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| **Project number:** | 693729 |
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| **PP** | Restricted to other programme participants (including the Commission Services) | |
| **RE** | Restricted to a group specified by the consortium | |
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| **Title:** |
|---|
| D2.2 - Citizen Dialogue Design Requirements |
| **Author(s)/Organisation(s):** |
| Andreas Sackl, Sarah Thiel, Peter Fröhlich |
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| D2.1 – User Requirements Definition<br>D3.1 – 1 Generic Dialogue Concept for Citizen-based Co-creation of Open Data |

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|---|
| This report presents the gathered requirements and derived recommendations for citizen dialog design. |
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# Introduction

The project smarticipate seeks to provide interactive technologies that help innovating the way people discuss, contribute and influence public decisions. Studies have shown that citizens' satisfaction with participation technologies is, amongst other factors (like e.g., user-friendliness of the application or trust in politics), determined by authorities' responsiveness to citizens (Harding, Knowles, Davies, & Rouncefield, 2015; Kweit & Kweit, 2004; Parasuraman, Zeithaml, & Malhotra, 2005; Webler & Tuler, 2000)}. Receiving meaningful feedback from authorities helps increase citizens' internal political efficacy (i.e., their subjective impression that they understand community issues) Kim & Lee, 2012).

To improve governance in the urban context, the smarticipate project aims to develop automatic feedback technology that should enable citizens to probe and refine their ideas, which in turn should provide urban planners and city authorities with validated, “useful” input. This "dialog with the city" should go beyond currently available solutions of 'chatbots", text-based dialog systems that compile databases to help automatizing customer services, tax return processes (Karsten & West, 2016), or voting procedures (phoneia - Technology & Entertainment, 2016). This “dialog with the city” should offer answers and ideally also comments to citizens' requests. For instance, when proposing the development of a new park at a certain location, the feedback should give an indication of whether that is in principle possible. The research on technologies that might enable such levels of informed dialogs between the city and their inhabitants is an ongoing process (West, 2004). Apart from questions related to the feasibility of semantic processing of open data, the opportunities and constraints for their design have so far not been explored.

The goal of the present project deliverable is to achieve an understanding about the user needs with regard to how they should interact with such a novel public service. The document starts with a synopsis of general user requirements that have been derived earlier in the project (see section 1). Section 2 provides knowledge and recommendations from Human-Computer Interaction research and practice with regard to these general requirements. Beyond this established body of knowledge, section *3* compiles a list of design questions that have not been addressed within empirical research. Then, in section *4*, we present the method and results of a user study to provide empirically grounded answers to these design questions. Finally, section *5* concludes with implications for citizen dialog design.

# 1 General Dialog Requirements

Deliverable D2.1 ("User Requirements Analysis", p. 52-54) summarizes four main activities that shall be supported by the smarticipate platform and it lists specific related requirements which are shown in the following. The dialog design has to be defined such that it can optimally support these tasks:

**1. Modeling**

The purpose of the first activity type 'modeling' is to create models of urban sceneries that shall then enable users to directly experience and interact with these urban models and thus provide more meaningful feedback and suggestions. Smarticipate will use 3D visualizations for this purpose. The specific requirements outlined are[1]:

- The council should be able to specify a budget for a specific development proposal
- Users should be able to specify estimated costs for a proposal as an attribute
- The system should export the 3D model in a standard format such as CityGML for perusal by the council along with relevant statistics
- The system should allow users to create 3D models of proposed development plans
- The system should allow users to import 3D models in standard formats
- System should allow users to create development proposals using mobile phones and other media
- System should allow users to designate a specific site as an Asset of Community Value (ACV)
- Users should be able to specify specific goals to be achieved by a proposal

**2. Visualizing**

The purpose of the second group of activities, 'visualizing', is to enable users to manipulate the visual objects, e.g. by adding trees or buildings, and then to receive immediate feedback on the consequences of their proposed changes.

- Calculate financial cost of building higher vs wider
- Users should be able to explore the 3D model

[1] see table 4 of D2.1 (p.54)

- System should provide automated feedback to the user about the constructed 3D model
- System should perform a planning policy check to verify if the development would be permitted under existing policies and regulations
- System should calculate estimated cost of a proposal
- The system should provide feedback to users about the suitability of a proposed development

**3. Collaborating**

Here the type of activity is 'collaborating', i.e. the opportunity to share development proposals with various stakeholders to get feedback:

- The system should allow users to vote on proposals
- Users should be able to select whether to publish a development proposal to wider community or not
- Users should be able to select the target audience when publishing a development proposal with wider community
- The system should send mobile notifications to relevant/interested users when a proposal is published
- The system should allow users to define permissions for other users on a proposed 3D model
- The system should allow users to leave feedback on a 3D model
- The system should allow users to share the proposals via social media and to receive comments
- Users should be able to toggle commenting for specific proposals
- The system should be integrating crowdfunding initiatives such as Spacehive

**4. Analysing**

The fourth type of activity is 'analysing, which subsumes the various activities that planners have to accomplish to make sense of the citizens' proposals and to use these as a basis for their decisions.

The system should be able to track the complete planning process.

# 2 Guidance from Human-Computer Interaction Research and Practice

After the above general, more task and functionality-related requirements, this section will depict known or already agreed quality issues and principles related to the design of the user interface. After a list of fundamental usability standards and principles, we will elaborate on more specific aspects such as design for mobile devices, graphical fidelity, interaction modalities, openness of dialogues and support of city planners.

**Usability Standards and Principles**

As already pointed out, one of the first non-functional requirements was that the system should be intuitive and user-friendly. This is also a necessary prerequisite to support the activity types outlined above. Thus, one of the foundational prerequisites for the specification, design and testing of the smarticipate user interface is that established standards and guidelines are considered and followed.

The most important standard with regard to the user-centred design process is "**ISO 9241-210**", issued by the International Organization for Standardization. As the project's work plan incorporates a fairly elaborated user- and stakeholder-centred process in several iterations, there are optimal conditions for compliance with this standard.

With regard to the actual user interface design, especially the following **12 design principles** should be followed:

1. Consistency: Consistency describes a common design of elements and processes. All user interface concepts should thus be consistently designed.
2. Feedback: Feedback means that users expect a sufficient system reaction to all of their actions.
3. Efficiency: The user interface must enable the users to carry out their tasks efficiently.
4. Flexibility: The system must allow a user to work differently than the other users, if she wishes or needs to, in order to accomplish her goals.
5. Clearly marked exits: The user must always know how she can leave a specific context, window or display when working with the user interface, and how she can return to her starting position
6. Wording in users' language: The wording in the user interface must be familiar to the user and easily understandable.

7. Task orientation: The user interface shall always be designed to best suit the users' tasks. The user should never need to adapt to the system.
8. Control: The user must always be in control of the system, the user must never have the feeling of the system controlling her.
9. Recovery and forgiveness: The system must prevent the user from (unknowingly) taking severe actions. The user should be able to undo changes or actions easily.
10. Minimize memory load: The user should be enabled to focus totally on her task, not being troubled with the user interface as such. Therefore the user interface must require as little cognitive effort as possible.
11. Transparency: the user must always know what will happen when she takes an action, i.e. the user interface must be transparent.
12. Aesthetics and emotional effect: Everything has an emotional effect: If a user interface has an inappropriate emotional effect, it will interfere with the user's tasks.

**User Interface Design for Mobile and Ubiquitous Devices**

As pointed out in D2.1 as a non-functional requirement, "the system should allow users to create development proposals using mobile phones and other media". In order to minimize the project development efforts, a unified design approach will need to be taken. The respective implementation approach is subject to deliverable D3.3.

In addition to the aforementioned principles, the specific requirements of mobile usage situations and mobile devices as such need to be considered (confer, e.g., Jones, 2006; Weiss, 2002, creativeBlog; Warsi, 2011; webcredible.com). Most importantly, the mobile context and situational factors should be thoroughly considered. For example, design should consider limited cognitive capacities in 'busy situations', associated with distraction and multitasking. Also, one should take advantage of opportunities by free available time while people are waiting or bored. Most importantly, the spatial context of users can be exploited as an added value, by enabling people to spontaneously enter comments and requests related to their surrounding urban area.

The form factor of mobile devices is another important driver for design requirements. Given the limited screen space, the amount of content needs to be minimized and single columns layouts should be preferred. Due to the constraint input possibilities, text entry should be minimized. Another special aspect of mobile user interface design is the multitude of platforms and interaction styles. Most importantly, one should not necessarily focus on touchscreen users, but also on other users who use keypad phones.

### Graphical Fidelity

Based on the user requirements stated in D2.1, interaction with advanced visualisations and 3D models is of high importance, hence, it is important to highlight the constraint of technical performance, especially on mobile devices. Given the assumed high performance expectations of users, 3D graphics should be thoroughly tuned and tested. A two-phase approach is recommended which – in the first stage – only involves the rendering of images on a server. The detailed realisation of such approaches is described in D3.3.

When looking at specific guidelines and principles for graphical fidelity, the classical but still challenging criterion of 'direct manipulation' (Shneiderman, 1998) is key. Thus, object and actions should be highly visible, and actions should be designed to be rapid, reversible and incremental.

### Interaction Modalities

In principle, graphical user interfaces are not the only option to implement participatory services. The term *dialog system* already suggests it: Spoken dialog systems, i.e. systems that communicate with the user with the help of voice recognition and speech synthesis, could also be a worthwhile approach for services like smarticipate. However, in the discussions between stakeholders and the project partners in charge for the requirements of the system, the opportunity of realizing smarticipate as a form of spoken dialog system was not highly prioritized. For example, gestural interaction, apart from pointing the smartphone towards a certain object and taking a photo of it, was never an important topic within the requirements discussions; hence, graphical user interface modes were decided to be focused upon.

### Openness of Dialogues

There is a continuum from highly conversational interfaces to simple one-way information services and, of course, the question arises which place smarticipate will take. Given the strong spatial and graphical focus that has evolved from the requirements discussions, as well as the constraints imposed by open data, typical smarticipate use cases will have to focus on pre-defined dialog templates and content, strongly based on visual interaction. Since in the case of smarticipate feedback shall be provided, several questions need to be answered which shall be addressed in the next section.

### Supporting City Planners

One of the few papers on the topic of citizens' contributing in e-participation systems has been published by the project team at the REAL-CORP conference 2016 (Thiel, Fröhlich & Sackl, 2016). Here, long-term experience over 5 months with the actual use of a dashboard system summarizing citizen contributions has been gathered. However, so far no study has dealt with advanced analysis tools which directly feed into the decisions of urban planners.

### Design for Automated Feedback in e-Participation Systems

As already outlined in the introduction, the user interface design requirements for automated feedback systems have so far not been explored.

# 3 Open Dialog Design Questions

In the following chapter we will discuss some design questions that have so far not been systematically investigated on in Human-Computer Interaction and related research disciplines. All of these questions are addressed in a user study that is laid out in section 4.

**Immediacy**

A critical success factor associated with personalized feedback is the time-lag between the complaint/request and the governmental answer. While automatic feedback is in itself is significantly faster than the response by a human administrator, studies on system response time in interactive systems  indicate that users may even be sensitive to small delays of one or more seconds. Hence, we assume that fast feedback (=low delay between sending proposal and receiving feedback) is crucial in our context. We also hypothesize that in correspondence to classical studies on system response time, users in this application context are also more tolerant regarding higher response delays, if additional information is provided while the data is processed at the server.

**Implicitness**

Another design question is related to the fact that immediate feedback should have priority in the presentation to the user. While presenting a pop-up notification or even a dedicated mail would raise most attention towards the provided citizen feedback, we hypothesize that a close, non-disruptive integration of the feedback into the current screen will be preferred. Additionally, usability research and practice have shown that providing implicit feedback, such as using mouse-over effects, should be implemented, as available information can be monitored without changing the screen state. Hence, users want to have feedback about possible options before a certain proposal is sent to the users (instead of receiving this feedback after proposal-submission). In this sense, our hypothesis is that a highlighting of constraints related to citizen proposals, e.g. when placing objects on a map, is appreciated.

**Precision**

A crucial aspect with regard to the feasibility of automatic feedback is the level of detail and accuracy that must be provided by the system. Based on previous research, we assume that precise information about costs are preferred compared to providing a range of costs or price probabilities.

**Social Awareness**

Citizen participation is a process of social exchange, and thus it is necessary to think about when the contribution of others should be displayed. Based on previous findings, we assume that

information about existing proposals should be communicated before the user submits a new proposal instead of providing this information after the submission.

**Response Format**

Dialogs with citizens can be implemented in many different conceptual ways. E.g., responses can be provided directly within the currently present screen. This form of dialog would appear rather incremental from the perspective of the user, but it would probably be regarded as very efficient. However, the "dialog with the city administration" could also be promoted to the foreground, e.g. by presenting the feedback in a pop-up window. A dialog with a citizen could also be even more explicitly implemented by sending an e-mail from the city administration to the users. As of time of writing, no related work is available that provides enough guidance regarding this issue. Looking at experience with people's expectations on performance and efficiency of modern apps, we assume that e-mail communication will not be appreciated in this regard.

**Information Type**

Another conceptual design question relates to the trade-off between information clarity and briefness. E.g., automated feedback presented as floating text could provide the clearest comprehension of its content. However, a numbers-only approach could be similarly clear for many users. Other users might be more susceptible to iconic forms of presentation, due to their quicker comprehension (in case their meaning is known).

**Anthropomorphism**

A further conceptual key consideration of intelligent approaches, such as the automated feedback targeted by smarticipate, is to which extent the system presents itself in a human-like manner. Many novel services are experimenting with avatar concepts, but others try to highlight the contact with real humans, such as the contact persons in the city administration.

**Data Source**

When dealing with (open) data-related services, we assume that people might appreciate to know who is issuing the data, to provide them with some background evidence on its accuracy and trustworthiness of the data. On the other hand, the provided identity information may not be comprehensible to everyone and therefore of limited use. In order to find answers to this question, empirical research is necessary.

**Identity of Sender**

Furthermore, as a side question, we were also interested in understanding whether the mentioning of the identity of the sender may increase trust and perceived transparency.

# 4 Citizen Dialog Design Study

During July and August 2016, a user study was conducted in AIT's Technology Experience Laboratory. The overall objective of this study was to obtain empirical evidence of unmet or unanswered user requirement questions. After the presentation of the goals and focused aspects of the study in section 4.1, the developed study methodology and test parts are described in section 4.2. Section 4.2.2 presents the results, structured according to the research questions.

## 4.1 Goals

The goal of the design study was to investigate on the questions concerning the user interface design which were brought up in section 3 .

| | Aspects | Alternatives |
|---|---|---|
| **1** | Immediacy | 5 sec |
| | | 10 sec |
| | | 30 sec |
| | | 60 sec |
| | | 30 sec + Update |
| | | 60 sec + Update |
| | | |
| **2** | Precision | Precise |
| | | Range |
| | | Probability |
| | | |
| **3** | Implicitness | Without |
| | | With Highlighting |
| | | Always highlighted |
| | | |
| **4** | Social Awareness | Community information before submission |
| | | Info nachher |
| | | |
| **5** | Response Format | Normal |
| | | New Dialog |
| | | E-Mail |
| | | |
| **6** | Information type | Floating text |
| | | Symbols |
| | | Pure numbers |
| | | |
| **7** | Anthropomorphism | Little |
| | | Direct address |
| | | Assistant Responso |
| | | |
| **8** | Data source | Without |
| | | With |
| | | |
| **9** | Sender identity | Without |
| | | With |

*Figure 1: Study Goals and Alternatives*

## 4.2 Method

AIT conducted an experimental user study with 30 participants in a contextually enriched laboratory setting. The study setup, including the study parts and their experimental design, is explained in section 4.2.1. Section 4.2.2 shows the prototype design for the alternatives (9 difference subtests). The participant background is then summarized in section 4.2.3.

### 4.2.1 Study setup

Table 1 provides an overview of the study parts.

*Table 1: Overview of the study setup*

| | Duration (m) | Type of data collected |
|---|---|---|
| **Briefing of the participant** | 10 | None |
| **Context scenario introduction** | 5 | None |
| **Experimental part** | 35 | Qualitative + Quantitative |
| **Card Sorting** | 20 | Qualitative + Quantitative |
| **Interview** | 10 | Qualitative |
| **Survey** | 10 | Quantitative |

We focused on the concrete user task of proposing tree planting positions by means of a map-based mobile participation app, as this had been identified by city officials to be both relevant and representative for the exploration of the idea of automatic feedback in citizen participation. Participants used a clickable HTML5/JS-prototype on a smartphone to place a tree symbol on a 2D map to create a proposal about a new tree, which they wished to be planted at the selected position. Then, the submitted proposal was processed on a server and feedback was transmitted to the smartphone and displayed, see Figure 1 for an example. Figure 1 also shows that the user was standing in front of a large projection of Google Street View. This context simulation was meant to enhance the immersivity of the laboratory setup - please see Busch, Lorenz, Tscheligi, Hochleitner, & Schulz (2014) for a detailed discussion about immersivity in laboratory settings.

*Figure 2: Context simulation in the AIT Technology Experience Laboratory*

**Experimental Part**

In the experimental part of the study, there were nine test blocks, which were corresponding to the nine investigated issues (see Figure 1). These blocks and the respective study alternatives within the block were presented to the participants in random order. Each condition was complemented by a short question about satisfaction ("How satisfied were you with the feedback related to the specific aspect?") with answering options ranging from "not satisfied" (=1) to "very satisfied" (=5). Furthermore, after each condition, participants were interviewed about the currently evaluated aspect to get further qualitative feedback.

**Card Sorting Part**

After this experimental part, participants were confronted with an adapted card sorting exercise, to gain a direct comparative view on user preference of the provided alternatives. The participants were asked to define their "perfect" interface for immediate feedback in the context of citizen participation. All alternatives were printed out on cards and the users laid them in the order of their preference. Also the card-sort task was complemented with a short interview to better interpret and weight participants' responses.

### 4.2.2 Test Prototype

In the following, the test prototype realizations for the selected test conditions in the nine subtests are shown.

**Immediacy**

For example, in the sub-test related to immediacy, test conditions were realized by presenting a default feedback page with different delays (5, 10, 30, and 60 seconds).

There were two further alternatives which provided additional feedback during the loading phase at 30 and 60 seconds waiting phases (e.g. "Request is sent to the server", "Data is being analysed").

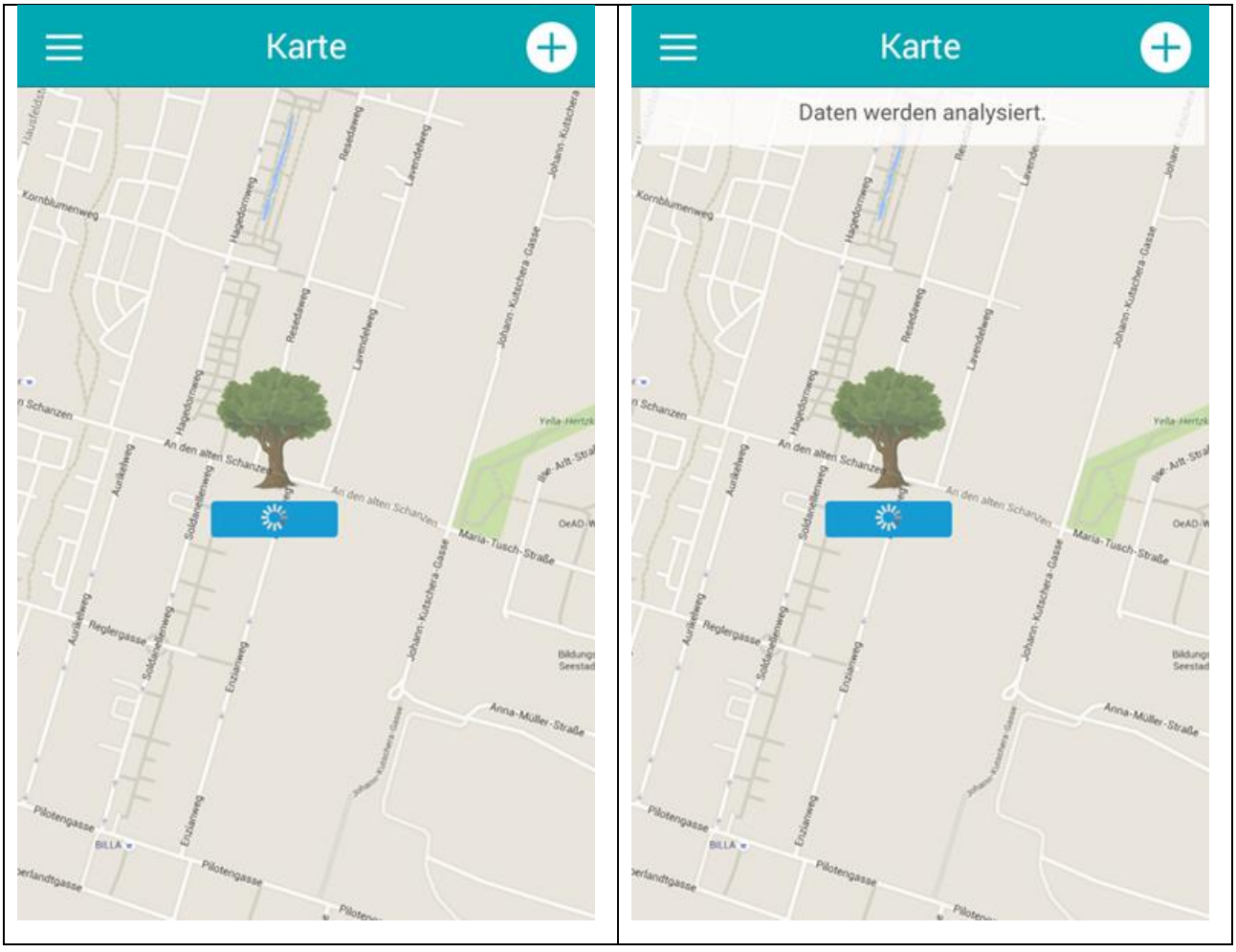


*Figure 3: Prototype realization for Immediacy sub-test (example screens). Left: waiting symbol, Right: Information on status updates*

**Precision**

For the precision sub-test, the following conditions were tested:

- precise costs ("6000€")
- a range of costs ("between 4000€ and 8000€")
- a probability ("6000€ (80% accuracy)").

The picture on the left shows the example of probability.

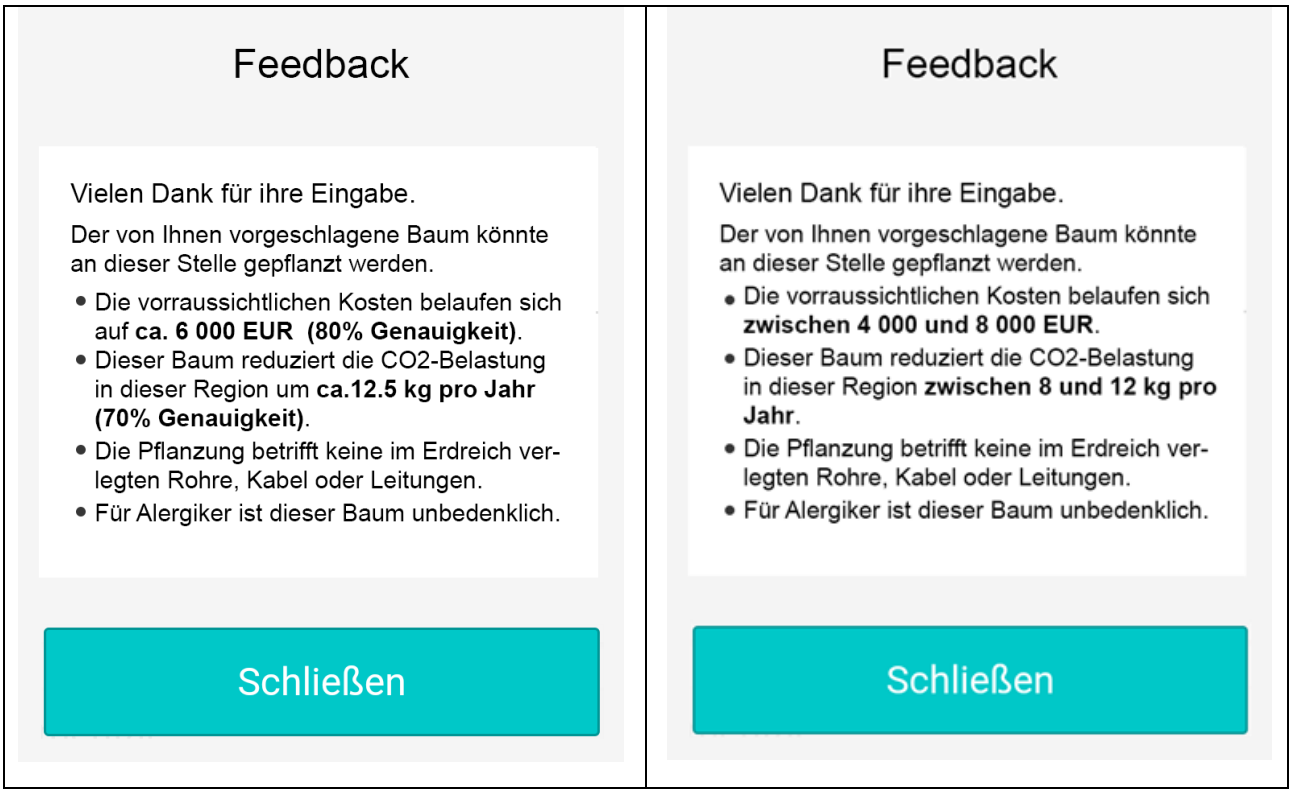


*Figure 4: Prototype realization for Precision sub-test (example screens). Left: probability, Right: range*

**Implicitness**

In the implicitness sub-test, one alternative included

- feedback after a submission
- two further alternatives presented the respective information before the submission:
    - always visible
    - only visible when hovering over the respective area.

The picture on the left shows how feedback after a submission was implemented, and on the left the feedback before a submission was implemented.

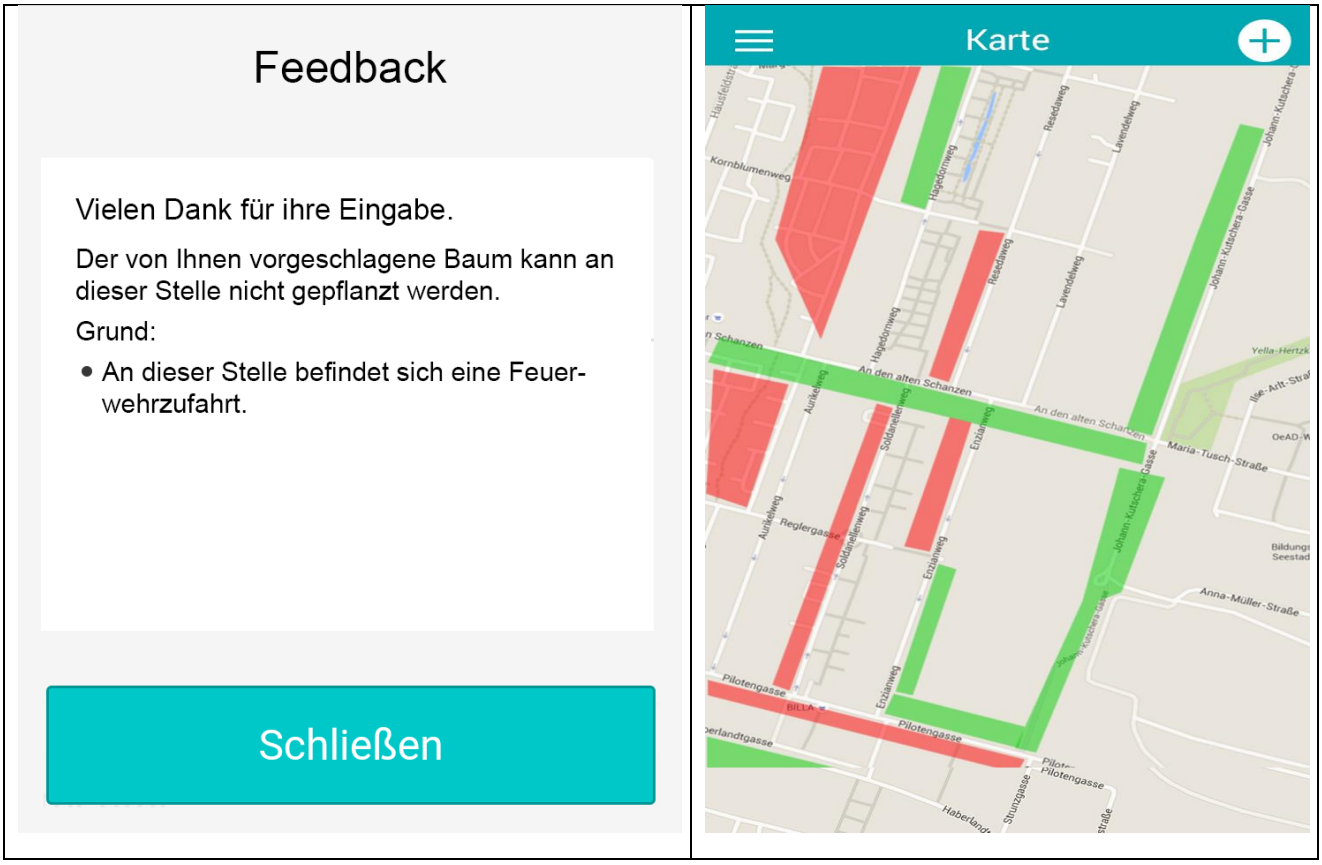


*Figure 5: Prototype realization for Implicitness sub-test (example screens). Left: Feedback afterwards, Right: Feedback before*

**Social awareness**

For the social awareness sub-test, there were two tested conditions:

- Information about others' opinions was provided *before* submission of the proposal
- Information about others' opinions was provided *after* submission of the proposal.

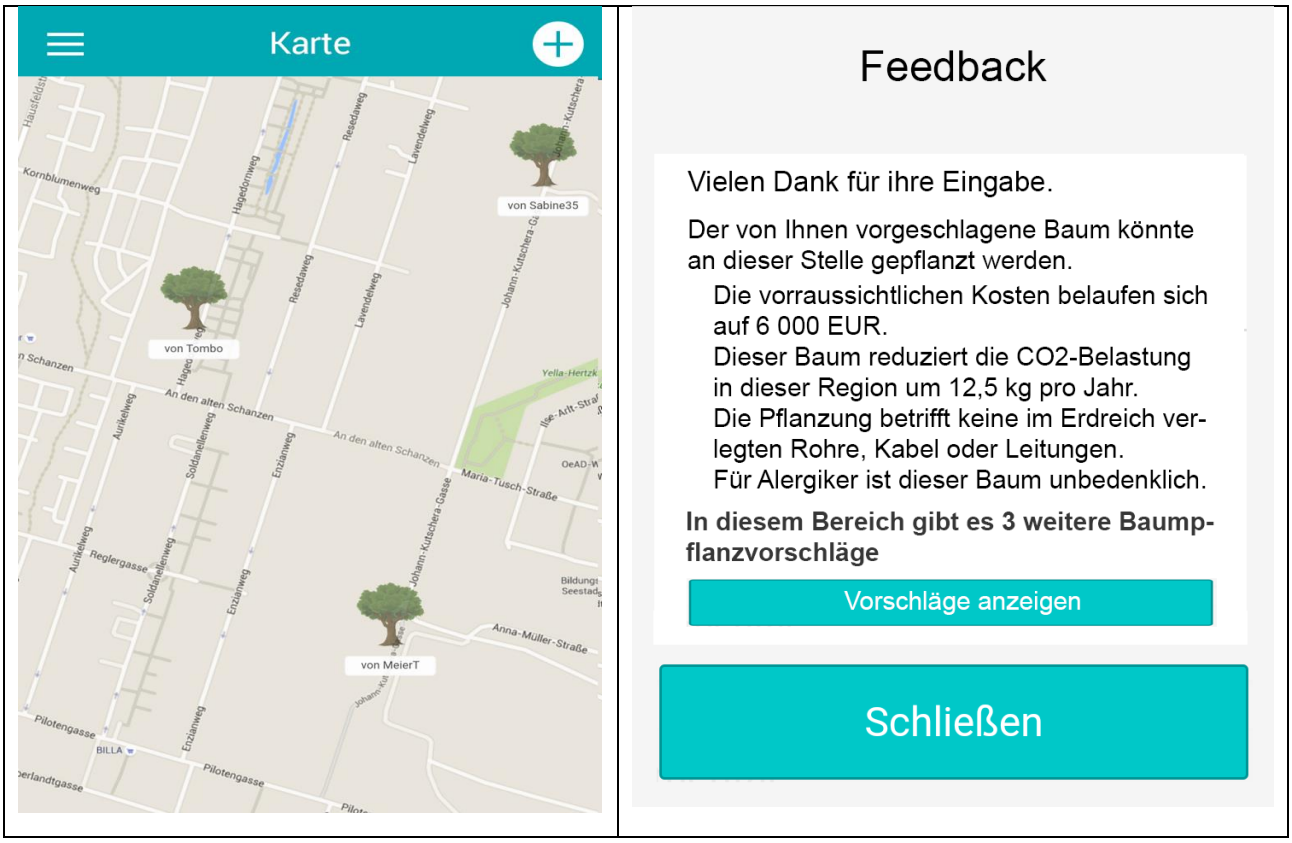


*Figure 6: Prototype realization for sub-test on social awareness (example screens). Left: Feedback before, Right: Feedback afterwards*

**Response format**

The three conditions were:

- Normal (control condition): Feedback provided within the app, without changing to a new screen.
- New dialog: Feedback provided on a further pop-up screen.
- E-mail: Feedback provided by e-mail

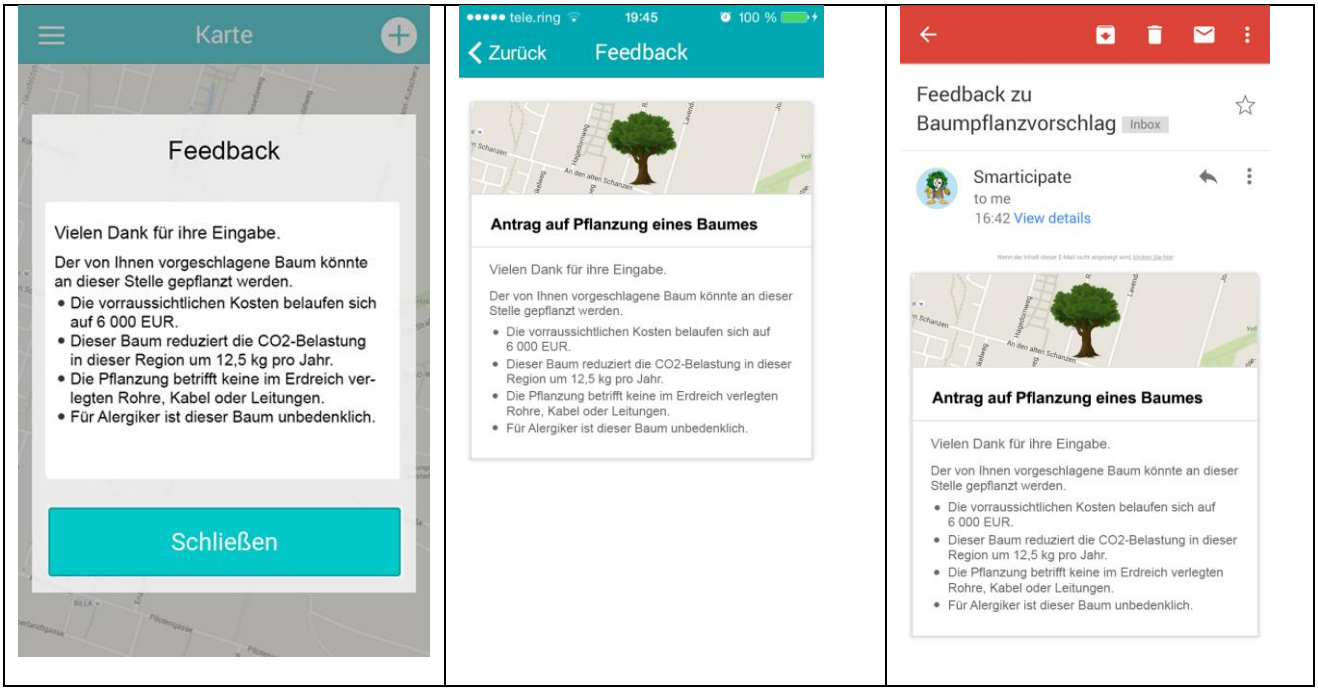


*Figure 7: Prototype realization for response format sub-test (example screens). Left: Pop-up, middle: new dialog; right: E-Mail*

**Information type**

The three conditions for this subtest were:

- Floating text
- Symbols
- Pure numbers

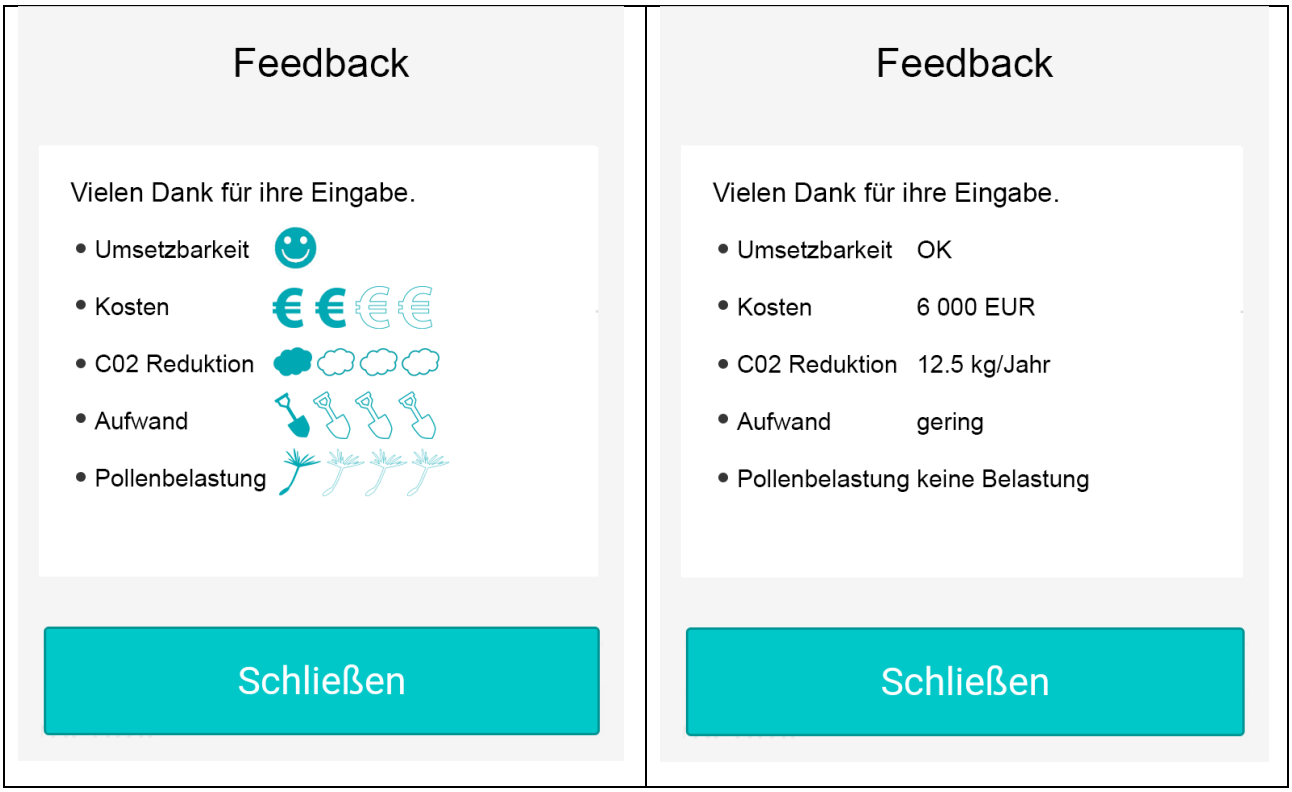


*Figure 8: Prototype realization for the sub-test on the information type (example screens). Left: symbols, Right: numbers*

**Anthropomorphism**

The conditions for anthropomorphism were as follows:

- Neutral presentation without personal address
- A message from a "real human", such as a person from the city administration
- A cartoon character, in the form of a "little helper"

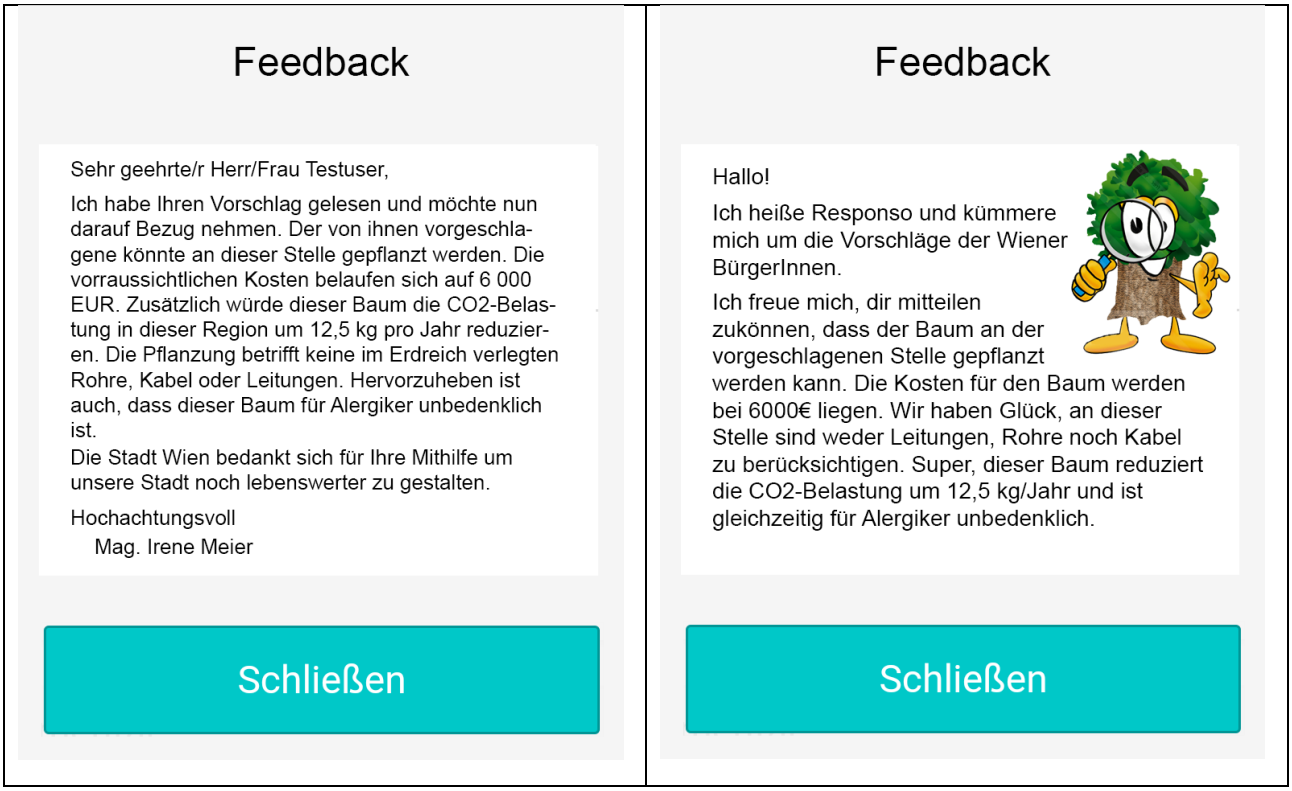


*Figure 9: Prototype realization for the sub-test on the degree of anthropomorphism (example screens). Left: human representative, Right: "little helper"*

**Data source**

In this subtest, the conditions were:

- With data source
- Without data source

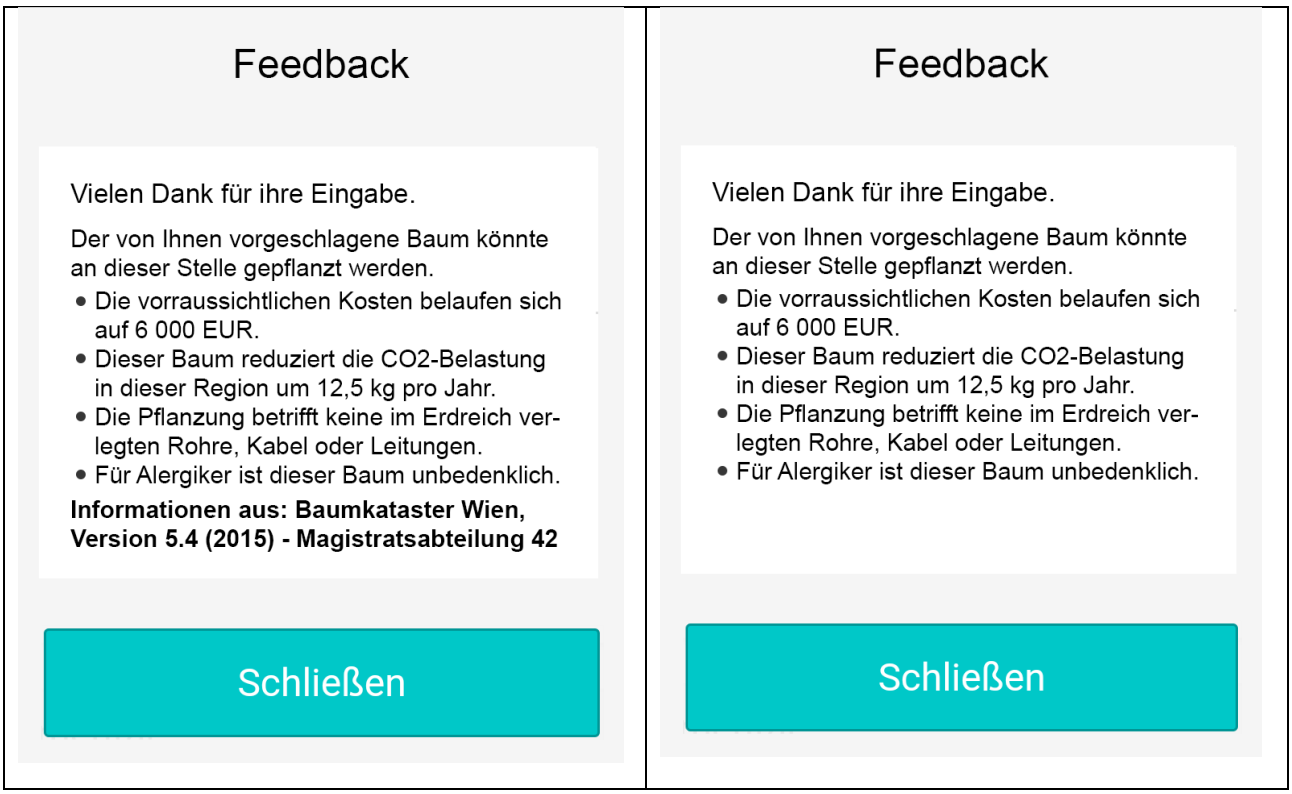


*Figure 10: Prototype realization for the sub-test on the data source (example screens). Left: with data source, Right: without data source*

**Sender identity**

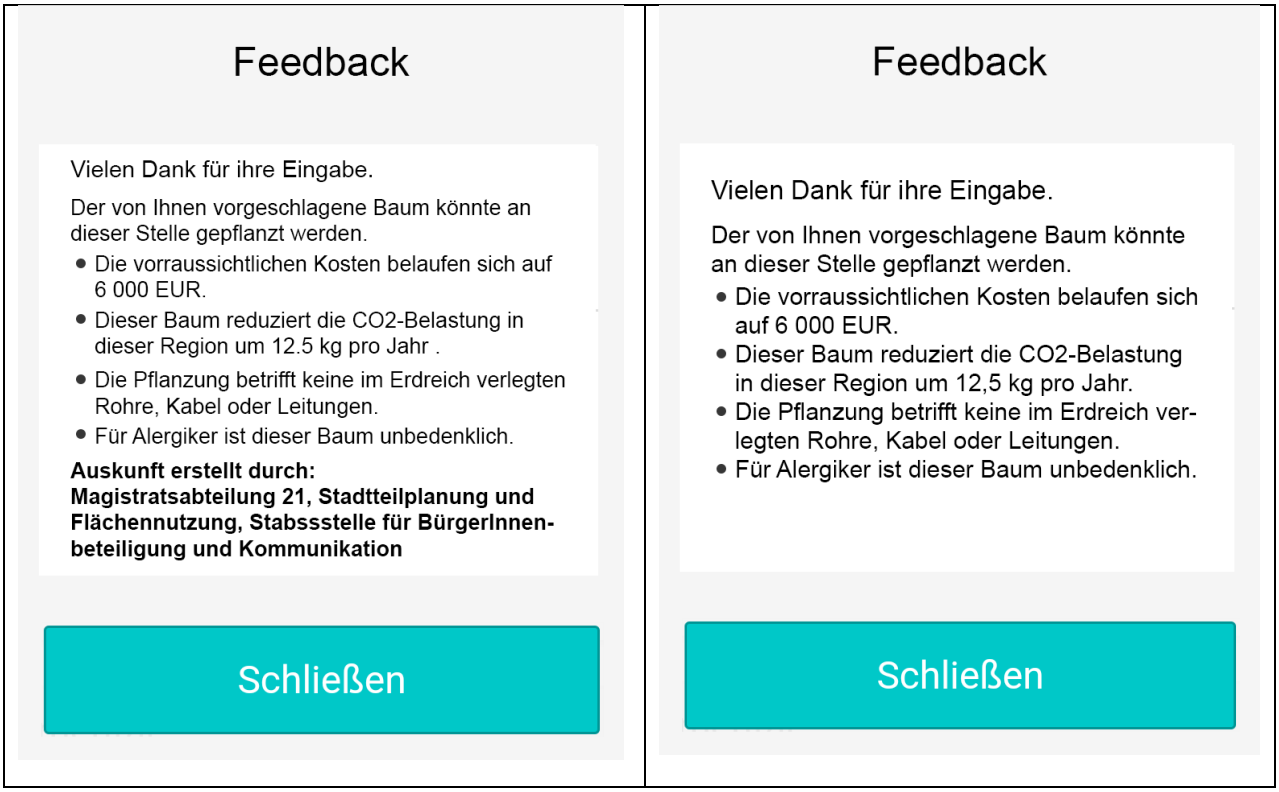


*Figure 11: Prototype realization for the sub-test on the sender identity (example screens). Left: with sender identity, Right: without sender identity*

### 4.2.3 Participants

30 citizens from the city of Vienna participated in our user study. 16 of the participants were women and 14 were men. The mean age was 36.9 years, 10 (33%) participants were between 18 and 30 years old, 11 (36%) participants were between 31 and 45 years old and 9 (31%) participants were older than 45 years.

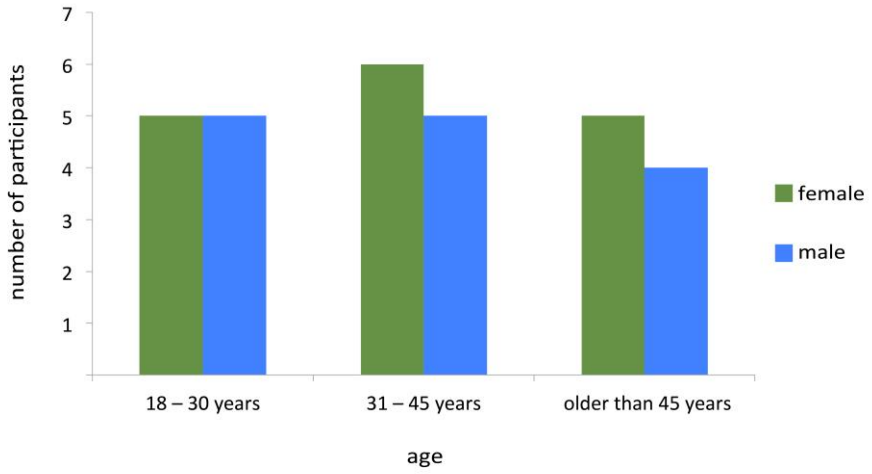


*Figure 12: Age distribution of the study participants sample*

Two of the participants (6.7%) had completed only the compulsory school. Seven persons (23.3%) owned a degree from a professional school or an apprenticeship. Five participants (16.7%) had a grammar school qualification. Six participants (20%) had either a vocational school or college degree; 33.3% of the study sample (ten persons) owned a university degree.

All study participants were experienced with smartphone usage and one third had used a digital participation platform before. In order to gather additional insights on the relevance of feedback in e-participation platforms as well as general information on citizens' attitudes towards official institutions such as trust, we asked our study participants to fill in a questionnaire.

**Subjective relevance of feedback aspects**

Whereas participants could indicate their preference from a couple of readily designed options, in the questionnaire we wanted to know how relevant participants rated the individual aspects that we had suggested to be included in a feedback message (1= "not important", 5 = "very important"). Compared to all other aspects, knowing which institution had issued the feedback (M = 2.77) and provided the data that the feedback was based on (M = 2,80) were rated to be the least important aspects. The most relevant aspects were a concise presentation of information (M = 4.20) and implicit feedback (i.e. highlighting potential planting areas; M = 4.33). 21 participants rated the latter to be "very important".

**Attitudes towards politics**

One third of the participants had used a digital participation platform before. Three of those participants indicated that this service had provided feedback to their request. The questionnaire further asked participants to indicate to what extent they trust their local and national government.

We found that while they had a moderate trust in the government, they had more trust in fellow citizens. Furthermore, our study participants can be described as rather politically active, as on average they had participated in two activities, such as participating in a survey study or contributing to town-hall discussions, in the last twelve months. There were only seven participants (18%) who had not been politically active during that time frame.

## 4.3 Results

The bar charts and descriptive statistics depict the satisfaction ratings from the main part of the user study and the preference ranks from the card sorting part. They are grouped by the four sub-tests and experimental alternatives.

For each of the above mentioned experimental alternatives we calculated Kendall rank correlations between the mean satisfaction ratings and card sorting rank values that were derived from the experimental and the card sorting part, respectively. These correlations were significant ($p<0.05$), except for the subtest regarding social awareness. Thus, participants mostly provided consistent feedback about the satisfaction of the aspects (evaluated via the clickable prototype in the experimental part) and the individually selected interfaces (via card sorting). In order to derive evidence on the pairwise statistical differences between the experimental alternatives, Wilcoxon signed-ranks tests were calculated. The significance threshold was $p<0,5$, which was Bonferroni-adjusted in each test block to avoid alpha-error inflation.

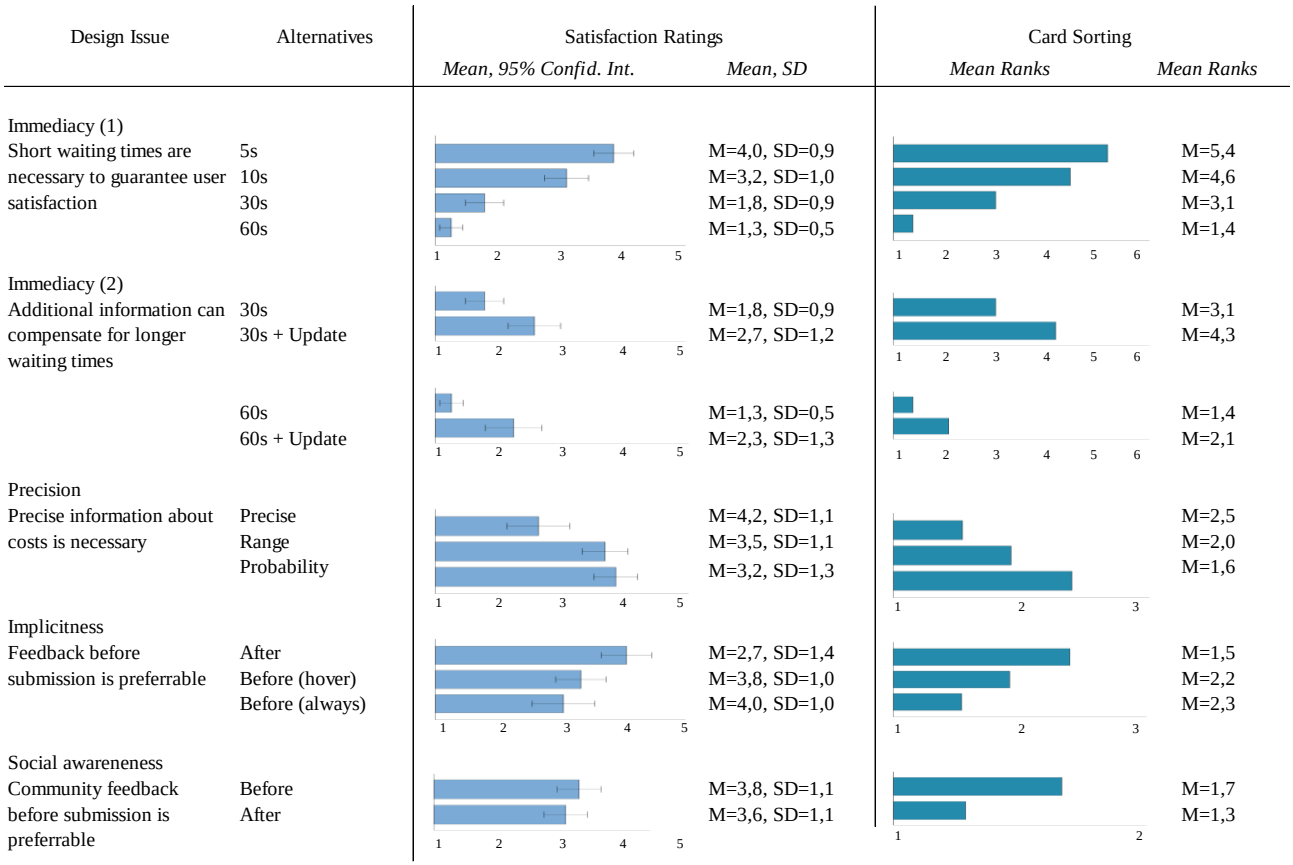


*Figure 13: Overview of Results. The middle column provides mean satisfaction ratings and 95% confidence intervals from the experimental part; 1 stands for "not satisfied" and 5 for "very satisfied". In the right column "Card Sorting", the means of the inverted ranks from the card sorting part are displayed; ''1'' represents the least preferred option and ''5'' stands for the most preferred option.*

### 4.3.1 Immediacy

The immediacy sub-test (see the related results in Figure 13 and Figure 14) resulted in significant differences for all comparisons. Satisfaction already diminished at short delays and continuously decreased with longer delays. Correspondingly, many participants said that waiting times of up to 10 seconds would be acceptable for them, based on their experiences with other mobile apps. In their responses, only few participants appeared to consider performance feasibility aspects of automated feedback systems, such as the processing of open data, and thus conceded 30 seconds to still be tolerable. The results also show that additional information about data processing compensated for longer waiting times to some extent: Users were more satisfied even if they had to wait longer for the feedback.

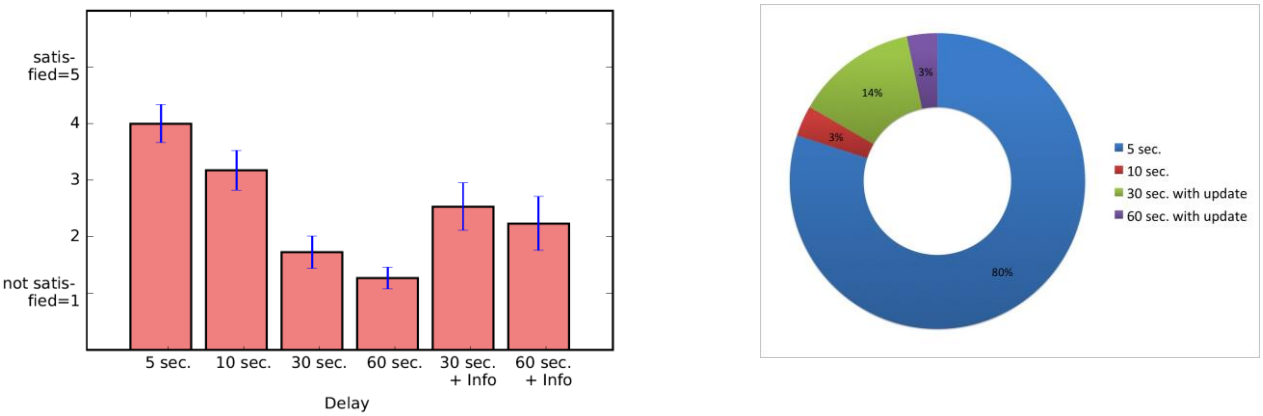


*Figure 14: Overview of Results for Immediacy. Left: mean satisfaction ratings and 95% confidence intervals from the experimental part; 1 stands for "not satisfied" and 5 for "very satisfied". Right: "Card Sorting", distribution of top ranking of the test alternatives*

Participants noted that the update was helpful and made waiting more agreeable, because "you can see that something happens". Some of the study subjects even preferred the update versions despite the pronounced delays of 30 and 60 seconds, arguing that "when I see that something is happening and that there is an effort to get the necessary data then it's okay to wait longer".

It was suggested that a progress bar or an hourglass showing the progress or waiting time remaining, respectively, would be more satisfying compared to the detailed progress information. Furthermore, some study subjects mentioned that it would be more informative to bridge the time delay by showing other relevant topic-specific information like the number of trees already suggested/planted or former $CO_2$ reduction. Further, two participants suggested that it might be better to get the feedback asynchronously (i.e. 5 minutes later) if it should not be possible to generate it really quickly. They would prefer this mode to pointedly waiting for the feedback while watching the screen and not being able to use the app for further exploration or tree suggestions while waiting.

### 4.3.2 Precision

In the precision sub-test (see Figure 15), displaying precise pricing information was rated significantly better than providing a range or probability. Comparing the preference for range and cost, no statistically significant difference could be found.

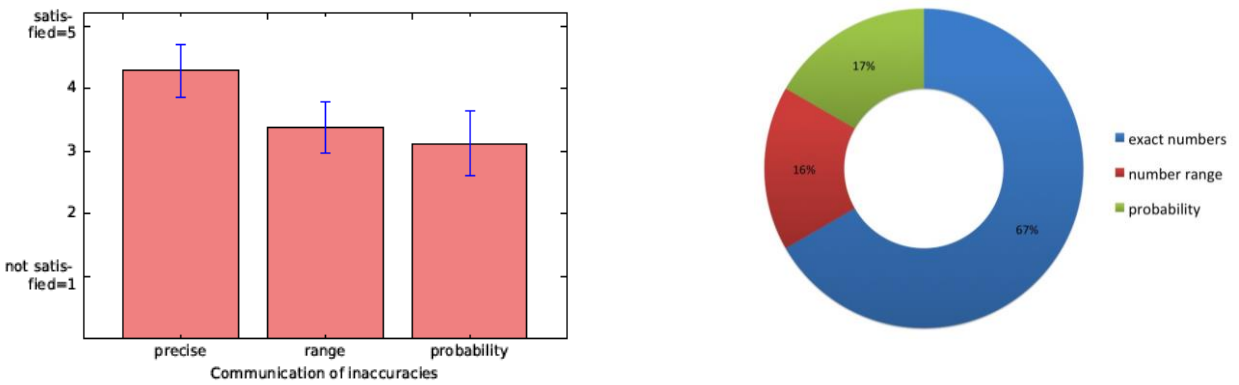


*Figure 15: Overview of Result for Precision. Left: mean satisfaction ratings and 95%confidence intervals from the experimental part; 1 stands for "not satisfied" and 5 for "very satisfied". Right: "Card Sorting", distribution of top ranking of the test alternatives*

Some participants however stated that displaying a range of estimated costs, rather than the precise amount, would be more realistic and honest. Also it was stated that if inaccuracies cannot be avoided, the term "ca." could be used instead of displaying a range or probabilities, because among others "you need to calculate the value to understand what the probability means".

### 4.3.3 Implicitness

With regard to implicitness of feedback (confer Figure 16), test participants preferred significantly getting information about alternatives (i.e. where it is generally possible or not to plant a tree) before an actual proposal was made (as opposed to receiving this feedback afterwards). However, many participants mentioned that it would be an important feature to get information about the reasons *why* a certain tree cannot be planted in a certain area before a proposal is sent.

There was no significant difference between the two approaches for offering feedback before the submission is transmitted, i.e., displayed when hovering vs. always displayed. Participants preferring the hovering approach highlighted its dynamic and playful interaction and better map visibility, while those favouring the persistent visibility liked to see all information without further need to act.

*Figure 16: Overview of Results for Implicitness. Left: mean satisfaction ratings and 95% confidence intervals from the experimental part; 1 stands for "not satisfied" and 5 for "very satisfied". Right: "Card Sorting", distribution of top ranking of the test alternatives*

Only a few subjects chose the prototype without depiction of options arguing that in this version a reason is given why it is not possible to plant a tree at a certain place. In line with this note, about a

third of the study subjects mentioned that providing the reasons for a potential impossibility of tree planting is missing and should definitely be added in the two pre-feedback versions.

By contrast, there were many positive comments about the pre-feedback giving information about optional places for tree plantings, both for the prototype that depicted the pre-feedback in a dynamic way or the prototype that showed the pre-feedback statically. The dynamic pre-feedback was immediate and clear for many participants, while some underlined the lively and playful character that "motivates to explore the map". Some of the participants however mentioned that the dynamic pre-feedback caused unnecessary efforts and time delays in the decision where to plant a tree on the map. Positive comments for the static pre-feedback were that it immediately provided the relevant information. However, some subjects described the static pre-feedback as confusing and too colourful. With regard to the prototype that did not provide pre-feedback, some participants noted that relevant information was missing, while other subjects experienced the usability as exhausting and frustrating when options for planting trees were not depicted on the map.

### 4.3.4 Social awareness

Participants' statements on when community opinion should be disclosed to users were not consistent. Some said they would like to make their own decision and thus would not want to see the other users' opinions, while others participants saw the aspect of getting influenced as a positive feature. The statistical analysis of the satisfaction scores revealed no significant differences, but the comparison preference ranks from the card sorting resulted in a significantly higher preference for displaying the community opinion before, rather than after proposal submission.

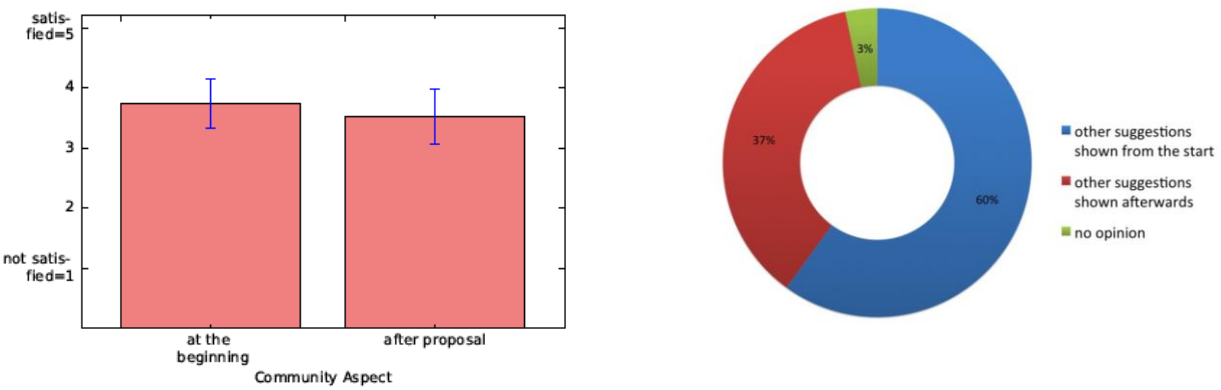


*Figure 17: Overview of Results for Social Awareness. Left: mean satisfaction ratings and 95% confidence intervals from the experimental part; 1 stands for "not satisfied" and 5 for "very satisfied". Right: "Card Sorting", distribution of top ranking of the test alternatives*

With regard to the test alternative of showing community feedback from the start, study subjects experienced the already depicted suggestions as “interesting and beneficial information” or an “orientation guide”. Seven participants expressed a desire to be able to “push” other users’ ideas for tree plantings because of possibly higher chances for a successful realization of the suggestion. In conclusion, all participants liked the possibility to be informed about other users’ ideas for tree planting places while the majority preferred to get the information before making a suggestion of their own.

### 4.3.5 Response format

Both the satisfaction ratings and the rank values in Figure 18 (left and right side, respectively) show that the response format of Emails was least preferred. Accordingly, the statistical analysis of the experimental part resulted in a significantly lower preference for E-mail than for the other two alternatives. The difference between a normal pop-up (called normal “normal” in the figure on the left side) and a new dialogue was not significant.

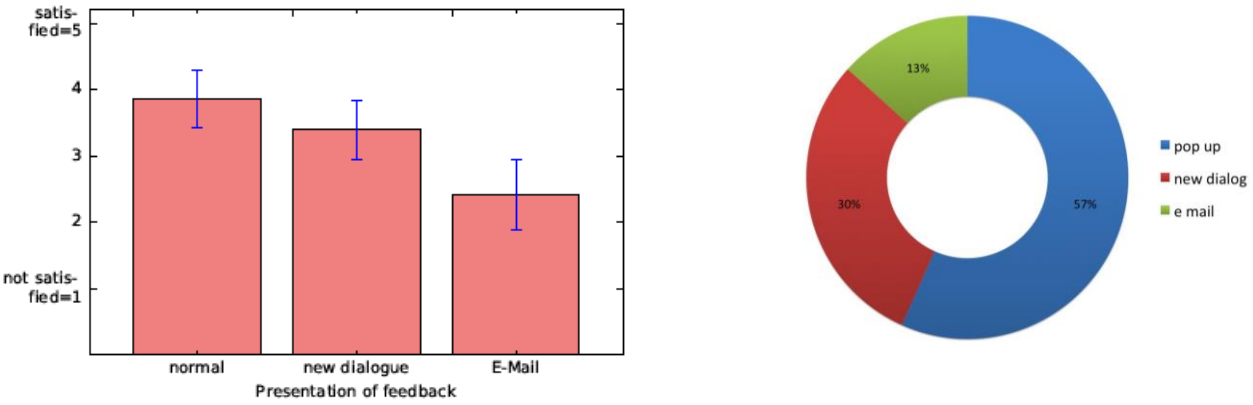


*Figure 18: Overview of Results for Response Format. Left: mean satisfaction ratings and 95% confidence intervals from the experimental part; 1 stands for “not satisfied” and 5 for “very satisfied”. Right: “Card Sorting”, distribution of top ranking of the test alternatives*

Subjects in favour of the new dialog mentioned they liked the fact that the tree is still visible on the screen, and people favouring the pop-up expressed a desire to see the planted tree in the pop-up version. Several participants experienced the e-mail version as too complicated. Furthermore, many study subjects criticized that it is necessary to leave the app to get the feedback when it is sent by e-mail. Also, it was noted that it is bad to get the feedback by e-mail because “one already

gets too many e-mails". The possibility to archive the tree suggestions and respective feedback in the mailbox was rated as beneficial by several participants, though.

### 4.3.6 Information Type

As Figure 19 suggests, symbols received significantly lower rating values than the other two alternatives. The comparison of rank values in the cardsorting trial resulted in a significantly higher preference for numbers for plain numbers than for symbols, the other pairwise comparisons were not significant.

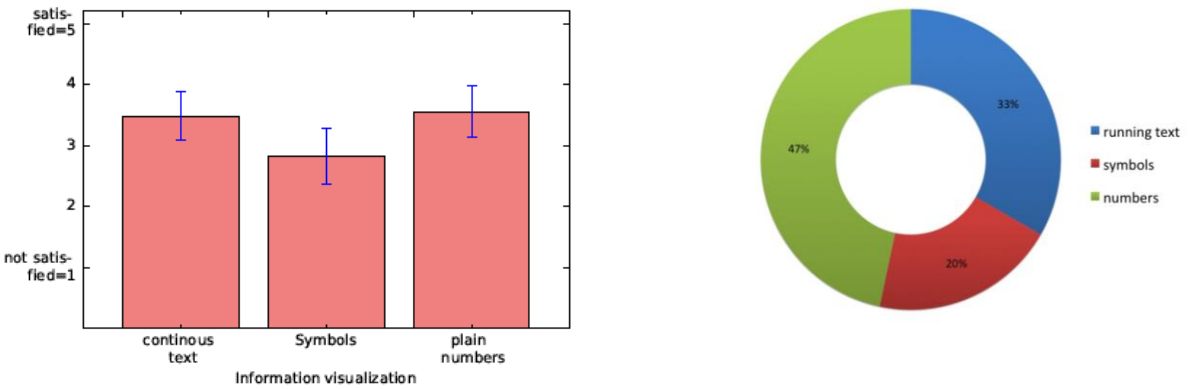


*Figure 19: Overview of Results for Information Type. Left: mean satisfaction ratings and 95-percent confidence intervals from the experimental part; 1 stands for "not satisfied" and 5 for "very satisfied". Right: "Card Sorting", distribution of top ranking of the test alternatives*

The test alternative with plain numbers was often qualified as clear, short and structured, and it was seen as simple and easy to understand. However, some subjects also mentioned that when information is presented by numbers alone relevant information is missing and that there is too much room for interpretation. It was mentioned that the symbol version makes it easy to understand the relations and to see the feedback information in context. The same comment was given with regard to the prototype in which information is presented using symbols because "one does not know what exact numbers the symbols depict". Thus, some persons suggested that a key or info button explaining the meaning of the symbols might be helpful. With regard to the floating text, positive comments included that they contained the largest amount of information, whereas critical comments were that they contained too much information and was confusing.

### 4.3.7 Anthropomorphism

Figure 20 shows that the personal answer by a "human" city agent was not appreciated by most participants. Mean ratings were significantly lower for this alternative than for the other two. The neutral, non-human-like attitude as well as the animated "little helper" did not differ significantly in the mean ratings. In the card sorting part, 14 participants (46.7 %) preferred the neutral version without a personal form of address, 13 subjects (43.3 %) preferred the prototype in which a little helper is depicted, and 3 persons preferred the personal form of address (personal form of appellation).

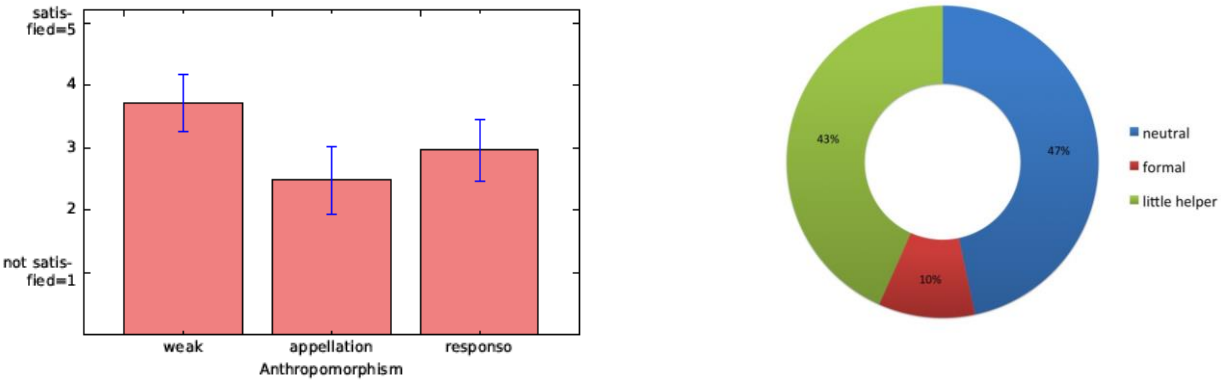


*Figure 20: Overview of Results for Anthropomorphism. Left: mean satisfaction ratings and 95% confidence intervals from the experimental part; 1 stands for "not satisfied" and 5 for "very satisfied". Right: "Card Sorting", distribution of top ranking of the test alternatives*

The neutrally worded feedback was described as objective, short and clear, and typically participants said that in this alternative the information content was comprehensive enough. The little helper was regarded as friendly, kind and casual, and people also emphasised the fun factor caused by it. Critical comments on the little helper were that it appeared childish and more suitable for a young target group.

Positive comments on the personal form of address were that people felt personally addressed. As a consequence, one participant said that this made him feel being taken seriously. Critical comments were that the personal form was implausible because "you know that the feedback is generated by a computer, not by a person". Also it was mentioned that this feedback version contained too much text being rather "like a letter", especially when making several suggestions for tree plantings and thus getting feedback several times. Additionally, also some participants criticized the high amount of official language in the personal form of address.

### 4.3.8 Data Source

Regarding the aspect "explanation of data source" there was no agreement in the study sample. In the card sorting task, 50 % (15) of the subjects preferred to be provided with the information on the data source, while 50 % (15) preferred the feedback in which the information is missing. Also the statistical comparison of the mean ratings in the experimental part did not reveal any significant differences between the two alternatives.

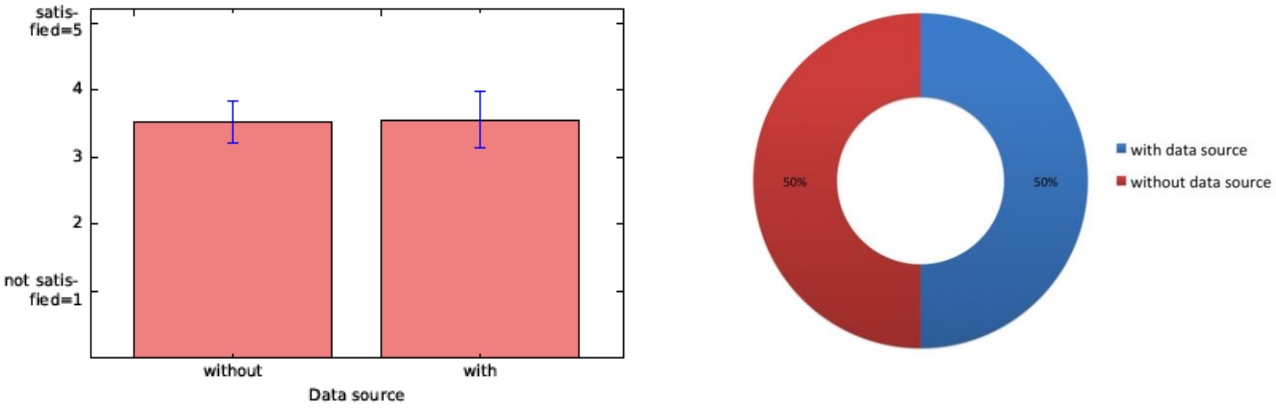


*Figure 21: Overview of Results for Data Source. Left: mean satisfaction ratings and 95% confidence intervals from the experimental part; 1 stands for "not satisfied" and 5 for "very satisfied". Right: "Card Sorting", distribution of top ranking of the test alternatives*

When participants rated the information on data sources positively, they said for example that "it is good to know where the data comes from". Study subjects who noted their trust in the government experienced the information on data source as important because "it underlines the official character". It was also mentioned that the information on data sources should be shown in a preceding step or additional information box as the same information is regarded as redundant when represented in several feedbacks.

### 4.3.9 Sender identity

Concerning the aspect "addressor specification" participants' preferences were quite balanced. In the card sorting trial, 50 % (15) of the subjects preferred to be provided with the information on the feedback addressor, while 46.7 % (14) chose the feedback in which this information is missing. Also here, the statistical comparison of the mean ratings in the experimental part did not reveal significant differences between the two alternatives.

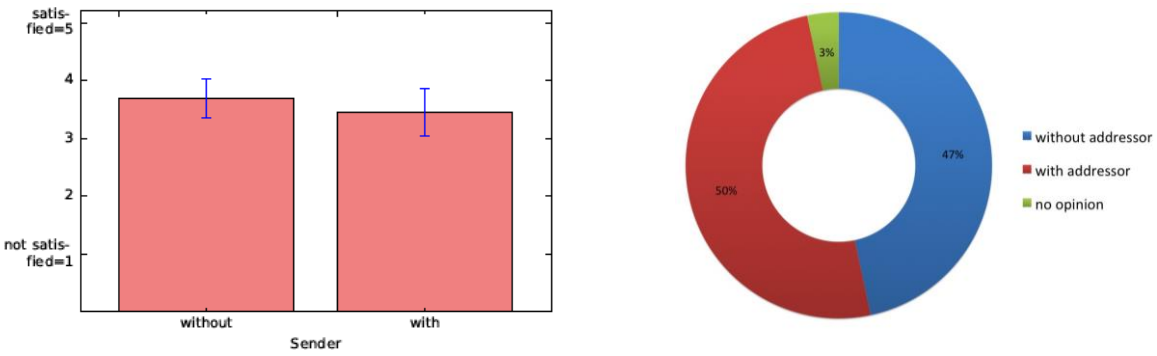


*Figure 22: Overview of Results for Sender Identity. Left: mean satisfaction ratings and 95-percent confidence intervals from the experimental part; 1 stands for "not satisfied" and 5 for "very satisfied". Right: "Card Sorting", distribution of top ranking of the test alternatives*

Critical comments related to the display of the sender identity were that the information was anyway expected to be provided by an official authority and that thus there was no need for "additional and detailed information". Also, information on the addressor was sometimes qualified as containing too much non-relevant information. With regard to the presentation style, some participants criticized that the bold type of the addressor specification caught too much attention. Moreover, it was suggested that it would be sufficient to provide that information in the site notice or an additional info box, rather than redundantly showing it in every feedback.

On the positive side, the specification of the feedback addressor increased the trust in the feedback information because it was felt to be provided by the government and thus mediated a higher experience of formality and seriousness. Also feedback on the addressor was regarded as relevant because "it is interesting to know the authority responsible or the reference person for further questions or concerns". To conclude, there was no agreement in the study sample with regard to the question whether the feedback addressor should be named.

# 5 Conclusions

This document presented the requirements for the front end dialog design within the project smarticipate. The first contribution of the document was an overview of the already existing knowledge on dialog design with regard to the general user requirements from T2.1. The principles presented in section 2 should be thoroughly considered within all stages of prototype design. The second contribution was, the developed study prototype, as it functioned as a first tested iteration of the dialog concept developed in T3.1. The third contribution was to deliver new knowledge related to the specific application context of automated feedback in citizen participation usage scenarios. The user study that has been presented in the previous section has been conducted in order to answer these open questions.

One of the core findings of the study is related to the aspect of **immediacy**: User satisfaction is decreased if longer waiting times are experienced. Our observation that already 10 seconds are regarded as a minimum quality threshold by the majority of users points to an important requirement that designers should seriously consider in the conception of future automated feedback features. The benefit of time savings compared to standard participation setups, where people often wait for days or weeks to receive feedback, obviously are overridden by expectations evoked by "fast" mobile apps and web services. Our further finding that longer waiting times can be compensated by displaying additional information about the feedback process confirms our hypothesis. We assume that expectations could be even better satisfied by using more advanced forms of progress feedback than the ones used in this experiment.

Additionally, our assumption related to **precision** was verified, i.e., precise information about costs of the submitted proposal should be communicated as often as possible. This implies even more demanding requirements on automated feedback technology for digital participation. However, our qualitative data also suggests that there remains a certain tolerance, i.e., some participants appreciated that authorities and companies are not always in the position to provide definite figures (e.g. due to liability concerns, insufficient data availability, etc.). Two of such alternatives to enhance "fuzziness" of information have been tested, but no clear preference between the price range and the probabilities could be found. We also discussed further suggestions with the test participants, such as using disclaimers like "ca.". Follow-up studies should seek to get more conclusive insight into the optimal trade-off between information precision and real-world feasibility in various contexts.

With regard to **implicitness**, we could also confirm our expectation, as the presentation of available options before the actual proposal submission led to higher user satisfaction than afterwards. Nevertheless, there was no significant difference between the two options "before

(hover)" and "before (always)", i.e., both implementation approaches could be used. Overall, participants rated the indication of available options as important.

Enabling **social awareness** is, not surprisingly, regarded as highly important for the design of automated feedback in participation systems. Parts of our data (the ranking results from the card sorting) showed: The community opinion should be provided before the proposal submission, rather than after the proposal submission.

With regard to the **response format**, the use of e-mail as a feedback medium triggered by app usage should be avoided, as intuitively expected. Pop-up windows should be regarded as a worthwhile response format, but they should not be implemented in abundance, due to the high efficiency demands that became evident.

From the study-part dealing with **anthropomorphism**, we also cannot deduct a clear cut recommendation. However, what should be avoided in any case is the “formal” address by city personnel. Taking reference to qualitative statements by the test persons, one should either experiment with neutral presentation forms without a personal form of address focusing on the feedback facts or the personal but casual form of address by a “little helper”.

The question which **information type** should be chosen could not be completely answered in our study. However, there are indications that the pure presentation of symbols should be avoided, whereas continuous text and plain numbers should be used in combination. Due to the unclear preferences of users on the issue of **data sources,** we suggest to provide detailed information about the data source in the additional description of the project and only if it is necessary and/or useful. Furthermore, our study results indicate that the **identity of the sender** should not be put too prominently into the foreground in the user interface, but rather into an additional description of the project.

If we consider the study results as how to reflect on a conceptual level how "a dialog with the city" should be realized, by means of automated feedback interfaces, two general statements could be made: First, in order to comply with the identified severe performance and precision requirements with the current technological state, tasks should probably not be much more complex than the tree planting application tested within this study. These should encompass well prepared use cases with detailed and purpose-structured data in the background, in order to deliver fast and precise results. Second, as a reaction to our findings regarding implicitness and social awareness, realizing a dialog with the city shall not be literally or idealistically envisioned as an interactive conversation, in the sense that users submit proposals, which are then iterated by citizen, systems and authorities. Rather, information should – at best – reduce interaction steps while still providing all relevant information. As we have found in our study, this is especially a challenge for mobile applications, where limited screen real estate may not allow for providing all necessary

rationale for decisions or constraints on the screen. Further studies are recommended to explore related design options in various usage contexts in the wide field of digital participation.

We would also like to highlight a few limitations: First, this user requirements document and especially the reported user study focused strongly on the citizen as the key user of automated feedback technology. The requirements for other groups, such as urban planners, were strongly considered in D2.1, and the involved representatives of this user group considered the end-user *citizens* as the most relevant group to consider. Second, all laboratory user studies face validity limitations, as they are not placed in reality. The chosen approach of context simulation by placing participants in front of a large wall with urban sceneries appeared to be successful in the sense that it could accommodate both for systematic comparison and realistic usage experience. Some of the key results are envisaged for publication in scientific human-computer interaction venues.

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