteration 4.

Study format: Comparing system prototypes delivered the most interesting insights

All five iterations delivered valuable input. Especially the format used in iteration 5 allowed to have rich conversations with participants, and the prototypes, realized as app printouts, appeared to be valuable triggers. The questions and scales used in iteration 5 helped to have more focused conversations with participants and to gather meaningful data on the system. Especially the comparison of the two systems seemed to work well, helping participants to express their thoughts on the systems. The questions used to facilitate the data collection worked decently but still needed to be improved. Furthermore, it seemed useful to consider to what extent the concepts tested in the study are worked out. While highly detailed and thought-out concepts may reduce participants' confusion and uncertainty, some open-endedness gives participants more space to imagine what the system could and should be like.

The questionnaire used in iteration 3, although delivering valuable insights, was experienced by participants as long and cumbersome. In comparison, the poster in iteration 4 appeared to be much more fun and inviting. However, interpreting the data from the emoticon stickers proved to be challenging.

5.2 Final studies

5.2.1 Set-up of the final studies

This section introduces the set-up for the individual interview study and the focus group. First, the general approach shared by both studies is described. This is followed by a description of the individual interview study, introducing the study goal, set-up, the participants as well as the prototypes of the Driving for Values system used during the interviews. Lastly, the goal, set-up and the participants of the focus group are described. The results of the final studies are described in the subsequent section 5.2.2.

General set-up final studies
The final studies consist of an individual interview study and a focus group that was carried out one month after the interview study. Both studies made use of several prototype versions of the Driving for Values system, which were presented as clickable app prototypes on a smartphone as well as in the form of several printouts. The prototype apps and printouts are described in more detail in the following sections. The studies were carried out in collaboration with the design consultancy Chemistry. The project team defined the study set-up, including the interview questions and printouts, desired characteristics of the participants and the features and screen content of the prototype apps used in the studies. Chemistry provided feedback on the study set-ups, created the prototypes according to the specifications set by the project team and was in charge of recruiting participants. Participants received monetary reimbursement for participating and were recruited via a recruitment agency as well as from the personal social circle of Chemistry employees. Both the project team and Chemistry played an active role in carrying out the studies. The studies were carried out at the AMS Institute, with the exception of two individual interviews that were carried out online due to the limited availability of the participants.

Figure 10 Snapshot of an individual interview with the participant (in orange) and the two researchers.

The individual interview study

Goal Goal of the individual interview study was to gather more insights about the most promising choice features identified in the initial iterations, specifically how they affect the experience of autonomy of regular car drivers as well as their acceptance of and the acceptability of the Driving for Values system.

Set-up The individual interview study was carried out by a team consisting of at least one researcher from the project team and a representative from Chemistry (see figure 10). Each interview took approximately one hour. The interviews revolved around the participants using at least two (out of six) different system versions to navigate to a predefined destination in Amsterdam and sharing their impressions of the systems, thereby also comparing them to each other. The project team defined beforehand which comparisons of system versions seemed most interesting. Six comparisons were chosen, and each comparison was tested with at least three participants, whereby the system versions were presented in different order.

The study sequence was as follows (see Appendix A for the interview guide). In preparation of the interview, participants were asked to fill in a questionnaire containing questions about their demographics and car driving habits (see Appendix B). The information on the driving habits was later picked up in the interviews, situating the use of the prototype in the participant's driving routine. For example, if a participant wrote that they use the car regularly to drive to work, they would be asked to imagine themselves using the prototypes for driving to work. After filling in the questionnaire, participants engaged with a first system version and were asked to provide their initial thoughts on it by answering questions and thinking out loud while engaging with the prototype. Participants would subsequently use another system version and react to it. This was followed by a set of questions focused on comparing the two system versions, starting off with questions investigating participants' acceptance.

To learn about participants' Sum of Attitudes and Willingness to Use, we asked them the following questions (once after they had tried out the first version of the app and once after they had tried out the second version):

- How do you find the app overall?
- What do you like/dislike, find pleasant or disturbing? Why?

After having asked the previous questions for the second time (after the participant had tried out the second version of the app), we moved to the comparison of the two versions and asked the participants to imagine a situation in which they typically use navigation apps for driving, and to answer the following questions:

- Which app version would you prefer to use? Why?
- Can you imagine actually using the app? Which version? Why? (How realistic is it really?)

Next, participants were questioned about the acceptability of the system versions they used:

- Should such an app be developed and implemented? Why, why not?
- Is there anything that you find morally problematic about the design of the two app versions? What and why?

We asked the first question right after we asked the participants whether they would use such an app (questions about acceptance). If participants just answered something akin to “No, I don’t like it”, we asked them whether they think that the app would benefit society, thereby inviting them to consider the societal perspective and not merely judge the app in terms of their personal preferences. When asking the second question, we showed them an overview of the two app versions that they had tried out and asked them to comment on the features of these versions.

This was followed by questions on the participants’ value experience such as “Do you see any value(s) impacted by the app?”. Printed cards were provided to the participants, each with a distinct value, such as accountability, dignity, or autonomy written on it to aid the discussion. From there, the focus of the interview moved to autonomy.

Participants were asked to reflect and comment on the system versions they had experienced by using various printouts, such as cards containing the following statements associated with autonomy: the system (or feature)...

- ... constraints my individual freedom;
- ... provides me with meaningful and desirable options;
- ... enables me to make morally good choices;
- ... makes me feel as if other people’s values are imposed on me;
- ... enables me to contribute to what I truly care about;
- ... allows me to make well-informed decisions.

We also asked them directly how they understand “autonomy”, and showed two definition cards to them:

1. Autonomy means to be able to choose and have control.
2. Autonomy is the capacity to judge, decide, and act on the basis of one’s own attitudes and reasoning.

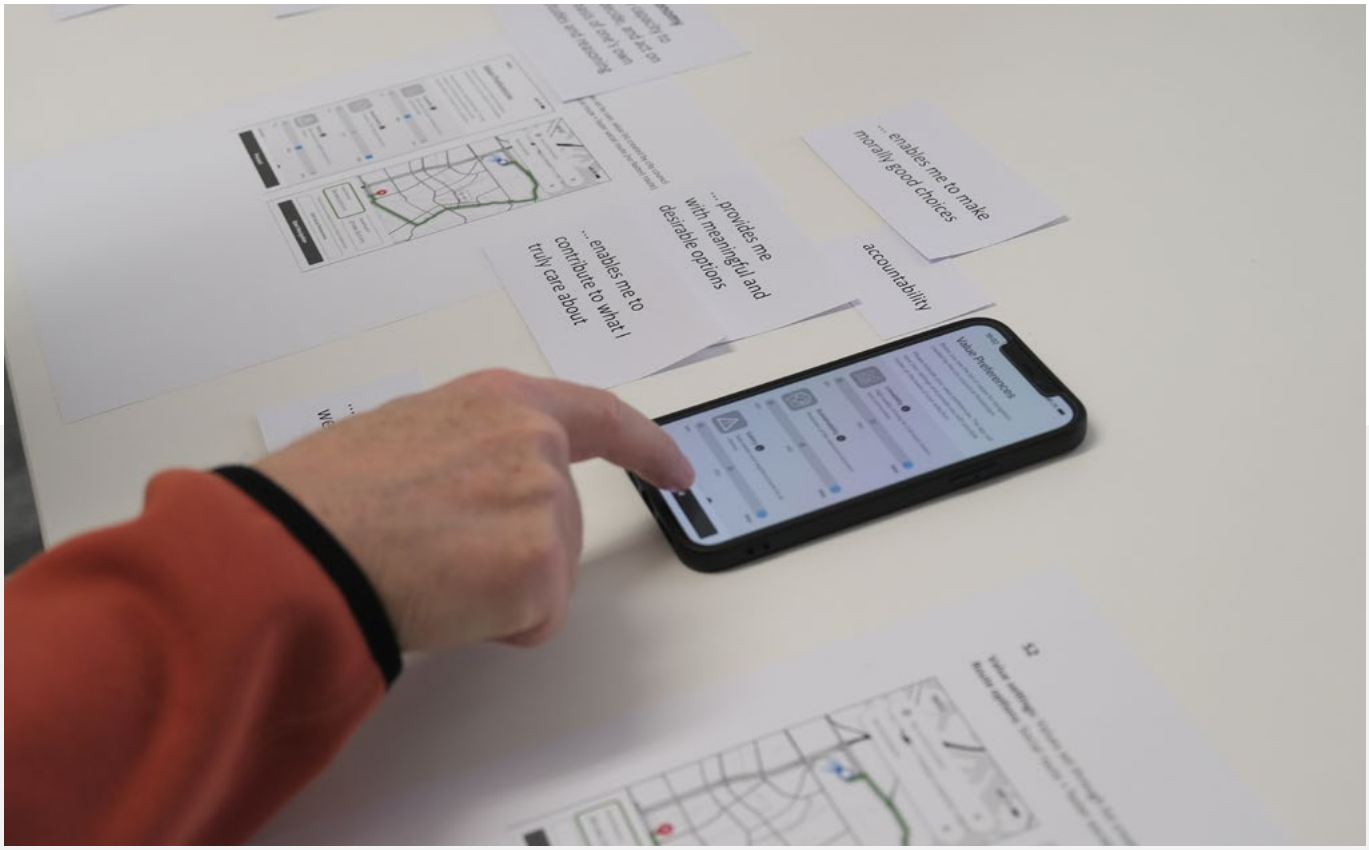

Figure 11 Close-up of a participant interacting with an app mock-up and print-outs during the individual interview study

Data was collected in the form of audio recordings from the interviews as well as notes taken during the interviews. Furthermore, pictures were taken of the printouts arranged by the participants. Since value experiences have an emotional component, our analysis of the interviews does not only take participants' verbal responses into account but also their non-verbal reactions, such as laughter or sounds expressing feelings of surprise or reluctance. To this end, we added those non-verbal, yet hearable, reactions to the transcripts. The results presented in this report are based on the analysis of the notes taken during the interviews as well as the pictures taken. This data was analyzed by the project team as well as Chemistry. The project team combined their own findings as well as the findings from Chemistry in the results presented in this report. Additional data analysis will be carried out based on the detailed transcripts. The results will be presented in a scientific publication.

Participants The individual interview study had a total of 18 participants, eight of which were female and ten male. Participants' age ranged from 22 to 64 years old. Six interviews were carried out in English and 12 in Dutch. All participants were native English speakers. The reason for carrying out some interviews in English was that not all project team members (and not everyone who was involved from Chemistry) speaks Dutch. The participants in the English interviews agreed to be interviewed in English at the recruitment stage. All participants were self-identified regular car drivers in a city in the Netherlands with most of them regularly driving in Amsterdam.

Prototypes The prototypes consist of six clickable app mock-ups, each presenting a distinct version of the Driving for Values system (see figure 11). The mock-ups can be explored **here** and were presented to the participants of the individual interviews on a smartphone. These app mock-ups are not fully functional navigation systems but present users with a default route as well as alternative routes to a predefined point of departure and destination (Rembrandtpark in Amsterdam). The routes suggested by the prototype had a driving time of approximately 35 minutes and the shortest routes presented in the app were approximately 10 to 20 percent shorter than the social route. The latter is founded on earlier research conducted by the municipality, which indicates that a significant number of drivers are willing to take social routes that are 10 to 20 percent longer than the fastest route (Gemeente Amsterdam, 2022).

Each of the six system versions represents a unique combination of the following four characteristics:

1.

The system is voluntary/ mandatory.

When the system is voluntary, drivers can choose to follow the social route or opt for the fastest route. When the system is mandatory, drivers are only presented with (a) social route(s) across all available navigation aids. However, they may still decide to drive without a navigation aid and rely on their own knowledge of the city. When a driver fails to follow the social route, the route is recalculated to show an updated social route to the driver's destination. No fines are given for failing to follow the route.

2.

Drivers can/ cannot choose an alternative social route

Some system versions present drivers with a single social route. Other versions include the option to choose an alternative social route that optimizes for the same values but is shorter in time and distance.

3.

Drivers can/ cannot influence the values for which the system optimizes

In some of the system versions, the value settings are fixed. In other versions, drivers are asked to set their own value preferences by using a slider to indicate the extent to which the system should optimize for each value.

4.

The list of values for which the system optimizes is defined by the city council of Amsterdam / defined bottom up by the citizens of Amsterdam.

All app prototypes present drivers with a list of values for which the system optimizes. These values presented in the prototypes are: Safety, Livability, Sustainability, and Economic flourishing. These values were defined by the project team, however, in the app mock-ups, a short text was used to indicate that these values have been set by the city council of Amsterdam or bottom up by the citizens of Amsterdam.

Below you find an overview of each system version, described around the four characteristics. These system versions were defined by the project team. They were chosen by mapping out unique system versions that can be created with the system characteristics mentioned above (and additional characteristics) and checking for which system version comparisons promised valuable insights.

1.

System 1

A. Mandatory.
B. Drivers cannot choose an alternative social route.
C. Drivers can influence the degree to which a value determines the route advice.
D. The list of values for which the system optimizes is defined bottom up by the citizens of Amsterdam.

2.

System 2

A. Mandatory.
B. Drivers can choose an alternative social route.
C. Drivers cannot influence the degree to which a value determines the route advice.
D. The list of values for which the system optimizes is defined by the city council of Amsterdam.

3.

System 3

A. Mandatory.
B. Drivers can choose an alternative social route.
C. Drivers can influence the degree to which a value determines the route advice.
D. The list of values for which the system optimizes is defined by the city council of Amsterdam.

4.

System 4

A. Voluntary.
B. Drivers can choose an alternative social route.
C. Drivers cannot influence the degree to which a value determines the route advice.
D. The list of values for which the system optimizes is defined by the city council of Amsterdam.

5.

System 5

A. Voluntary.
B. Drivers cannot choose an alternative social route.
C. Drivers can influence the degree to which a value determines the route advice.
D. The list of values for which the system optimizes is defined bottom up by the citizens of Amsterdam.

6.

System 6

A. Voluntary.
B. Drivers cannot choose an alternative social route.
C. Drivers cannot influence the degree to which a value determines the route advice.
D. The list of values for which the system optimizes is defined bottom up by the citizens of Amsterdam.

Focus group set-up

Goal The goal of the focus group was to generate additional insights regarding the participants' acceptance of and the acceptability of the Driving for Values systems as well as their experience of autonomy by exploring their ideal version of the system.

Set up The focus group was carried out in the form of a 1.5 hour session that largely built on the prototypes used in the individual interviews. The focus group started off with a re-introduction of the six system versions used in the individual interviews. Participants were asked to pick a system version they had experienced in the interviews and present them to each other. This was followed by a discussion of the various features of the different system versions, such as: being able to set value preferences, or being able to choose the fastest route. These features were illustrated on printed feature cards. Participants were then asked to collaboratively build their own, ideal system version using the feature cards and blank cards, on which they could put down their own ideas for features. The focus group concluded with a round of reflection on the system version the participants had created, thereby specifically focussing on how this system performed with regards to acceptance and acceptability as well as autonomy and other values (see Appendix C for the focus group guide).

Participants The focus group was carried out with a total of five participants, all of which had previously participated in the individual interviews. The group was made up of one female and four male participants.

5.2.2 Results of the final studies

This section presents the main results from the individual interview study and the focus group.

Results 1-1 interviews

Predominantly positive reactions towards the Driving for Values concept

Almost all participants approved of the general concept of a navigation app that stimulates car drivers to take alternative routes contributing to the greater good in the city. Only two participants rejected the concept outright. Participants appeared to recognize the potential benefits such a system could offer for themselves as users of the public space as well as for the city as a whole.

Conditions for acceptance and acceptability

This positive judgment was often tied to conditions, which render the system acceptable and increase its acceptability. Valuable options can enhance autonomy and thereby improve acceptance and acceptability. Yet, participants had different ideas on which options they would like to have (e.g., social route and the fastest route, or two social routes, or two social routes and the fastest route).

Being able to choose between routes is a desirable option

Most participants expressed a preference for being presented with a choice between two route options by the navigation system, one of which being the fastest route and the other a social route. Removing the fastest route appears to be experienced as taking away a desirable and familiar option, and reducing the users' sense of freedom. Similar to the initial iterations, participants stated that they would choose to take the social route when they are not in a hurry. As indicated by previous studies from the municipality, a 10-20% increase in travel time for the social route over the fastest route seems to be deemed acceptable.

Mixed feelings towards setting personal value preferences in the app

The value preferences setting was welcomed by several participants, who appreciated the level of control over the system this provided. Several participants commented that they would be more inclined to take the social route knowing that they had influenced the values based on which it is created. Some participants critiqued this feature, stating they felt that setting the values when starting the app for the first time and being able to adjust them later on added too much complexity. Furthermore, several participants stated that they were unsure about what the effect of changing their value preferences was on the routes they received. Lastly, some participants voiced privacy concerns as they worried about what might happen to their personal value profiles.

No clear preference regarding if the values should be defined by the city council or by citizens

There is no clear preference among the group of participants between having citizens define the values or the city council. While individual participants had preferences, overall positive and negative points were mentioned for both tested options. Having citizens define the values was desirable for some participants, who commented that this would make for a system that is more in touch with the inhabitants of the city and their needs compared to having the values defined by the city council. Furthermore, it would give them as citizens an additional channel to influence the system. Others were worried that citizens might behave too selfishly and try to focus on what is desirable for their own street or neighborhood even if that might be undesirable for other neighborhoods. Those preferred having the values defined by the city council.

Citizens' trust and support necessitates a deeper understanding of the system's objectives and impacts

Many participants pointed out that in order for them to trust and believe in the system, it is important that they understand the objectives of the system and how their choices as users translate into an actual positive impact on Amsterdam citizens. Taking the social route was commonly seen as a tradeoff, requiring participants to do something good for society but increasing their travel time. Taking the longer route appears to be deemed worthwhile only if users are convinced of its objectives and positive impact. There were different ideas on what kind of impact participants were looking for (e.g., a percentage showing how often I as an individual user chose the social route, newspaper reports on reduced accidents since the app was introduced, or just seeing the neighborhood flourish). But the impact mattered, so much that some participants were even willing to vote for the mandatory use of the app as this would increase the overall impact.

Ease of use and efficiency are important for acceptance

Participants want to be able to choose a route quickly, they don't want to make too many clicks or read a lot of information and make decisions before every ride. They want a simple and effective interface. This might be due to other apps they are used to (e.g., GoogleMaps) and that have a high usability, but also to the specific context of a navigation app for car driving, which is commonly used when someone is ready to go with a specific destination in mind.

Preference for integrating the Driving for Values system into existing apps

Participants commented that they prefer having the Driving for Values system integrated in an existing navigation app over a new, separate app. Reasons participants mentioned for this was that they trust the current navigation apps to provide good advice and that they would simply not want to download and

learn to use a new app. Several participants believed that this would be the only acceptable way to reach widespread adoption, explaining that they are more willing to adopt the system if others use it too. Some participants further suggested to include reward or gamification mechanisms to increase adoption.

Reflection on studying acceptance, acceptability and autonomy

Participants seemed competent in judging what they find acceptable for themselves, i.e., what they would use, why or why not, and how this could be improved.

Exploring the acceptability of the system proved to be more challenging. When asked directly about "moral issues" or "what is good for society", some participants struggled. A few participants seemed to use the concept of acceptability to play down their own felt resistance by referring to "others" and moving all social responsibility to them ("it's not for me, others might use it"). However, when confronted with less direct questions, comments made by participants indicate that they reflected on the system's potential impact on society and moral topics such as fairness (e.g., who should be able to influence the system and who shouldn't).

Initially, the concept of autonomy proved to be difficult to discuss in the context of a navigation system for most participants. Only after engaging with the statement cards were participants able to discuss autonomy and directly express or refer to notions related to it.

Reflection on the prototypes used in the study

The social route concept and the additional features proved to be somewhat challenging for participants to understand. The concept had to be explained quite extensively and participants had lots of questions about how the system works, what its objectives are and how they can contribute to these objectives.

The values (livability, sustainability, safety, economic flourishing), explanation of these values and examples provided in the app prototypes proved to be insufficient for several participants and somewhat challenging to understand. Several participants found that not all values (especially economic flourishing) had an obvious link to car driving, which led them to question the value's relevance.

Results focus group

Participants' ideal version of the Driving for Values system

The ideal version of the system that the participants came up with had the following features and characteristics:

- The app provides users with one social route and the fastest route available.
- The app provides information on the impact of the social route. At the same time, participants highlighted the need to avoid information overload in the app.
- Clear and detailed information on the system's overall objectives are provided (in the app and through other channels).
- The system's objectives are defined by municipality representatives and the citizens together in a yearly referendum. The municipality representatives should prevent "not in my backyard" attitudes and balance the interests of different people. The outcome of the referendum is implemented by a team from the municipality and participants are informed how their input was used.
- The system may make use of some form of point system or gamification to promote widespread adoption.
- The system is integrated in existing navigation apps, such as Google Maps and Waze.
- The app functions across modes of transport, inviting users not just to take different routes but for example to take the bicycle instead of the car.

Participants' evaluation of their ideal version of the Driving for Values system

Almost all participants agreed that it is desirable to implement the driving for Values system they had come up with in Amsterdam. One participant commented:

'I am a motorist who enjoys his freedom but I am also a city resident and I know what it means when lots of cars go through your street'

While there was lots of disagreement initially, the discussion was productive and participants were able to find common ground and compromises. Only one participant, who was also most vocal about their negative feelings about the Driving for Values system in the individual interviews, remained hesitant. The participants further stated that the system they designed promotes autonomy, among others by offering useful and desirable options, allowing users to make well informed choices and enabling them to contribute to what they find important.

5.3 Additional findings: Deciding on the public values pursued through the system

The Driving for Values system could be used to contribute to diverse public values, from improving safety for school children over improving air quality to fostering gender equality. We sat down with a civil servant working on improving animal wellbeing in the city, who seemed interested in steering car drivers to avoid roads where animals are commonly injured by cars. The Driving for Values system has many stakeholders, such as different departments within the city, business owners, and citizens. These stakeholders likely have different values that they would like to see taken up into the system. It seems tempting to include many public values as, once the system is created, it would most likely be easy to optimize routes provided to car drivers for as many public values as possible. For example, civil servants working on animal welfare could map out where animals get into accidents with cars in Amsterdam and steer drivers to avoid these places. But how do we choose certain public values to be taken up into the system and not others? And how do we make sure that we don't end up taking up every public value? After all, we might better foster some public values with interventions outside of the domain of routes and road rules. We believe that a democratic process should be established to determine which public values the system should promote and which ones it should not.

6 Recommendations

This chapter introduces the recommendations of the project team to the municipality of Amsterdam. These recommendations are intended to support the municipality in further researching and designing the Driving for Values and similar systems. Information gathered from the approximately 65 participants of our seven studies as well as insights gathered from monthly workshops with academic experts and municipality representatives are the basis of the recommendations presented below.

Further pursue the idea of voluntary route advice promoting public values.

A. We recommend that the municipality continues to explore and develop the Driving for Values concept further. Participants, notably from Amsterdam, support the concept of a navigation system providing alternative social routes, recognizing its potential benefits. However, their acceptance and adoption hinge on the system's design, implementation, and operation. Citizens have specific criteria and suggestions for the system to be acceptable (see further recommendations).

Promote autonomy

A. We recommend designing the system for autonomy. Autonomy is an important moral value that both concerns car drivers and other users of the public space. Systems that respect autonomy are more likely to be accepted.

B. The system should balance the autonomy of the car drivers with the autonomy of other users of the public space. Cars may infringe on the autonomy of other traffic participants, e.g., by exposing them to involuntary traffic risks. Enlarging the autonomy of citizens therefore is an important justification and rationale for the system, and also allows some infringement of the autonomy of car drivers, but not more than required.

C. Autonomy is not about having complete freedom or as many choices as possible but about having options which facilitate meaningful choices. The design of the system should support this by providing car drivers with options and choices to:

- **I.** contribute to what they feel is most important to them. This can be in the form of enabling drivers to influence the high level public values that the system promotes across the city (valid for all drivers in the city) but also setting personal value preferences to receive routes that are in line with one's own ideals.
- **II.** choose among two social routes, one of which being shorter in duration and time.

D. Social route advice should only be provided if it generates sufficient societal benefit as otherwise, it would be an unnecessary infringement on driver's autonomy. This means that a threshold needs to be defined about what constitutes sufficient societal benefit. Moreover, for routes that meet the threshold and are advised, proof of the generated societal benefit needs to be provided. How this proof is provided, by whom and to whom also needs to be defined in the development process.

E. Design for autonomy should not come at the cost of usability, that is important for acceptance and adoption of the system. Existing navigation apps (e.g., Google Maps, Waze, City Mapper, etc.) are setting high standards for usability. Based on the feedback gathered from our participants, we recommend that the Driving for Values system should be integrated in existing navigation apps and not be developed stand alone.

Build a trustworthy and transparent system

A. We recommend investigating and defining a strategy to make drivers trust the system (the socio-technical system as a whole, including the individual routes it suggests and the processes behind it). Communicating to drivers how they contribute to the objectives is key for acceptance.

B. The beneficial "social" effects of the system and the individual routes should be made transparent and communicated to citizens and drivers.

C. Values 'used' or 'shown' in the app should make sense in the domain of car driving in Amsterdam. If the values pursued with the system are too far disconnected from this domain, they can be difficult to understand and therefore accept.

D. The introduction of such a system should be accompanied by a campaign in which people are informed about the purpose, the ideas behind it, the precise workings of the system and in which discussions with citizens are organized. The campaign should include a hotline people can call in case they have any questions, etc. The ethical, social, and environmental advantages of using the system should be carefully explained to citizens.

E. The government influencing routes should be held to higher standards than Google Maps, in terms of transparency.

Manage compliance

A. We recommend making the use of the system optional, and not prescribed by law. But the design of the system can greatly affect how many people participate (such as how you set defaults). In designing, set a desired compliance threshold. Do not aim for full participation of the population, but also guard against too low participation. Change the design if compliance levels get out of the desired 'compliance bound'.

B. The user's experiences with the system should be monitored over time and adapted and improved where necessary.

C. The municipality should think about ways of incentivizing people to not only use the system but also to choose the social route.

D. Not everybody has to contribute to every goal: The level of compliance with route advice correlates with the public value created. For example: every car that does not go past a primary school at school opening time reduces the risk of a traffic accident in which a child gets hurt. This

means that not everybody has to abide by the advice, allowing people who really do not like this not to do so, thereby minimizing infringement on individual freedom.

E. The design of the system should not overly exploit the moral duty car drivers feel towards the public values that they embrace by putting them under excessive moral pressure to increase compliance.

Ensure democratic control and citizen participation

A. We recommend setting up a democratic process in which it is decided which public values will be integrated in the route advice and which not. The process should be organized close to the city council. At the same time, the process should enable citizens to contribute to the goals and design of the system so that they don't feel like the system is imposed on them by the municipality.

B. Existing platforms such as "Signalen in Amsterdam" should be leveraged to allow citizens to voice their concerns about the current traffic situation in Amsterdam, and subsequently take those concerns up in discussions with citizens. The idea behind this would be that the system would be developed bottom-up, starting with the current problems as they are perceived by the citizens. Those would be guiding the design of the system. The platform could then also be used after the system has been implemented, as a place where citizens can provide feedback and make suggestions for improvement of the system.

C. The public values for which the system optimizes should be continuously critically reviewed. Only the public values generating sufficient value should be maintained.

D. The system's performance with regards to the public values it was designed to promote should be continuously monitored. Clear (functional and normative) performance indicators should be defined in the development of the system.

Recommendations for further research

We recommend conducting further research to investigate:

A. Extending the system to additional user groups, such as cyclists, pedestrians, etc., in order to develop a system that caters to all traffic participants, not just car drivers.

B. How citizens should be involved. This could for example focus on how to keep them involved as the system evolves and is adapted, exploring the "meaningful moment idea" in more detail or approaches such as participation through citizen interest groups or citizen representation by the city council.

C. The democratic process through which it is decided which public values are integrated into the system.

D. The perception and impact of the system on other users of the public space.

E. The transparency mechanisms used to make beneficial "social" effects of the system visible and communicate them to the citizens.

F. Whether routes and road rules provided by the system should always be optional, or if they are situated in which the system should define and communicate hard rules which could lead to fines.

G. Users' experience of other values which are closely related to autonomy but were outside of the scope of this project. The most relevant values to investigate further are:

- **I.** Privacy. Respect for autonomy requires respect for people's privacy.
- **II.** Democracy and participation. These are core values that need to be respected and that contribute to human moral autonomy (see recommendation 5)
- **III.** Transparency and trustworthiness. (See recommendation 6).

H. The use of incentivising mechanisms (Positive: parking points, gamification, etc. but also negative: fining people if they don't comply) and their effects on user experience.

7 Conclusion

Driving for Values and similar digital systems designed to manage and regulate public spaces by influencing individuals' decisions and behaviors raise ethical questions about values like freedom, autonomy, and justice. Furthermore, they can be perceived by citizens as intrusive, as they restrict their choices and freedom. It is therefore important to consider these values in the design process of such digital systems. Designing technologies that gain social acceptance and meet moral standards involves more than just integrating values and related design requirements into the design process. It also necessitates verifying whether the proposed design solutions truly uphold the values they aim to support, such as autonomy. Our investigation shows Design for Values can be used to systematically incorporate values of moral importance in the design of prototypes of digital systems used in the public space and facilitate empirical studies with users and citizens. The recommendations presented in this report, informed by insights gathered from the approximately 65 participants of our seven studies as well as from monthly workshops with experts from academia and municipality, can guide the municipality of Amsterdam in further pursuing the Driving for Values system. Furthermore, we advise that similar investigations be carried out for public digital systems for all kinds of system concepts in various domains, to design technologies that are both socially accepted and morally acceptable.

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Appendices

Appendix A

Guide interview study

Appendix B

Questionnaire containing questions about their demographics and car driving habits. This questionnaire was used in the individual interview study.

Appendix C

Guide focus group

Welcome & Introduction

"As car traffic impacts citizens' life in several aspects, the City of Amsterdam wants to offer a solution in form of a dynamic policy that adapts to the daily traffic situation to support important collective values such as safety or environmental protection. In this study, we would like to explore design options for an app that could accompany such a policy."

>>Show information sheet<<

Q Do you have any questions?

"For research purposes, we will audio-record this session and take notes. We will anonymise your data, keep it safe, and delete the recording after the data analysis. You can stop at any moment you like - this will not impact your reimbursement."

>>Show consent form<<

Q Do you have any questions?

Q How did you get here today? (What mode of transportation did you use?)

>>Ask questions from questionnaire here if participant did not fill it in<<

"We would like you to test an early version of a navigation app that shows alternative routes to get around in Amsterdam. To learn from your experience, please think out loud while exploring the app and comment on anything that you find noteworthy."

App version A

"This is an early prototype for an alternative navigation app designed for the city of Amsterdam. Imagine that you just downloaded it to your phone to try it out in the typical setting in which you usually drive and use a navigation app >>refer to typical scenario mentioned by participant<<. Please click through the app to start navigation and **"think out loud"**, that is, share any thoughts and comments that you have."

>>Show app version A<<

Q After going through the app, do you have any initial comments?

Q Please describe the app and explain what you think it is for.
Is anything unclear?

Q How do you find the app overall? >>try to move beyond usability and colours<<
(What do you like/dislike, find pleasant or disturbing? Why?)

App version B

"This is a second early prototype version for an alternative navigation app designed for the city of Amsterdam. Again, imagine that you just downloaded it to your phone to try it out in the typical setting in which you usually drive and use a navigation app >>refer to typical scenario mentioned by participant<<. Please click through the app to start navigation and **"think out loud"**, that is, share any thoughts and comments that you have."

>>Show app version B<<

Q After going through the app, do you have any initial comments?

Q Please describe the app and explain what you think it is for.
Is anything unclear?

Q How do you find the app overall? >>try to move beyond usability and colours<<
(What do you like/dislike, find pleasant or disturbing? Why?)

Comparing app versions A/B

Q Please explain how the two app versions that you just explored differ.

Acceptance

Q Imagine the context in which you typically use navigation apps for car driving. Which app version would you prefer to use? Why?
>>Show overview of the two app versions and ask participant to comment<<

Q Can you imagine to *actually* use the app? Which version? Why?
(How realistic is it really?)
>>Refer to typical scenario mentioned by participant<<

Acceptability

Q Should such an app be developed and implemented? Why, why not?

[Q] If participants just answers "no / I don't like it": Do you think it would benefit society?

Q Is there anything that you find morally problematic about the design of the two app versions? What and why?
>>Show overview of the two app versions and ask participant to comment<<

Q How could this be fixed/improved/avoided?

Values [optional]

>>Show value cards<<

Q Do you see any value(s) impacted by the app?

Q Which one is the most important one? Why?

[Q] If it is not autonomy: How would you define it?

Autonomy

Q Comparing the two versions, which of the following statements fits which version?
>>Show cards/printout with statements<<

... constrains my individual freedom
... provides me with meaningful and desirable options
... enables me to make morally good choices
... makes me feel as if other people's values are imposed on me
... enables me to contribute to what I truly care about
... allows me to make well-informed decisions

Q Please assign each statement to one app version and **think out loud** while doing so.
>>Ask "Why?" to explore what roles the different features play here<<
Once participant has sorted cards to the two versions:

Q Which app version should rather be developed and implemented? Why?

Q Which version would you rather use? Why?

- **Q** Does the app you explored (version A, B or both) affect your autonomy? How & why?
  >>Show the two app versions again OR refer to overview of the two versions<<
- **Q** What is autonomy for you? If participant finds it difficult to define autonomy:
  >>Show cards with definitions of autonomy<<

Autonomy means to be able to choose and have control Autonomy is the capacity to judge, decide, and act on the basis of one's own attitudes and reasoning

- **[Q]** What do you think about these definitions,
  which one fits best your understanding of autonomy?
- **[Q]** Do the navigation apps that you usually use affect your autonomy?
  (In what way? Which apps?)
- **Q** Can you think of any changes in the app's design that would enhance autonomy?

Closing

- **Q** Is there anything else that you would like to add?
- **Q** Would you be interested in participating in a follow-up study?
  If yes, you will be contacted through the recruitment agency again.

  "If you have any questions, please don't hesitate to contact us."
  Contact information can be found on the study information sheet.

Questionnaire on demographics & navigation

How old are you?

- ◯ 18–25 years
- ◯ 26–45 years
- ◯ 46–65 years
- ◯ 66+ years

What is your gender?

- ◯ Female
- ◯ Male
- ◯ Other

What is your highest level of education?

- ◯ Elementary education
- ◯ VMBO/MAVO/HAVO/VWO diploma
- ◯ Secondary vocational education (MBO)
- ◯ Higher education (HBO/WO)
- ◯ I prefer not to disclose

What is your nationality?

What is your cultural background?

Where do you locate yourself in terms of monthly net income?

- ◯ 0–1.500€
- ◯ 1.600–2.500€
- ◯ 2.600–3.500€
- ◯ 3.600 or more
- ◯ I prefer not to disclose

What is your current place of residence?

What mode of transport do you primarily use in the city?

◯ Bike ◯ Car ◯ Public transport

◯ Other:

What benefits & frustrations do you experience with transportation and traffic in the city?

How often do you drive a car?

◯ Once a month or less ◯ 2–4 times a month

◯ 2–4 times a week ◯ On a daily basis

On what occasions/for what purposes do you usually travel by car?

How would you describe your driving skills?

◯ Basic driving skills ◯ Good driving skills ◯ Excellent driving skills

Do you use navigation apps?

◯ No ◯ Yes

Which one(s)?

On what occasions?

STRUCTURE FOR FOCUS GROUP

Preparation
Show info sheet to participants
Participants fill in consent form
“Any questions?”

Introduction (10 minutes)
Welcome participants, introduce ourselves
Explain project and plan for the focus group
Explain ground rules for the focus group, e.g., let one person speak at a time

PART A: Re-introduce prototypes (20 minutes)
Show participants all 6 prototypes to remind them of the versions that they have already seen

- Hand out one printed system version to each participant
    - If we have more versions than participants, we as researchers can also present a system version
- Task: Ask participants to make themselves familiar with their version (5 minutes?) and to present it version to the other participants
- Discuss: What are the differences?

PART B: Discussion of system features (30 minutes)

- Task: Ask participants to place all feature cards in one of the columns: **“for me… GOOD / BAD”**
- Discuss
    - What do you like about the different features?
    - What don’t you like about the different features?
    - Which features are most important?
- Task: Ask participants to place all feature cards in one of the columns: **“for society… GOOD / BAD”**
- Discuss
    - What do you like about the different features?
    - What don’t you like about the different features?
    - Which features are most important?

Feature cards

1. Value preferences can be chosen by user
2. Set of values chosen by city council
3. Set of values chosen by citizens
4. Values described and explained
5. Only one route shown
6. Fastest route shown
7. More than one route shown
8. Two social routes shown
9. App use is mandatory in Amsterdam
10. Value scores explained for social route
11. + blank cards!

Questions on autonomy

- Discuss: How do these features relate to autonomy?
- Which features promote autonomy?
    - Participants have to put star-shaped stickers on the feature cards or vote for most autonomy-promoting feature by putting little dots on the cards
- What is more important: having several options or having options that align with your own values?

PART C: Identifying the best system version (30 minutes)

- Task: Build the best system version as a group, thinking of the version that you would most likely use (version with highest acceptance).
    - Use the features of the prototypes plus any additional features.
    - Present your system version to us.
- Discuss best system version
    - Why do you like this version?
    - Are there any trade-offs with acceptability? Should the app be developed? Why?
- *To find out whether this system version supports or undermines autonomy:*
    - How does the system relate to the following (autonomy) statements?
        - ... constrains my individual freedom
        - ... provides me with meaningful and desirable options
        - ... enables me to make morally good choices
        - ... makes me feel as if other people's values are imposed on me
        - ... enables me to contribute to what I truly care about
        - ... allows me to make well-informed decisions
    - Dutch version:
        - ... beperkt mijn individuele vrijheid
        - ... biedt mij zinvolle en wenselijke opties
        - ... stelt mij in staat moreel goede keuzes te maken
        - ... geeft me het gevoel dat de waarden van anderen aan mij worden opgelegd
        - ... stelt me in staat bij te dragen aan wat ik echt belangrijk vind
        - ... stelt me in staat weloverwogen beslissingen te nemen
- [optional: What version should definitely *not* be developed? Why not?]

[Optional: Relating system versions to values]

What values do participant see relevant:

a) for the general impact and purpose of the app
b) for their/citizens'/users' interaction with the app

Show and discuss value cards

- vrijheid
- privacy
- vertrouwen
- bruikbaarheid
- verantwoording
- waardigheid
- autonomie

- rechtvaardigheid en eerlijkheid
- transparantie

Responsible Sensing Lab

Smart city systems can help solve urban challenges. But when collecting data, what public values are involved? Responsible Sensing Lab explores how to integrate social values in the design of sensing systems in public space.

responsiblesensinglab.org

/responsible-sensing-lab

esdit

The aim of the research programme is to develop a comprehensive philosophical understanding of the socially disruptive technologies (SDTs) of the 21st century, and in particular their challenge to the very concepts and values that we normally appeal to in our moral thinking.

esdit.nl

/esdit-research-programme