Evaluation Plan

Deliverable 7.1

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List of abbreviations

RSUS Regional Sustainability Services

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1. Executive Summary

This evaluation plan serves to outline, structure and define the evaluation of the project SimpliCITY as proposed in WP 7. The theory-based approach will ensure that reliable measurements and indicators are used for the smart sustainable city development. The evaluation will include both formative as well as summative elements, in order to ensure a successful progression throughout the project, as well as a reliable conclusion about SimpliCITY and a strong, data-driven approach to the lessons learned.

The evaluation of the project SimpliCITY will focus on three different aspects:

Users, engagement and involvement

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 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.

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) will be evaluated in experimental conditions.

Effects of SimpliCITY on sustainable behaviour

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 could 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. The *tracked activity* (e.g., kilometers bicycled or walked) as well as self-reported questionnaires can be used for estimating an effect of the project SimpliCITY.

2. 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
Project partners	Polycular OG, Hallein, Austria Stadt Salzburg (City of Salzburg), Austria Salzburger Institut für Raumordnung und Wohnen – SIR (Salzburg Institute for Regional Planning & Housing), Salzburg, Austria Uppsala Kommun (City of Uppsala), Sweden University of Uppsala, Sweden
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3. Introduction to the evaluation plan

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.

3.1. Phases of the evaluation

The evaluation will involve two pilots for both Salzburg and Uppsala.

Pilots in Salzburg (with Stadtmacherei App):

- *Pilot 1*: Pilot 1 will run from from July until September 2020. During this time, several elements in the app with different characteristics will be offered (e.g., different tours). Some aspects of the evaluation will be formative in order see how improvements can be implemented. The formative evaluation will include (see 4.2. Aspects of evaluation for a description of the aspects):
    - "Usage, engagement and involvement" (aspect 1)
    - Aspect 2 "Effects of Gamification"
    - Results from design evaluation on aspect 3 "Effects of SimpliCITY on sustainable behaviour"

Pilot 1 will also include 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 starts in April 2021 and lasts until middle of May 2021.
    - *Aspect 2:* Effects of nudging

The following evaluation plan serves as an overall guideline. The content of the actual evaluation is dependent on the availability of data, but the analyses will adhere to the plan as closely as possible.

4. Areas and aspects of evaluation

4.1 Areas of evaluation
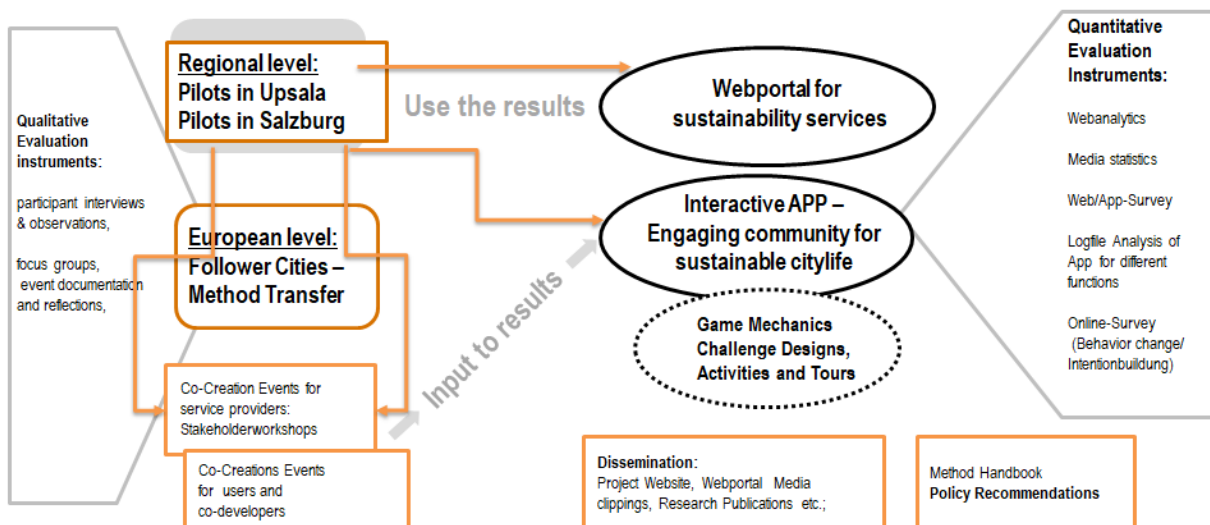

Figure 1. Areas of evaluation

For the evaluation plan, we focus on results that the project achieves and whether the project was able to reach its goals with these results. For this, we focus on two areas for evaluation (see right side of Figure 1). These are:
- the *webportal* for sustainability services (www.stadtmacherei.at)
    - with the involved RSUS
- an interactive *app*

- with an *engaged community* and
- with effective *game mechanics*, *challenge designs*, *activities* and *tours*.

Most of the evaluation will focus on the app, as success of the project and results can be most directly shown here, but other aspects will also focus on the webportal and the involved RSUS. While the evaluation of the app might seem technical, even this area is always seen through the lense of community - engaged users that are having an ongoing, satisfying experience with the app and the services on the webportal.

4.2. Aspects of evaluation

The evaluation of the project SimpliCITY will focus on three different aspects. Some of the aspects will be used to improved the ongoing project (therefore, having a *formative* character, mainly concerning aspect 1). Nudging will be explored in pilot 2.

The aspects are:

1. **Users, engagement and involvement**
   - User characteristics, usage and engagement
   - User satisfaction and user needs
   - Involvement of RSUS
2. **Effects of gamification and nudging**
3. **Effects of SimpliCITY on sustainable behaviour**
   - Effects on awareness and knowledge
   - Behaviour changes

In the following, the aspects and their motivation are described in detail.

4.2.1 Users, engagement and involvement

4.2.1.1. 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 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.

Number of total users, characteristics of users and characteristics of new users will be operationalized by:

- Total users: Number of users
- Monthly new users
- Characteristics of users
  - Gender, age, district, habits regarding shopping and mobility: information collected during user profile questionnaire.

An overview of the operationalization can be found in Table 1.

Further, it is also of interest *how the users engage* with the app, i.e., their amount of activities (e.g., how many kilometres they bicycled), *and how often* the users engage with the app (e.g., daily, on weekends).

Engagement of users with the app will be operationalized by:

- Frequency of usage
  - for all users (and various subgroups), and
- Amount of activities within the app
  - for all users (and various subgroups)

Table 1. Operationalization for Total usage and engagement.

What	Why	How	When	Area
Overall users of the app	Goal reach of SimpliCITY	Number of users	Ongoing data collection	App

Characteristics of users (socio-demographic, habits)	Information for follower cities, differentiation into subgroups (for analyses and experimental conditions)	Information gathered during user profile questionnaire	Ongoing data collection	App
Monthly number of new users	evaluating marketing strategies (e.g., print), identifying seasonal changes	Number of new users per month	Ongoing data collection	App
Frequency of app use	establishing patterns for further development of the app	Frequency of usage depending on time of the week	Ongoing data collection	App
Amount of activities within the app	Success of the app, satisfaction with the app	Number of activities (e.g., kilometres bicycled, taking part in tours)	Ongoing data collection	App

4.2.1.2. 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 asking users what they would like to see on the app (e.g., new service listings, ideas for new tours etc.) and what their **needs** are. 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. *This aspect will be analysed during the evaluation as a formative aspect.*

User satisfaction and user needs will be operationalized by:

- Option to give feedback in the app directly

An overview of the operationalization can be found in Table 2.

Table 2. Operationalization of User satisfaction and user needs.

What	Why	How	When	Area
Satisfaction with the app, needs and wishes of users	indicator for success of SimpliCITY; improving the app; identifying weaknesses	Feedback option in the app	Feedback available all the time	App / webportal

4.2.1.3. Involvement of RSUS

It is of interest how many regional sustainability services are part of the webportal and the community, and whether users would like to involve other or additional RSUS as part of a co-creation process (see Table 3 for operationalization).

Table 3. Operationalization of Involvement of RSUS.

What	Why	How	When	Area
How many and which RSUS are involved	indicator for success of SimpliCITY, possibility of co-creation with users	Overview of service list	End of pilot 1	Webportal

4.2.2. Effects of gamification and nudging

SimpliCITY operates with effects of gamification and nudging in order to engage citizens in sustainable behaviour. Gamification is used for more user engagement within the app (and further, more sustainable behaviour), while nudging is used for promoting sustainable behaviour.

4.2.2.1. 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 behaviours or behaviour changes (Engel, 2017; Hamari et al., 2014).

For SimpliCITY, users are rewarded with heartbeats for bicycling and for taking part in tours. The effectiveness of these gamification elements can be evaluated within the SimpliCITY community. This information is relevant for the project team for further improvement of the app as well as for follower cities.

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*, 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.

Different tours are offered within the appp (i.e., a selected group of POI in a district that users visit with a set of clues), therefore, it is of interest how interesting these tours are to users. For tours, there is the possibility to r*ate tours after completing* them. This offers additional information about characteristics of popular and less popular tours. An overview of the operationalization is given in Table 4.

Table 4. Operationalization of Effects of gamifications

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What	Why	How	When	Area
rating of the tour	Information about which characteristics of tours are popular	rating system after tour and comparison of all available tours	Ongoing data collection	App
User characteristics and gamification elements	General amount of gamified elements collected, relation to user characteristics	Reporting amount of heartbeats for all users and for subgroups	Ongoing data collection	App

4.2.2.2. 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).

There are a number of nudges available (see Sunstein, 2014), for SimpliCITY, the effect of social comparison will be investigated. (i.e., informing people what most other people do, ideally for a local comparison group and as specific as possible).

Experimental variation of nudges (i.e., some users get feedback with social comparison while other users don't) should ideally reveal not only a difference in the engagement with the app, but also should show a difference in sustainable behaviour (see 4.2.3. Effects of SimpliCITY on sustainable behaviour). One drawback of nudges is that it is not clear whether they lead to a long-term behaviour change (Marteau et al., 2011) and whether a possible long-term effect holds true for all the different nudging methods. While a long-term effect was demonstrated for a default option as nudging method (Venema, Kroese, & De Ridder, 2018), this might not translate to e.g., social comparison as nudging method. As the default option is always present and therefore might form a strong habit, a single intervention could lead to only a short spike in behaviour change. This will be investigated in the ongoing project.

This aspect is of interest for the project team for better learning how to use nudging within the app, as well as for smart city managers in order to learn about fostering sustainable behaviour within the community. While the goal of nudging here is also a behaviour change,

which will be covered in aspect 3 (see 4.2.3. Effects of SimpliCITY on sustainable behaviour), the set-up of the operationalization is different as the evaluation of nudging follows an experimental design. Therefore, it is mentioned as a separate aspect in the evaluation.

Social Comparison

Social comparison theory (Festinger, 1954) 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. For example, a statement that most people in the neighbourhood pay their electricity bill on time helps to improve timeliness of payments (see Nudge Lebanon, 2019). In addition, social comparison theory also states that our tendency to compare ourselves to others seems to become weaker as the other person's opinion or ability becomes more divergent from our own (Festinger, 1954). Similarly, the effect of using social comparison as a nudge seems to be stronger if there is a strong identification with the specific reference group (Doran, Hanss & Øgaard, 2017). One caveat of nudging via social comparison is that if people get presented with the information that other people are doing less than oneself (e.g., that other people are conserving less water in the household), the effect of the nudge turns around (i.e., people tend to relax in their efforts) (Doran, Hanss & Øgaard, 2017). Still, social comparison is one nudge that can be implemented with relative ease and with promising outcomes. The relevant group that the social comparison refers to is of interest and seems to be an essential element of the effect of the nudge.

In the app, a user assigns himself to a specific district that he lives in (and further, that he collects various gamified elements for). The relevant group can be therefore the specific district a user lives in. This identification with the relevant group is also fostered by district tours that are offered in the app (e.g., the user can explore all the district has to offer), and certain challenges that promote competition between districts (e.g., a challenge about which district can ride more kilometers on the bicycle). Therefore, district identity (i.e., neighbourhood) seems to be a relevant group within the SimpliCITY community. In order to foster sustainable behaviour, a nudge based on social comparison should indicate that other participants are already showing more of the relevant behaviour (e.g., most of the other SimpliCITY users do X already).

For evaluating the effectiveness of social comparison nudge in this research project, it is planned to send a sample of the users a notification within the app that most of their neighbours are already showing more of a certain intended behaviour (e.g., that they bicycled more kilometers within a week: "85 % of your neighbours in your district biked more than you last week!") (see also Klieber et al., 2020). This notification could also be personalized based on previous information the user provided or on behaviour he or she showed. The sample of users would be randomized (and analyses would be controlled for gender and age). It is expected that users that receive a notification should show more of the intended behaviour than users who do not receive a notification. In addition, it is expected that for users who have previously been more active for their district (i.e., who have a stronger identification with the reference group), the nudge should show an even stronger effect. The nudge can be sent multiple times, a simplified model of the experiment with simulated results can be found in Figure 2. Here, after a few weeks of using the app (and therefore, becoming more identified with a district), users in the control group receive a notification in week 3.
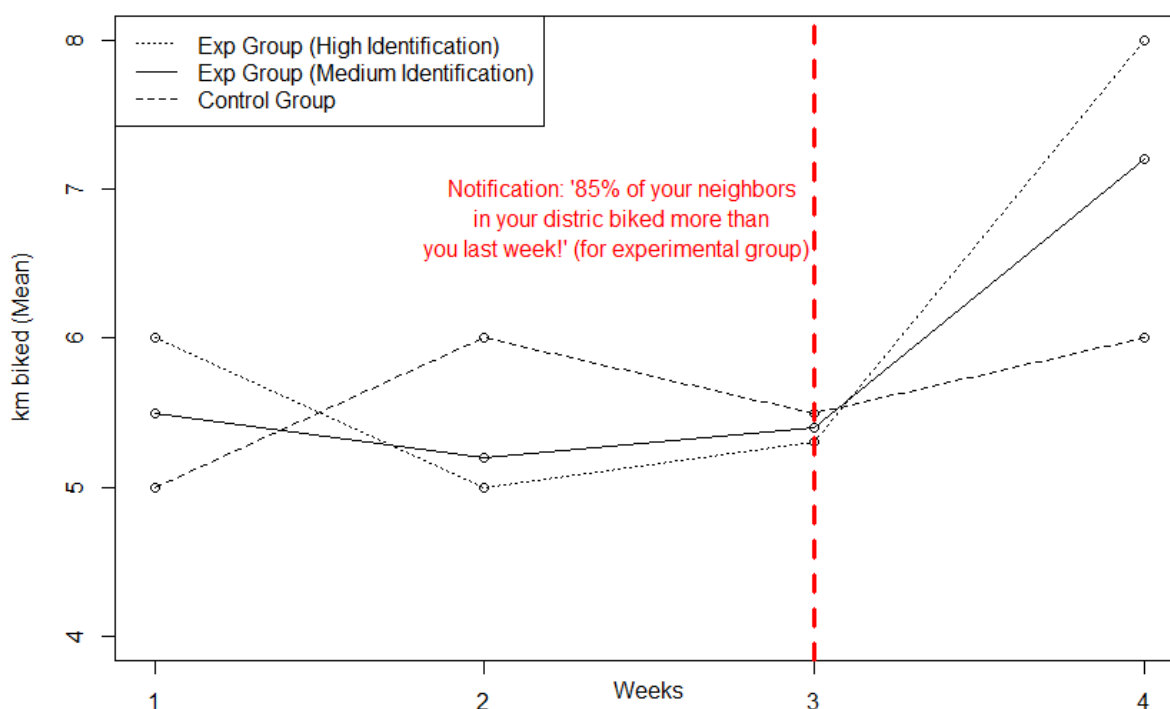

Figure 2. Experimental design and simulated results for social comparison nudge.

Users in the experimental group would receive a notification in week 3 ("85% of your neighbours in your district biked more than you last week"), users in the control group would receive no notification. It is expected that users in the experimental group would bicycle more following the nudge, and depending on how much the users identified themselves with their district, the effect would be moderated by identification (see Table 5 for an overview of the operationalization).

Table 5. Operationalization of Effects of nudging.

What	Why	How	When	Area
Effect of social comparison, with interaction of identification with district	exploring nudging effects within SimpliCITY	Notifications that "X% of people have bicycled already z km this week" for experimental group, no notification for control group (comparison km bicycled, shops visited)	Pilot 2	App

4.2.3. Effects of SimpliCITY on sustainable behaviour

SimpliCITY aims to

- ✓ scale up and increase the visibility of regional sustainability services (RSUS) by means of a novel webportal (....)
- ✓ raise awareness for a "sustainable city lifestyle" and increase the number of engaged urban citizens by developing methods and tools for nudging a community towards the consumption of RSUS (...).

Therefore, one aspect of evaluation should focus on the effect of SimpliCITY on sustainable behaviour. SimpliCITY focuses on bicycle mobility, local production and consumption and social inclusion and for these domains, effects should be investigated for either specific *behaviour* (reported or measured) or *awareness* (e.g., knowledge about services, about relevance of topics).

4.2.3.1. Effects on awareness and knowledge

Before a behaviour change occurs, awareness and knowledge are usually seen as important factors (see Ajzen, 1991 and 4.2.3.2 for further details). Awareness and knowledge are concepts that are not always clearly defined or distinguished (see Trevethan, 2017, for a discussion). They can be can be modelled on two different continuums, where higher awareness would be characterized by a higher personal relevance, and higher knowledge by more specific information about a topic (Trevethan, 2017). They can also be defined as two ends of the same continuum, for example, McCallum and colleagues (2005) describe the lower end of the continuum as a general awareness, and detailed and specific knowledge at the higher end of the continuum. The latter definition seems fitting for the goal of SimpliCITY: Participants would move from being vaguely aware that some RSUS exist (e.g., that there are secondhand stores) to having more specific knowledge about them (e.g., where the closest secondhand store is and what can be sold and bought there).

- Users will have to opportunity to indicate whether they perceived an effect of SimpliCITY on their individual level of knowledge about sustainable services in their city.

An overview of the operationalization can be seen in Table 6.

Table 6 Operationalization of Effects on awareness and knowledge.

What	Why	How	When	Area
General awareness and specific knowledge about behaviour and RSUS	indicator for success	questionnaire about perceived effect of SimpliCITY	Pilot 1	App / webportal

4.2.3.2. Behaviour change

Behaviour change is influenced by various factors. Ajzen's (1991) theory of planned behaviour proposes that behaviour is influenced by the attitudes toward the behaviour, subjective norms as well as the perceived behaviour control (i.e., people's perceived ability to perform a certain behaviour) that lead to an intention and then to an actual behaviour. The theory of planned behaviour is commonly used in research around pro-environmental behaviour (Macovei, 2015). Therefore, awareness and knowledge is included in the evaluation, as they often precede a behaviour (see 4.2.3.1. Effects on awareness and knowledge), but it is also important to focus on behaviour itself.

The effectiveness of an intervention (in this case, participation in the SimpliCITY project) can only be evaluated if the desired target behaviour can be measured validly. For SimpliCITY, we can rely on self-reported behaviour as well as measured behaviour (i.e., tracked activity).

For sustainable and pro-environmental behaviour, *self-reports* are a common tool, ranging from the use of single items to multi-item scales (see Lange & Dewitte, 2019). Self-reports will be also used for the evaluation of SimpliCITY. Aspects for self-reports (note that knowledge and awareness will be evaluated as well, see 4.2.3.1. Effects on awareness and knowledge) are

- bicycling behaviour (e.g., times per week, percentage of all transport assessed with a slider)
- shopping behaviour (e.g., number of shops visited, number of local products purchased)
- social inclusion (e.g., number of donations to organizations)

In general, it is advisable to use already existing scales, as psychometric properties (i.e., reliability, validity) of the scales are already known. For SimpliCITY, the combination of mobility, local consumption and social inclusion is very specific and goes beyond what is typically covered in pro-environmental behaviour scales. However, single items might be taken from already established questionnaires (e.g., General Ecological Behaviour by Kaiser, 1998).

For the *tracked activity* (i.e., kilometres bicycled 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. Several comparisons are possible:

- Comparison to a self-reported estimate of alternative behaviour (e.g., asking participants whether they would have usually used their car or public transport when tracking their bicycle activity)
- Perceived effect of SimpliCITY on own behaviour (i.e., users indicated how interacting with the app changed their behaviour)

An overview of the operationalization can be found in Table 8.

Table 8. Operationalization of effects of SimpliCITY on sustainable behaviour.

What	Why	How	When	Area
perceived effect of SimpliCITY	effect of SimpliCITY	online questionnaire	Design evaluation (pilot 1)	App
tracked activity	effect of SimpliCITY (comparison to either self-report, alternative behaviour or similar program), comparison with mobility tracker	tracking function and comparison	Ongoing data collection	App

5. Timeline of evaluation

Task	Timeframe
Developing and finalizing items for user profile questionnaire	May 2020
Developing and finalizing questionnaires for users (aspect 1 & 3)	May – June 2020
Design Evaluation (part of Pilot 1)	July 2020
Pilot 1 (Salzburg)	August – September 2020
First analyses of data (aspect 1, part of aspects 2 and 3) for formative evaluation	October - November 2020
Pilot 2	April 2021 – middle of May 2021
Experimental condition for nudging	Pilot 2

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