Individual Mobility Budgets for supporting behaviour change in a Living Lab in Vienna

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1. Introduction

While reducing carbon emissions is becoming more and more pressing in the face of the increasingly catastrophic effects of climate change, the transportation sector is achieving virtually no emissions savings of note despite a brief period of low emissions during the pandemic (Sarfraz et al. 2022). Previous efforts to reduce traffic emissions have not met with the expected success, and technological developments are not sufficient to reduce emissions in the limited time available (Waygood et al. 2019). Therefore, it is inevitable to push for behavioural changes to avoid unnecessary trips and to choose the lowest-emission means of transport possible.

The transnational research project "MyFairShare"¹ explores the concept of individual mobility budgets as an approach to help individuals change their mobility habits and participate in achieving reduction targets. The concept is tested in six Living Labs in five different countries (Austria, Germany, Latvia, Norway, UK) to investigate the comprehensibility of the concept, its perceived fairness as well as its applicability in different contexts and at different levels, i.e. national, community, corporate and community level.

This paper gives an insight into the concept of Individual Mobility Budgets and the test case of the Vienna Living Lab. In this experiment, residents of the Viennese urban development area aspern Seestadt were confronted with different information about their mobility behaviour. Afterwards, the experiences were discussed in a consensus conference and implementation requirements for Individual Mobility Budgets were elaborated with the participants.

2. Mobility Budgets as part of a sufficiency strategy

Conventional strategies such as efficiency (more output for the same energy input) or consistency (switching to other energy sources) do not have the desired effect because rebound ef-

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1. https://www.myfairshare.eu/
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fects outweigh the savings (Waygood et al. 2019). Therefore, the focus on behavioral change in terms of sufficiency is increasingly important in order not to jeopardize the impact of technological advances (Sarfraz et al. 2022). Sufficiency calls for a moderate use of resources and advocates the "just measure" between scarcity and abundance (Darby 2007). In the context of mobility, this means being aware of the limited amount of tolerable emissions and choosing one's destinations and means of transport in such a way that these limits are not exceeded.

The average limits of annual emissions for mobility on the way to climate neutrality were calculated for Austria in a feasibility study ("mobalance") to develop the basic concept of Individual Mobility Budgets (Millonig et al. 2022). In this concept (see Figure 1), the annual (continuously decreasing) amount of transport emissions up to the desired reduction target is distributed among the population. Each person knows how much is available to them and can freely decide how to use this budget. People in locations with poor accessibility or with care obligations for others (e.g. children) receive a higher share than others to compensate for these circumstances. At the same time, however, the public sector must also invest in low-emission accessibility of daily activities (work, education, shops, leisure) in order to ensure adequate mobility for mobility-disadvantaged persons, even in the face of ever-tightening emission limits.



Figure 1: Concept of Individual Mobility Budgets

An essential aspect of the concept is the fair distribution of budgets. In MyFairShare, special focus is therefore placed on the development of a fair distribution key. Fairness concepts (Rode 2022) and implementation requirements are additionally tested in several Living Labs with representatives of different target groups in order to identify the approach with the broadest possible acceptance.

The Living Lab in Vienna² conducted a field test introducing the concept of an Individual

^{2.} https://www.myfairshare.eu/living-lab/inspiring-community-effort/

Mobility Budget to volunteers living in a new multifunctional urban development area at the outskirts of the city. The aim of the Living Lab was to understand how Individual Mobility Budgets can effectively increase awareness and lead to behavioural change.

3. Experiment design and setup

The experiment consisted of three parts: In the first phase, the participants collected trip data for one week and filled out the questionnaire. This first week served to gain insights into the participants' regular mobility behaviour. Based on the completed questionnaires, participants were divided into three groups, each of which received specific weekly feedback (phase 2) to test whether different feedback led to changes in decisions and behaviour. The third phase consisted of a Consensus Conference to which all participants were invited. This method is a participatory approach to involving lay people in the decision-making process on complex issues by formulating their own knowledge and values and coming to a consensual statement together (Zurita 2006).

The aspern.mobil LAB³, an urban mobility lab located in aspern Seestadt with around 11,000 inhabitants at the time of the experiment, organised the implementation of the experiment in the Seestadt and integrated the experiment into its Seestadt Mobility Panel⁴, a longitudinal smartphone-assisted mobility survey that has been running since 2019. This included activating the participants, filling out the questionnaires and tracking their journeys using a mobility tracking app ("Wegesammler2.0").

Participant activation for MyFairShare has been integrated into the established activation and communication strategy of the aspern Mobility Panel. The information material, communication guides and drafts etc. were adapted to the use case of MyFairShare. In total, the experiment was preceded by five weeks of participant activation. Every adult resident of aspern Seestadt was generally eligible to participate. The activation was carried out door-to-door on site by a team of three people: Based on household register data, households drawn from a random sample were informed by mail about the upcoming visit of a member of the activation team and contacted personally at their doorstep a few days later. The activation team spent a total of 91 hours on participant activation.

In addition to personal activation, online and analogue channels were used to promote the experiment and provide all necessary information for self-registration. Channels included newsletters from aspern.mobil LAB and the local neighbourhood management, social media posts on Facebook and Instagram, posters on site, distribution of flyers in letter boxes, etc. (Bürbaumer et al., n.d.). Additional personal support for registration was offered on site at certain times, though this has not been required in this case.

In order to increase the number of registrations and to reward the required amount of individual time engagement, an incentive strategy was introduced. This included a voucher worth 65 EUR per person and small giveaways such as a post-it folder with the logo of the research project for the participants to take notes during the experiment. The condition for the

^{3.} https://www.mobillab.wien/en/

^{4.} https://www.mobillab.wien/en/panel-en/

voucher was to participate fully, i.e. four weeks of tracking and participation in the consensus workshop.

The recruitment target was to register 60 people, which was almost achieved: 57 people registered for the experiment (7 sign-ups through personal recruitment, 50 sign-ups through self-registration), of which 41 were participating for the first time in an enquiry and 15 people had already participated at least once in the Mobility Panel.

4. Experimental phase

4.1 Baseline data collection

The experiment started with one week of baseline data collection: participants were asked to simply use the tracking app and complete a questionnaire. The questionnaire included questions regarding socio-demographic and household-related characteristics as well as questions on personal attitudes to mobility-related topics, which in turn enabled the participants' allocation to a typology of mobility information types ("pro:motion" typology(Markvica et al. 2020)). The typology consists of six different types of behaviour defined by their attitudes towards different modes of transport, their willingness to change their behaviour to more sustainable modes of transport and the communication channels they use (see Figure 2). The typology has proven to possess high explanatory power in terms of understanding mobility patterns and the effectiveness of measures to change behaviour. Recently, the typology has been updated due to societal changes during and after the pandemic.



Figure 2: Key characteristics of pro:motion types.

The tracking app was used to survey mobility behaviour on the basis of routes and trip legs. The app can automatically record routes and recognise means of transport by collecting data from various built-in sensors (GPS, WLAN, Bluetooth, acceleration, etc.). The result is a dataset that describes mobility behaviour and choice of modes with high spatio-temporal resolution. The recorded trips can be reviewed by the participants (e.g. for completeness), edited (e.g. if a transport mode was not recognised correctly) or extended (e.g. by adding a trip purpose). Via a dashboard, the data can be loaded directly into GIS and statistics tools for analysis. For each participant, the distances travelled were aggregated for each mode of transport used to create user-specific communication mails depending on the test group. Out of 57 registered participants, 47 completed the baseline data collection phase and were eligible to enter the next stage of the experiment.

4.2 Group scenarios

After the first week of the experiment, the participants were divided into three different groups based on the completed questionnaires, which were then assigned to different test scenarios. Each scenario consisted of different assumptions and targets regarding resource consumption (carbon emission budgets) as derived from their tracked trips and mode choices:

- Group A was the control group and received only feedback on the emissions caused by their mobility
- Group B received information about their personal carbon emissions compared to Vienna's target values for a specific year (e.g. reduction target for 2030). The later the target year, the tighter the mobility budget became.
- Group C was asked to imagine carbon taxes depending on the type of vehicle. The economic cost of travel was related to the carbon emission reduction targets and, therefore became more expensive as the experiment progressed.

Each participant received an individual assessment of their mobility behaviour in the week before. The exact assessment differed depending on the group membership (A, B or C). In addition, the members of groups B and C were given tasks for the coming week. An overview of the respective tasks is given below.

Scenario communication			
Week	Group A: Control	Group B: Mobility Budget	Group C: Carbon Tax
	Group		
1	Feedback on carbon	Feedback on carbon emis-	Feedback on carbon emis-
	emissions	sions	sions
2	Feedback on carbon	Reduced weekly Mobility	Increased costs 2030 (85€/
	emissions	Budget for 2030 (16.12kg)	carbon ton)
3	Feedback on carbon	Reduced weekly Mobility	Increased costs 2040
	emissions	Budget for 2040 (1.54kg)	(200€/carbon ton)
4	Feedback on carbon	Required framework condi-	Required framework condi-
	emissions	tions to maintain 2040 level	tions to maintain 2040 level

Table1: Group-specific scenario communication content.

Participants in groups B and C received additional information to make the challenges more comprehensible, e.g. the different costs depending on the means of transport used or the maximum distance per means of transport within the given mobility budget. In the last tracking week, people were asked to reflect on how the environment would have to adapt to allow them to reach climate-neutral emission levels, e.g. infrastructural adaptation, accessibility of activities, supplies, etc. From 47 initial participants only 42 completed the second stage of the experiment, which means a drop-out of 5 persons.

4.3 Consensus Conference

The Consensus Conference was the last step of the experiment that took place shortly after the trip data collection ended. Here, participants shared their experiences from the experiment and jointly develop policy recommendations for an individual mobility budget. Led by experts and moderated by researchers, participants aimed to reach consensus on how an individual mobility budget could be implemented and discuss different aspects of how such a policy instrument should be designed to reduce carbon emissions in an equitable way. Usually, consensus conferences are events that spread over two to four days, as the process involves expert contributions as well as room for clarifications of attitudes and discussions on topics that are of broad social relevance, which is necessary for the participants to reach informed consensus. In this case, the event was shortened to one day in order not to lose participants who were not willing to invest more than one day. From the 42 participants, who completed the second phase of the experiment, roughly a quarter attended the Consensus Conference (12 out of 42)., even though the date of the conference was already communicated during the activation phase and participants were asked only to sign up for the experiment if they were able to join the event.

The Consensus Conference was divided into four main sections:

- a group mapping exercise, which reviewed the participants' level of information on climate targets in the mobility sector
- a discussion about the individual experiences and behavioural changes in relation to the challenges posed in the experiment
- an expert input on the concrete challenges related to decarbonisation of transport and the potentials of Individual Mobility Budgets, and
- a discussion with the aim of reaching consensus on three specific aspects of designing and implementing mobility budgets.

During this discussion, the participants were asked to agree on a solution to three predefined questions that were presented along with a number of potential answers based on the state of knowledge and expert assessments. The task of the participants was to discuss and weigh the different solutions and finally collectively agree on a solution. This answer did not have to be one of the proposed solutions, but could also be an answer developed by the participants

themselves. The questions were formulated as challenges and were addressing different aspects of designing and implementing Individual Mobility Budgets:

- Challenge of swift realisation: Which circumstances are most likely to lead to a successful implementation?
 - Top-down policy enforcement due to urgency
 - Bottom-up mobilisation of civil society by activism and education
 - Policy involves the population in decision making
- Challenge of fair allocation: What budget distribution scheme would be fairest?
 - Everyone gets the same budget
 - People with longer travel distances get more (rural areas)
 - People who have to assist and care for others get more (families)
- Challenge of scope of validity: Which budget flexibility would be the most practical and secure?
 - Time-limited budgets (e.g. per year) with option to pass-on to others (trading) before budgets expire
 - Time-limited budgets with social fund reserved for emergencies
 - Bank account-like budgets with savings options (but without overdraft facility)

5. Preliminary results and discussion

At the time of the submission of this paper, tracking and survey data have only been analysed for preparing the weekly individual feedback reports and the analysis of all collected data is still ongoing. Hence, this section predominantly summarises the results related to individual experiment experiences as reported by participants and the collective consensus finding during the conference.

In general, as was already expected during the recruiting phase, there was a high share among the participants who belonged to higher educated and more sustainability aware people present in the sample in comparison to the general population. The amount of participants with high interest in either new technologies and self-optimisation or in sustainability and information on their own behaviour shows in the dominance of the pro:motion Types "Spontaneous - On the Go" and "Highly informed Sustainability" in the samples of the experiment and the conference (see Figure3).

5.1 Tracking experiment

During the experiment phase, none of the communication strategies in the different groups led to changes in the mobility behaviour. In the Control Group and the Carbon Tax Group, the information provided was not sufficient to have any participants pondering about whether



Figure 3: Distribution of pro:motion Types in the participants of the experiment and the Consensus Conference. Note that due to privacy protection participants of the conference were asked to provide their participant code used during the experiment to be able to allocate them to the type determined by the initial survey. Come of the participants did not provide that code and could not be allocated to their type.

to change their behaviour. In the Mobility Budget Group, behaviour changes were also not occurring, however, the participants reported more awareness about the finite and shrinking carbon budget in the transport sector. Also, this realisation led some to express frustration about the fact that even trips with public transport would have to be reduced in the future, although they assumed that they already had very sustainable mobility patterns. For the time of the experiment, the persons allocated to Group B (Mobility Budgets) however did not feel the need or see the possibility to change their current behaviour, as they often were already within the limits of today's carbon budgets or the distances and modes they had to travel could not be avoided at this time.

Concerns were expressed not only regarding the difficulty of significantly reducing individual transport emissions with shrinking budgets, but also regarding data protection in order to monitor emissions, although the information they received on their behaviour was generally viewed positively.

5.2 Consensus Conference

The participants willingly engaged in the thought experiment to determine the framework conditions for the introduction of Individual Mobility Budgets. Still, although the discussants dealt with the topics very conscientiously and seriously, the feeling of discussing a very hypothetical scenario with little relevance to reality prevailed.

In terms of implementation options, participants suggested a combined strategy. Although a top-down process was seen as the most effective, there was little confidence that policy makers would take the initiative. Therefore, it was agreed to initially inform and mobilise the population, which would then involve policy-makers for implementation, who would finally take over the enforcement of appropriate framework conditions.

When it came to the question of a fair distribution key for the budgets, a consensus was quickly reached that as many personal circumstances as possible should be taken into account in order to achieve the greatest possible fairness. Proposals included regional supplements for poor accessibility, additional budgets for people who cannot do their work in a home office, and additional budgets for people with care obligations.

For practical implementation, time-limited and expiring budgets were uniformly rejected; instead budgets similar to bank accounts with savings options were preferred. Possibilities for gifting budgets to relatives and a high degree of transparency were also decided by consensus, as was an emergency fund for extraordinary situations.

The conference ended on a very positive note, with participants showing high motivation and reporting that they had found the event very exciting and the discussion had contributed greatly to opinion-forming.

6. Conclusion and outlook

The experiment aimed to investigate whether the concept of an individual mobility budget is a viable and acceptable option for achieving climate-neutral mobility for people living in a given area and who therefore have the same opportunities to change their behaviour.. The Living Lab resulted in several learnings regarding both the methodological approach as well as the behavioural insights.

The approach itself proved to be very time and labour intensive, although only a small number of participants remained at the end of the process. The high recruitment effort in the course of the door-to-door visits was only moderately successful and did little to substantially increase the number of participants recruited through self-registration. Although a relatively high number of participants completed the data collection phase, the number of attendees for the final conference fell short of expectations, although the importance of participation was communicated from the beginning.

In terms of awareness building and participatory processes for increasing acceptance and co-creative strategies for implementation, the results were very promising. Even though the participants deemed Individual Mobility Budgets not to be a concept that could actually be realised, they reached a high awareness for significant climate challenges and the urgency and need for action. The complexity of the climate crisis and the challenges for transport, the effectiveness of measures and urgency of actions was however still hard to grasp for the attendees, despite the effort taken to translate it all into the individual context and the openness of the participants. Despite these limitations, the Living Lab showed that even measures that are perceived as "radical" can reach a common understanding and support if individuals are informed and involved accordingly and if they can take control of the decision making process.

The next steps in the project include further analysis of the quantitative and qualitative material collected in this Living Lab. It is also planned to re-contact the participants who have expressed interest in follow-up activities to find out if there have been any long-term effects on their awareness, attitudes and behaviour after the experiment. Furthermore, the results of this Living Lab will be compared with the results of the other Living Labs studied in the project in order to derive generalisable findings and recommendations for the use of the concept.

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