# Evaluation Results

## Deliverable 7.2

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|---|---|
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## Document versions:

| Version | Date | Changes | Author/s |
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| **1** | 2020-12-17 | First draft | Claudia Luger-Bazinger |
| **1.1** | 2021-01-13 | Changes after presenting results to project consortium | Claudia Luger-Bazinger |
| **2.0** | 2021-01-28 | Results of pilot 1 | Claudia Luger-Bazinger |
| **3.0** | 2021-06-15 | Results of pilot 2 | Claudia Luger-Bazinger |

## List of abbreviations

RSUS Regional Sustainability Services

# Table of contents

# Executive Summary

This deliverable shows results from the first pilot of the mobile application in the SimpliCITY project. In sum, the results show the following:

- **Habits and characteristics indicate a young**, but not necessarily a (bachelor) student **community that is already leaning heavily towards riding their bicycles**. This should be kept in mind when planning future activities (e.g., users are probably ready to use their bikes, activities should be also geared towards families with young children).
- Users found the **app to be fun and easy to use**.
- **Users made a number of suggestions** that the project team was able to incorporate.
- **More than five times of the targeted reach of RSUS are already involved**. There is a good mixture of RSUS, spanning a wide variety of topics.
- **Results show that the app has an effect on behaviour of users** (i.e., in 22 % of tracked bicycle kilometres, users indicated that they would otherwise have used the bus or car).
- **Using social comparison as nudging methods showed promising results**, however, effects are not entirely clear. **Taking into account context data (e.g., weather) could optimize the nudging methods**.
- Users found **the app to be motivating to learn more about sustainability in the city, to behave more sustainably** and for **contributing to sustainability in the city.**
- Users also reported that they found the **heartbeats as a rewarding and motivating feature of the app.**
- **Exploring the RSUS and using the mobility tracker are the most popular activities**. As a lot of RSUS are featured, the listing of RSUS should be rotated regularly (i.e., the order should not only be alphabetical). The mobility tracker should be also marketed towards user who don't use it already. In addition, users found that the **activities in the app contribute to sustainable behaviour**, especially the **RSUS list** and the **mobility tracker**.
- The app **is mostly used during the morning and afternoon**, and not a lot during the weekend. This should be considered when introducing new features or informing with notifications.

# Administrative Information

Basic information on the SimpliCITY project and the present deliverable:

| | |
|---|---|
| **Project title** | **SimpliCITY - Marketplace for user-centered sustainability services** |
| **Project coordinator** | Salzburg Research Forschungsgesellschaft mbH (SRFG), Salzburg, Austria; project manager |
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# Introduction

This evaluation plan is part of the WP7 “Evaluation and Smart City Learning” within SimpliCITY. The evaluation plan serves to outline, structure and define the evaluation of the project. It is the result of a thorough review of the existing literature to ensure the soundness of the evaluation and the consideration of existing experience in the fields of research on innovation and technology acceptance and behavioural studies, as well as regarding common practices when conducting surveys and designing questionnaires.

The objectives of WP7 “Evaluation and Smart City Learning” are:

- high-level quality development of SimpliCITY evaluation criteria and design in collaboration with the scientific partner as well as the SimpliCITY stakeholders
- establish a formative and summative evaluation process of pilots and community building
- establish a smart city learning network for follower cities and further interested cities/ smart city initiatives all across Europe in order to exchange know-how and experiences
- transform the analysis and interpretation of experiences from the pilots into coherent lessons learned and policy recommendation

The theory-based, user-centered approach of this evaluation plan will ensure that reliable measurements and indicators are used for the smart sustainable city development. The evaluation plan defines the necessary data basis and elaborates on needed instruments.

# Pilot Phases

*Pilots in Salzburg (with Stadtmacherei App)*:

- *Pilot 1*: Pilot 1 ran from July until end of September 2020. During this time, several elements in the app with different characteristics were offered (e.g., different tours). Some aspects of the evaluation will be formative in order see how improvements can be implemented. The formative evaluation includes:
    - “Usage, engagement and involvement” (Aspect 1)
    - Aspect 2 “Effects of Gamification”
    - Preliminary results from design evaluation on aspect 3 “Effects of SimpliCITY on sustainable behaviour”

Pilot 1 also included a design evaluation in July 2020 to get a first impression about the usability and the user experience of the app (focuses on all three aspects).

- *Pilot 2:* This phase started in April 2021 and lasted until May 2021. It focused on the nudging aspects of the evaluation.

The goal during this phase was to collect enough data in order for first impressions about the Stadtmacherei app, its users and community, and the effect of the app on sustainable behaviour. The results of pilot 1 serve to further structure the improvement of the app. In pilot 2, the effects of nudging are explored.

## Aspects of evaluation

The evaluation of the project SimpliCITY will focus on three different aspects. Some of the aspects will be analysed after pilot 1 in order to use the results for improvement of the ongoing project (therefore, having a *formative* character, mainly concerning aspect 1).

The aspects are:

1. **Users, engagement and involvement**
    - User characteristics, usage and engagement
    - User satisfaction and user needs
    - Involvement of RSUS

This aspect is concerned with how many users are engaging with the app, what the characteristics of the users are, as well as how they are engaging with the app and which RSUS are involved. This information is not only interesting for the as a measure for success of the app, for improving the app as well as for follower cities, it is also useful information for smart city managers and follower regions.

2. **Effects of gamification and nudging**

Gamification uses game design elements outside of games, for example, as rewards or challenges employed in an app. SimpliCITY utilizes several gamification elements in the app that reward users for activities. It is of interest of how user characteristics interact with these gamification elements. Nudging can be described as a strategy to change people’s behaviour without threat, forbidding or severe economic consequences. For SimpliCITY, social comparison (informing people what most other people do, ideally for a local comparison group and as specific as possible) and reminders (for a certain behaviour) will be evaluated in experimental conditions.

3. **Effects of SimpliCITY on sustainable behaviour**

    - Effects on awareness and knowledge
    - Behaviour changes

One aspect of evaluation should concentrate on the effect of SimpliCITY on sustainable behaviour. SimpliCITY focuses on bicycle mobility, local production and consumption and social inclusion. For these domains, effects on both awareness and knowledge as well as on changes in behaviour should be investigated. Awareness and specific knowledge can be seen as two ends of the same continuum (McCallum et al., 2005) whereas general awareness sits on the lower end of the continuum, and detailed and specific knowledge sit at the higher end of the continuum. For SimpliCITY, a change in behaviour will be assessed on self-report scales. In addition, the tracked activity (e.g., kilometers bicycled or walked) can be used for estimating an effect of the project SimpliCITY.

## Results of design evaluation

For an overall impression of usability, user experience and first impression of effects, a design evaluation was part of pilot 1. Users downloaded and tested the Stadtmacherei app for a month (July 2020). At the end of the testing, they answered an online questionnaire about their experience. The questionnaire included the topics of impressions about the app (aspect 1), behaviour change and perceived usefulness regarding sustainability (aspect 3), gamification (aspect 2) and a general feedback (aspect 1). Until specified otherwise, users indicated their agreement on a 7 point Likert-scale (from “strongly disagree” to “strongly agree”).

**31 users** (14 female, 15 male, 2 NA, mean age = 24.29) were part of the design evaluation, users were part of the University of Salzburg and received credits for their participation.

Some questions were concerned with whether users found the app easy to use and first impressions of the app (aspect 1).

> Nearly **two thirds of users** (65 %) agreed or somewhat agreed that the **app was easy to use**, **58 % agreed** or somewhat agreed that the **app was fun to use.**

A part of the questionnaire asked whether users thought that the Stadtmacherei app would foster sustainable behaviour (aspect 3).

Nearly **two third of users** (65 %) agreed or somewhat agreed that **the app was motivating to learn more about sustainable services** in Salzburg. **58 %** agreed or somewhat agreed that the app would **motivate them to behave more sustainably**, **58 %** agreed or somewhat agreed that the **app motivates them to participate** in making the city more sustainable.

Users were also asked about their impression which features of the app would contribute to encourage sustainable behaviour, namely, the *mobility tracker* (for bicycling), *taking tours of the city* and *the list of RSUS in the app.*

**84 %** of users **agreed or somewhat agreed** that **the list of RSUS would strongly contribute to sustainable behaviour**, **71 %** agreed or somewhat agreed to the same statement regarding the **mobility tracker**, **61 %** agreed or somewhat agreed to this regarding the **tours.**

Users were asked whether they found elements of the app motivating.

**84 %** stated that they found the **heartbeats motivating to progress and get better**.

Overall, the design evaluation showed very positive results. Users seemed to enjoy the app, the gamification seemed to be motivating and the app also had its intended effects on sustainability in the city of Salzburg. Therefore, in a first step, a first impression showed promising results for all three aspects of evaluation.

# Results of Pilot 1

## Users, engagement and involvement

### User characteristics, usage and engagement

It is of interest **how many users are engaging with the app**, what the **characteristics of the users** are, as well as **how they are engaging with the app**. This information is not only interesting as a measure for success of the app and for improving the app, it also serves as useful information for follower cities. This aspect will already be analysed after pilot 1, and constitutes a *formative aspect of the evaluation*.

The *number of overall users* is one of the goals of SimpliCITY, but more factors such as characteristics of users as well as acquisition of new users are of interest to learn more about the users to further progress the app, for follower cities and to understand future analyses better.

### *Users of Stadtmacherei App - Characteristics*

**587 users** were using the Stadtmacherei app during pilot 1.

### *Gender & Age*

Users are **mostly women** (59.5 % females, 38.6 % male, 1.9 % inter / diverse; response rate: 80.7 %), with **over half of users** between **26 and 45 years old** (see Figure 1).

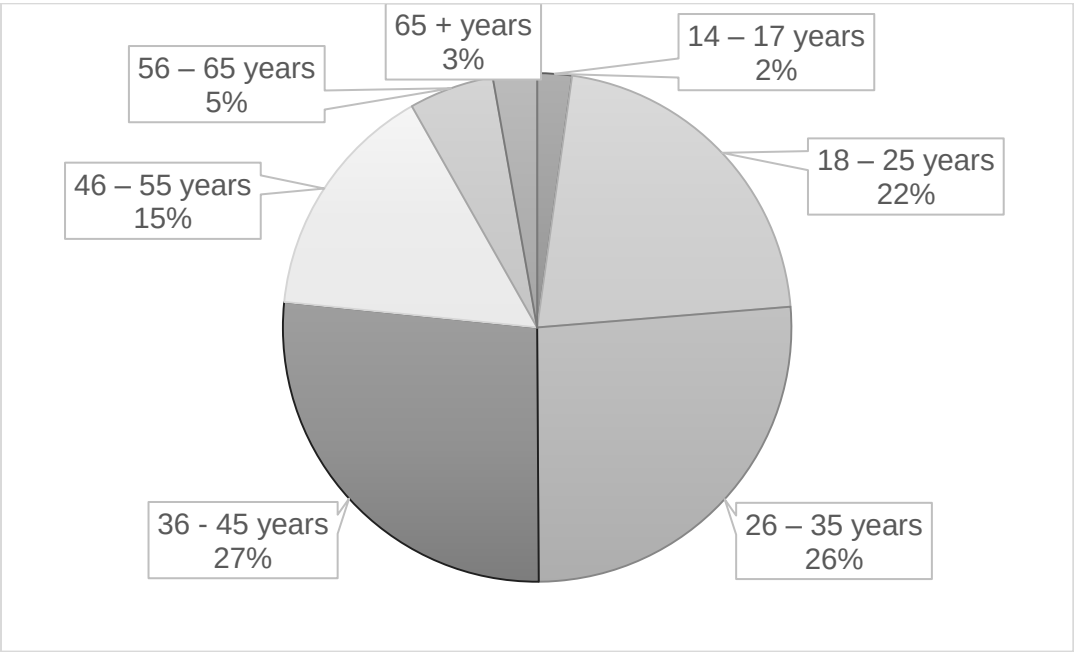



**Figure 1.** Age groups (from user profile, response rate: 79.2 %)

### *Context information about users*

Information about users was collected from the user profile in the Stadtmacherei App, where users have the option to provide information about themselves; however, providing this information was not mandatory. *Considering that providing this information was optional, response rate are satisfactory.*

Almost **two thirds of users ride their bicycle at least 2 – 3 times** per week (see Figure 2). No significant differences between men and women were observed in bicycle mobility behaviour. **Three quarters of users report that they shop in local shops at least 2 – 3 times per week or even daily** (see Figure 3). While this indicates in general an audience that is already aware of sustainability issues, there are also more than a third of users who

ride their bicycle only a multiple times a month or never, a quarter of users does not shop locally more than a couple times per month. **This shows that the app is not only 'preaching to the choir'**, but reaching a broader group of citizens.

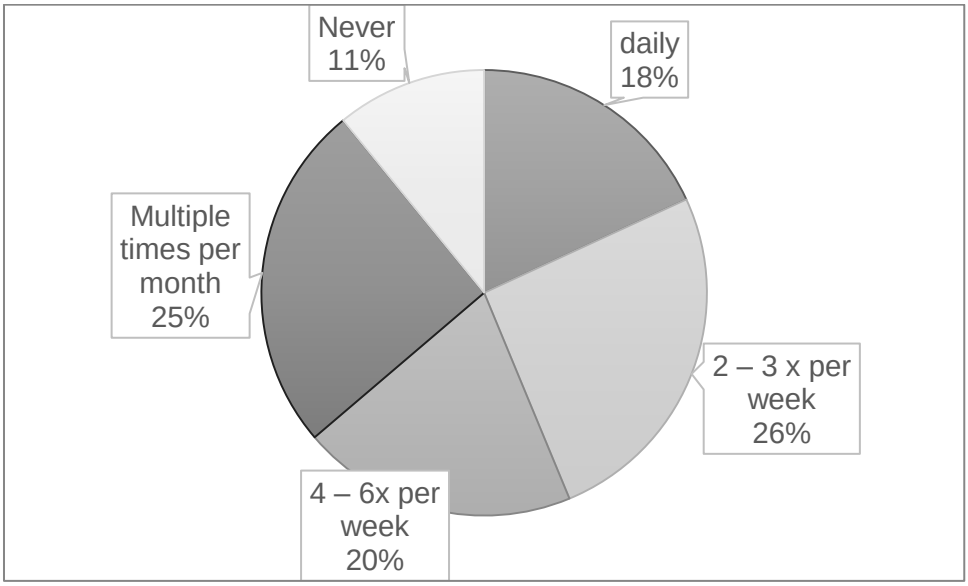



**Figure 2.** Habits of users: *How often do you ride your bicycle?* (in %) (from user profile, 63.9 % response rate)

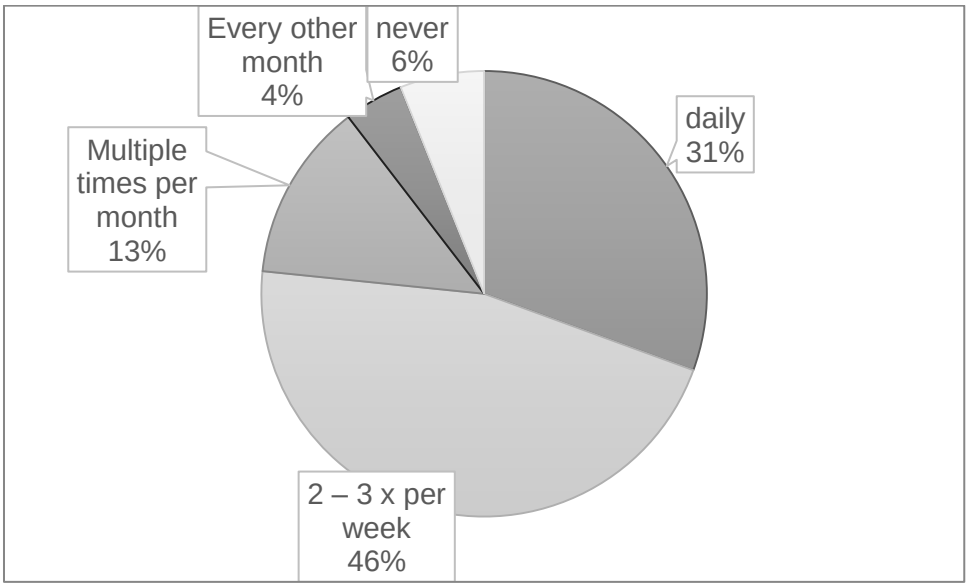



**Figure 3.** Habits of our users**:** *How often do you shop locally (not in the supermarket)?* (in %) (from user profile, 55.5 % response rate)

Users indicate which district they live in and then collect heartbeats (i.e. gamification elements that are rewarded for activity in the app) for this district. Table 1 shows were users in the Stadtmacherei app come from.

Results shows that **users from all over the city were involved in the app.**

**Table 1.** Districs in Stadtmacherei App *(in % of users, reponse rate 66.3 %).*

| **Distric** | **%** |
|---|---|
| Aigen | 10,5% |
| Altstadt | 2,3% |
| Elisabeth-Vorstadt | 1,5% |
| Gneis | 10,0% |
| Gnigl | 4,1% |
| Hellbrunn | 2,8% |
| Itzling | 3,9% |
| Kasern | 4,9% |
| Langwied | 8,7% |
| Lehen | 7,2% |
| Leopoldskroner Moos | 1,5% |
| Liefering (inkl. Forellenweg) | 1,0% |
| Maxglan | 5,7% |
| Morzg | 1,3% |
| Mülln | 4,1% |
| Nonntal | 6,4% |
| Parsch | 8,5% |
| Riedenburg | 5,9% |
| Salzburg Süd | 6,7% |
| Schallmoos | 2,6% |
| Taxham | 0,3% |

### *Acquisition of new users*

**90 % of users joined in September**, 10 % in August. As marketing strategies were concentrated in September, this shows that these strategies drew users towards the Stadtmacherei community.

### *Activities in app*

The main activities for users in the Stadtmacherei App are *using the mobility tracker* (for bicycling), *taking tours of the city and the districts* which include points of interest and involve quizzes and *presenting regional and sustainable RSUS* that can be explored by users (virtual in service list or as point of interest that can be visited).

For the mobility tracker, users can use this feature when they are taking a ride on their bicycle. After they finished their ride, users can indicate whether they would usually have taken their car or the bus for this trip. This allows an estimation of the effect of the app on mobility behaviour.

> In sum, users of the Stadtmacherei **bicycled 1493 km**. Men bicycled on average 28 km, women bicycled on average 21 km, however, this was not a significant difference ($t(57) = -0.53$, $p = .60$).

For pilot 1, **5 different tours were offered**. Two were district tours, one was a virtual tour, two were tours for special topics (one concerned the Smart City Salzburg, one was curated by a popular local website “Fräulein Flora”, targeted at a younger audience). All tours featured local, sustainable and inclusive content.

> Users **enjoyed the tours** with a mean rating of the tour of 3.22 on a Likert scale from 1 – 4 (4 being the highest rating).

The most popular tour was the “Fräulein Flora” tour with a mean rating of 3.75, which can probably attributed to the popular curator of this tour.

**18 points of interest were discovered by users** (i.e., users were located at a specific point of interest that was currently featured). The POIs covered the topics bike mobility, recycling, social projects.

> When comparing what **activity users engage in most often**, the most frequent use of the app consists of **exploring the RSUS list** (47 %), followed by using the **mobility tracker** (26%) and **tours** (22 %).

## Frequency of Use

Results show that the app was **mostly used in the morning** (47 % of use happened between 06:00 – 13:00), the most common day of usage was **Thursday** (17 %), followed by **Tuesday and Friday** (each around 16 %). Saturday and Sunday were the days were the app was less frequently used (each 10 %).

The *mobility tracker was most commonly used in the morning* (47 %) followed by afternoon (41 %, between 13:00 - 20:00). The most common *day for using the mobility tracker* was *Thursday* (20 %). For tours, these were made mostly during the morning (46 %), the most common day for tours was Tuesday (22 %).

## User satisfaction and user needs

For further engagement with the app, it is important to address the **level of satisfaction with the app**. This can be done *indirectly* (by using data indicating how users interacted with the app, i.e., kilometres bicycled), but this question can also be assessed *directly* by giving users the opportunity to comment on what they would like to see on the app (e.g., new service listings, ideas for new tours etc.). This aspect focuses on the app itself as well as the webportal (e.g., what service providers are missing etc.) This information is interesting for the project team for improving the app as well as for follower cities.

Users had the opportunity to give feedback directly in the app. **8 suggestions were made by users** (see Table 2) **and the integrated into the app and the community.**

**Table 2.** User Feedback and suggestion.

| **User Feedback** | **Resulting Action** |
|---|---|
| Suggestion to integrate fairtrade shops and „Weltläden“ | New fairtrade shops included in RSUS |
| Suggestion to improve description of non-profit youth organization in app | Description was updated |
| Suggestions to cooperate with local student organization | Cooperation was planned |

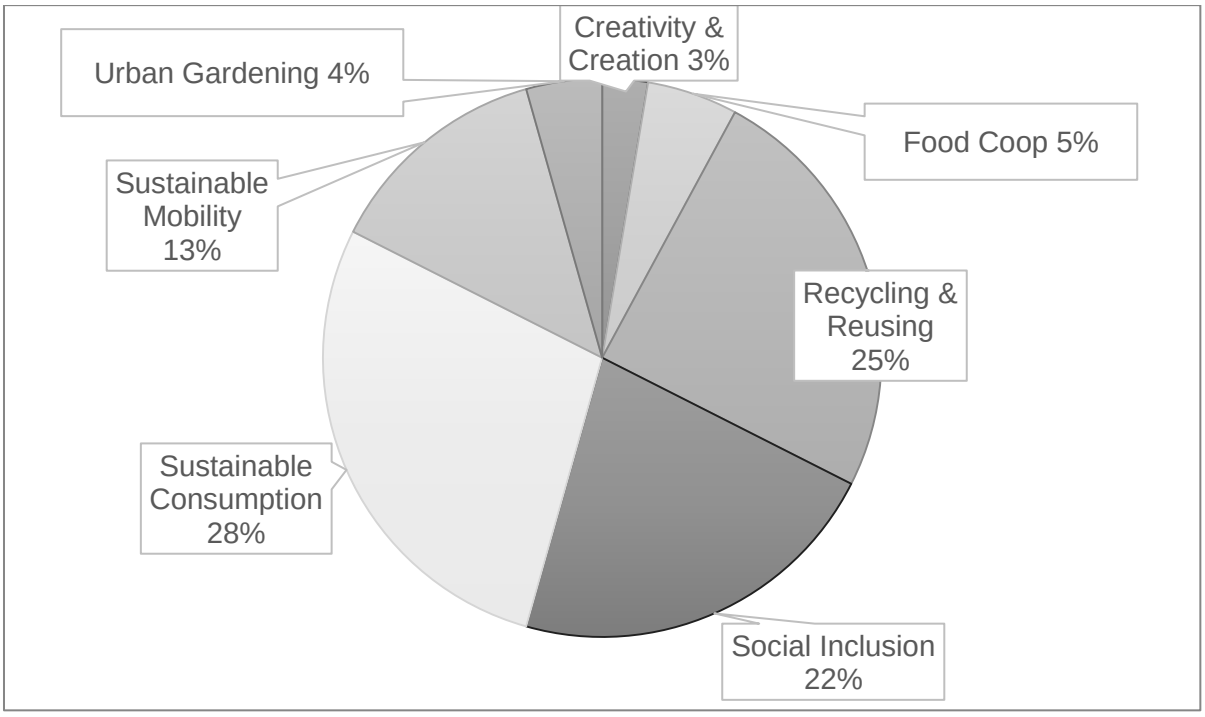
| | |
|---|---|
| Suggestion to include new RSUS (non-profit social organization) | RSUS was included |
| Suggestion to include new RSUS (local theater) | RSUS was included |
| Suggestion to include new RSUS (local repair café) | RSUS was included |
| Suggestion to include new RSUS (local food coop) | RSUS was included |
| Suggestion to include new RSUS (miniature public library in phone box) | RSUS was included |

## Involvement of RSUS

**114 different RSUS** were involved in pilot 1. These RSUS could be clustered into **7 different categories** (see Figure 4). **This number of involved RSUS is more than five times of the goal reach of SimpliCITY.**

The RSUS are in a service list integrated in the app. The most commonly explored services were about recycling & reusing (6 % of clicks), a social inclusion project (3 %) and an organic supermarket (3 %).

**Figure 4.** Categories of RSUS involved in pilot 1.




## Effects of gamification

Gamification uses game design elements outside of games, for example, as rewards or challenges employed in an app. Gamification has been successfully used to keep citizens engaged in other smart city initiatives (Kazhamiakin, 2016). Gamification used in apps should motivate the users to users to engage more often with app and to further lead to specific behaviors or behavior changes (Engel, 2017; Hamari et al., 2014).

For SimpliCITY, users are rewarded with heartbeats for bicycling, for taking part in tours, for discovering points of interest and for solving quizzes during the tours.

It is of interest *how many heartbeats* (i.e., gamified elements as rewards for activies) are collected by the users of the app and *how this related to user characteristics*. Relating to users, *it is of interest of how user characteristics relate to interaction with gamification elements*, e.g., how many kilometres men or women are bicycling, as it is likely that factors like gender or age influence the effect of gamification on engagement and behaviour (Kovisto & Hamari, 2014). As this also plays an important rule in exploring user characteristics and activites, it is closely related to the first aspect in the evaluation, *but provides a more holistic view of the app and its gamification elements*, while the first aspect is more concerned with particular activities only, like bicycling.

In sum, **users collected 1969 heartbeats**. **Men collected 1045 heartbeats in sum, women collected 900**, but no significant difference between the mean collected heartbeats was found (t (312) = -0.99, p = .32).

## Behaviour change

Behavior change is influenced by various factors. Ajzen's (1991) theory of planned behavior proposes that behavior is influenced by the attitudes toward the behavior, subjective norms as well as the perceived behavior control (i.e., people's perceived ability to perform a certain behavior) that lead to an intention and then to an actual behavior. The theory of planned behavior is commonly used in research around pro-environmental behavior (Macovei, 2015). The effectiveness of an intervention (in this case, participation in the SimpliCITY project) can only be evaluated if the desired target behavior can be measured validly. For SimpliCITY, we can rely on self-reported behavior as well as measured behavior (i.e., tracked activity).

For the *tracked activity* (i.e., kilometres biked or walked), it is an interesting outcome to see how much activity the participants generate. For estimating an effect of the project SimpliCITY, however, some kind of comparison needs to be made. For pilot 1, the comparison to a self-reported estimate of alternative behavior is made (e.g., asking participants whether they would have usually used their car or public transport when tracking their bike activity). For the mobility tracker, users can use this feature when they are taking a ride on their bicycle. After they finished their ride, users can indicate whether they would usually have taken their car or the bus for this trip. This allows an estimation of the effect of the app on mobility behaviour.

For **117 km bicycled**, users indicated that **they would have usually taken the bus**. For **207 km bicycled**, users indicated **they would have usually taken the car**. This means, that of 1493 km bicycled overall, **22 % would have been otherwise covered by car or public transport, giving an example of the effect of SimpliCITY on behaviour.**

# Results of Pilot 2

## Effects of Nudging

Nudging can be described as a strategy to change people's behaviour without threat, forbidding or severe economic consequences — while nudging uses interventions that are cheap and also easy to avoid, it seeks to alter the way choices and the related environments are presented (see Ly & Soman, 2013; Thaler & Sunstein, 2008). One way to nudge people

is to make use of social comparison theory (Festinger, 1954): This proposes a general human tendency to evaluate opinions and abilities (and further, behaviour) by comparing them to that of other people. This tendency has been also used to promote behaviour change: A meta-analysis (Abrahamse & Steg, 2013) showed that social influences can be beneficial in promoting individual changes towards more sustainable behaviour. For nudging, following social comparison theory, one way to influence people's behaviour is to provide them with some information that their relevant social group is displaying a particular behaviour already. In SimpliCITY, this relevant social group can be the community within the app. We tested nudging within pilot 2, with around 358 users within the app, in the months of April and May 2021.

### Method

For using social comparison in order to nudge people for more bicycling behaviour, over a period of two weeks, users were sent six notifications within the app. Each notifications focused on the comparison of bicycling behaviour with others users in the community (e.g., "Your neighbors are leaving you behind on their bicycles! Catch up and use the mobility tracker today!", see below in the results sections for all notifications).

### Results

Notifications were sent over two weeks, with equal days between notifications. For the analyses, firstly, click-through rates were analysed (see below). Click-through rates refers to a news page that users are led to once they click on the notification on their mobile phone. It seems that the interest was spiked with the first notification, but click-through rates were lower for subsequent notifications. However, this does not mean that notifications were not seen, as notifications were still displayed on the users mobile phones, it just means that fewer users clicked the notification to read the related news page.

| **Notification** | **Click-Through Rate** |
|---|---|
| Did you know that your neighbors are bicycling a lot? Use the mobility tracker today as well! | 12.5 % |
| Your neighbors are leaving you behind on their bicycles! Catch up and use the mobility tracker today! | 9.15 % |
| The community is collecting kilometers and heartbeats! Come along and use the mobility tracker. | 9.69 % |
| Did you use your bicycle today already? Your district is on the bicycle today, come along and use the mobility tracker. | 5.78 % |
| Collect heartbeats for your district on your bicycle! Use the mobility tracker today. | 6.16 % |
| Your neighbors are using the mobility tracker, come along and bicycle through the city. | 6.03 % |

Regarding the effects of nudging, as a randomization of the notifications was not an option due to technical reasons, we looked at the kilometres bicycled before, during and after the

nudging notifications were sent. As the notifications were sent over a two week period, we defined a two week time frame before the notifications and a two week time frame after the last notification as the before and after conditions.

> In the two weeks before the notifications**, users bicycled 469.3 kilometers**. During the notifications, **users bicycled 600.8 kilometers**, which seems to indicate an effect of the nudging notifications.

However, in the two weeks after the notifications, users bicycled 652.7 kms. It is unclear whether this was still a result of nudging or due to other factors, as the long-term effects of nudging are unknown (Marteau et al., 2011).

Weather data could play a factor, as the time frame before the notifications was a little colder on average (5.6° Celsius, 27.1 mm of rainfall) than the time frame during the notifications (12.1° Celsius, 11.6 mm). The time frame after the notifications was the warmest, but had the most rainfall (12.4 ° Celsius, 62.6 mm) (see https://meteostat.net/de/station/11150?t=2021-04-22/2021-05-03 for historic weather data for Salzburg). However, if the warmer weather played a role, it is not due to more users bicycling, as even less people (105 users) made use of the mobility tracker after the nudging notifications compared to the two weeks during the notifications (115) (before the notifications, 87 users were using the mobility tracker). In sum, there is some support that nudging was successful, but more context factors have to be taken into account. A combination of context data and nudging could be the most successful.

## Conclusion

Based on the results from this evaluation, the project team was able to discuss and plan the following points:

- **Habits and characteristics indicate a young**, but not necessarily a (bachelor) student **community that is already leaning heavily towards riding their bicycles**. This should be kept in mind when planning future activities (e.g., users are probably ready to use their bikes, activities should be also geared towards families with young children).
- Users found the **app to be fun and easy to use**.
- **Users made a number of suggestions** that the project team was able to incorporate.

- **More than five times of the targeted reach of RSUS are already involved**. There is a good mixture of RSUS, spanning a wide variety of topics.
- **Results show that the app has an effect on behaviour of users** (i.e., in 22 % of tracked bicycle kilometres, users indicated that they would otherwise have used the bus or car).
- **Using social comparison as nudging methods showed promising results**, however, effects are not entirely clear. **Taking into account context data (e.g., weather) could optimize the nudging methods**.
- Users found **the app to be motivating to learn more about sustainability in the city, to behave more sustainably** and for **contributing to sustainability in the city.**
- Users also reported that they found the **heartbeats as a rewarding and motivating feature of the app.**
- **Exploring the RSUS and using the mobility tracker are the most popular activities**. As a lot of RSUS are featured, the listing of RSUS should be rotated regularly (i.e., the order should not only be alphabetical). The mobility tracker should be also marketed towards user who don't use it already. In addition, users found that the **activities in the app contribute to sustainable behaviour**, especially the **RSUS list** and the **mobility tracker**.
- The app **is mostly used during the morning and afternoon**, and not a lot during the weekend. This should be considered when introducing new features or informing with notifications.

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