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Traffic impact of flexibly rented, private parking spaces

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This work addresses the following topic(s) from the Call for Contributions:
(Please check at least one box)

- Placemaking to integrate urban spaces and mobility
- Promoting sustainable mobility choices in metropolitan regions (2nd choice)
- Governing responsible mobility innovations (1st choice)
- Shaping the transition towards mobility justice
- System analysis, design, and evaluation
- other: _____

Extended Abstract

Problem statement

The reduction of existing on street parking spaces great potential for providing additional green space or extending the traffic areas for pedestrians and cyclists (Campisi *et al.*, 2022). Especially in dense urban neighbourhoods, such a reallocation of road space could reduce urban heat effect and increase the mode share of environmentally friendly modes (Gössling, 2020). While the elimination of such parking spaces is politically controversial, underused and vacant private parking spaces offer the potential to substitute on-street parking. To exploit this potential, various start-ups have developed internet-of-things applications to provide intelligent parking systems that allow private parking spaces to be rented flexibly.

Existing building regulations normally state the number of parking spaces that can or need to be allocated for different types of purpose, e.g., for residents, employees, costumers. However, this practice legally prevents private parking spaces from being rented flexibly. City governments in Switzerland currently tolerate the new offers as only a comparably low number of private parking spaces are being rented out flexibly.

Little is currently known about how parking spaces booked via digital car park booking systems are used. To be able to assess to what extent the new offer impacts traffic demand and provides the potential to reduce on-street parking, we need to first understand how the new offer leads to changes in travel and parking behavior.

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Research objectives

Our research aims to answer the following research questions:

- How do different user groups make use of the flexible rental of private parking spaces (frequency, parking duration, times of day, days of the week)?
- How does the new parking supply influence mode and location choice decisions?
- What is the net effect of the offer with regards to car traffic?
- How many public parking lots can potentially be replaced due to the new offer?
- How does the flexible rental of private parking spaces should be regulated to benefit urban mobility?

Methodological approach

The applied methodological is set out in Figure 1. The start-up Parcandi¹ provided data on 18,253 bookings of flexibly rented private parking spaces in 33 locations in various Swiss cities and municipalities for the period 1.1.2022 - 31.12.22. This data has been analysed to describe occupancy patterns at different locations and to distinguish user groups and usage patterns.

Between 24.3.23 and 23.6.23, persons who booked a Parcandi parking space during this period or used the service more than five times in 2022 were invited to complete a web-based questionnaire. The questionnaire was used to collect the following information, among other things: activities carried out during the parking process, the locations visited before and after, and how they would have behaved if the Parcandi service had not been available.

In total, 681 persons fully completed the survey and form the basis for the descriptive analysis and the statistical models to describe the stated substitution effects and quantify the related traffic impact. By applying those results to the booking data, the overall substitution effect and traffic impact for the year 2023 are estimated.

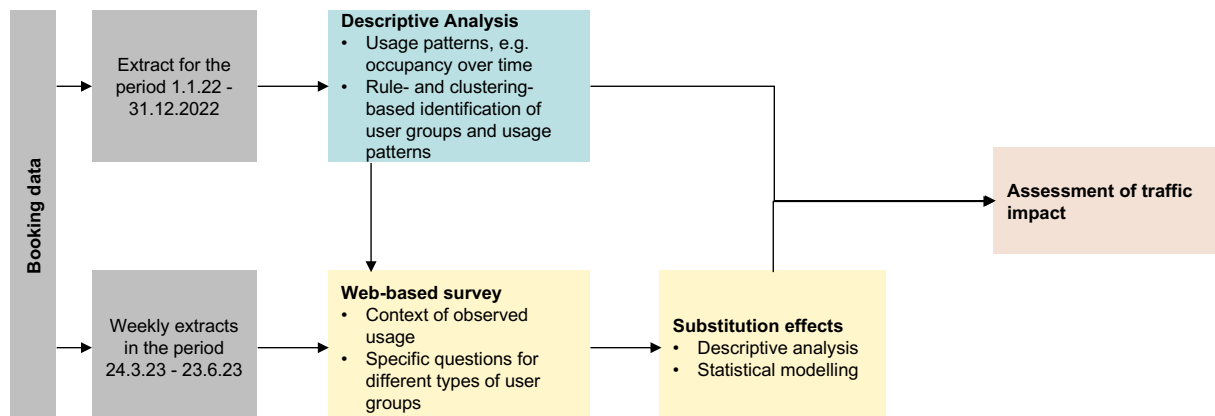


Figure 1: Methodological approach

Results

Figure 2 shows the average weekly usage pattern of flexibly rented parking spaces across all locations. The utilisation of parking spaces is more than three times higher during the day than at night over the course of the day and week. Except for Sunday, this cyclical pattern is also clearly pronounced on every day of the week. The peak in car park occupancy is reached at lunchtime.

People who have parked in a parking space at least five times over 24 hours or once on five consecutive days in 2022 (long-term users) form a baseline demand. Over the course of the entire week and day, the occupancy of this group practically does not vary and accounts for approx. 70% of the occupied parking spaces at night and

¹ <https://parcandi.com/>

approx. 30% at the midday peak. The groups of frequent users (at least 10 uses in 2022) and occasional users (all others) make up much of the variable occupancy component.

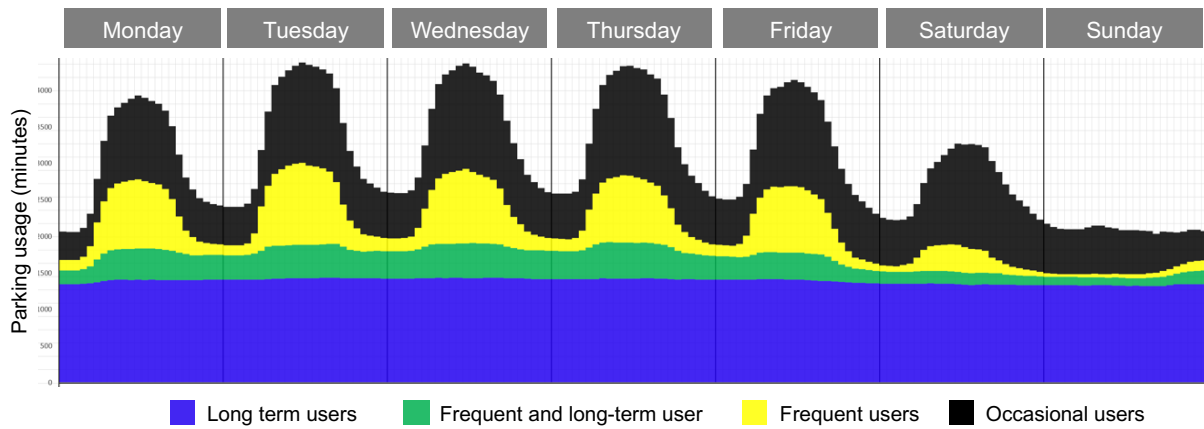


Figure 2: Weekly usage pattern of flexibly rented parking spaces across all locations

The frequency of activities conducted while parking differs significantly depending on the user group and parking duration (less or longer than 24 hours). While almost half of occasional users' parking sessions are for work activities, this applies to more than 80% of frequent users. Among the other type of activities, leisure, education, and social visits are the most frequently reported.

Based on the application of the developed statistical models (occasional users) and descriptive analysis (frequent and long-term users) on the booking data for the year 2022, the substitution patterns as indicated in Figure 3 have been derived. In about 75% of the cases, the car would also have been parked elsewhere. Flexibly rented private parking spaces therefore primarily lead to a decrease in demand for other types of parking spaces in the immediate vicinity. This confirms findings from literature (Yan *et al.*, 2019). In around half of those cases, a parking space in a neighbouring (multi-storey) car park. The use of a public car park in the blue zone is substituted in 23% of cases. Regarding parking spaces in the white zone, this figure amounts to 12%.

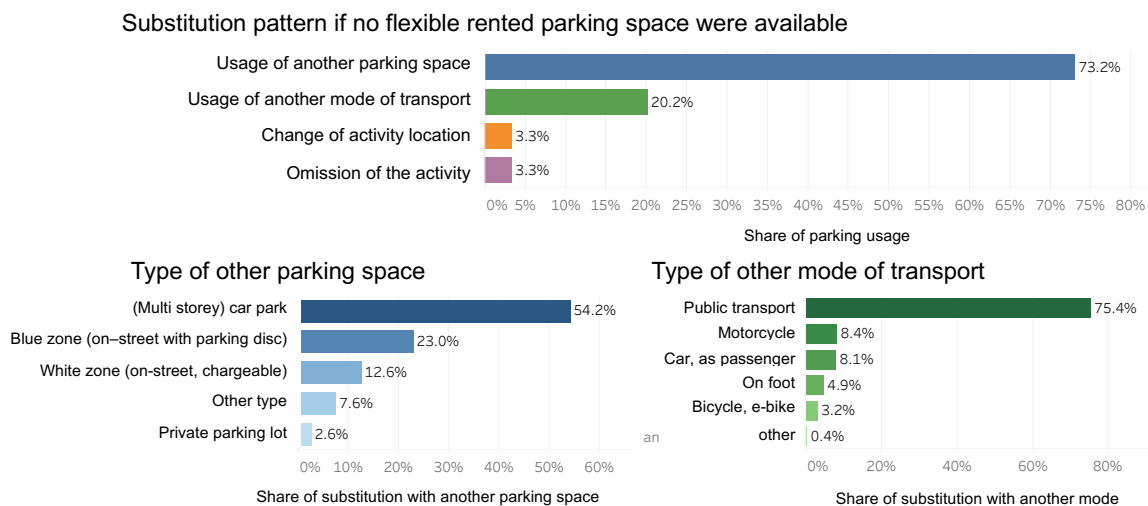


Figure 3: Generalized substitution effects for flexibly rented parking spaces

In around 20% of cases, the car journey would be replaced by another means of transport. In 75% of these cases, public transport would be used. In these cases, the offer of flexibly rented parking spaces leads to additional

traffic. The additional traffic attributable to such transport mode choice effects is estimated at 118,000 km for the year 2022, or 6.5 km per usage.

In about 3% of the cases, either the location of the activity would be adapted, or the activity completely omitted, if the offer was not available. The additional traffic calculated for 2022 due to adapted activity locations amounts to 2,165 km (0.12 km per usage), and due to induced activities amounts to around 37,000 km (2.03 km per usage).

If usage of a parking space in the blue or white zone is replaced, park search traffic will be reduced. Over all locations, the reduction of car mileage for search traffic is estimated to 3,700 vehicle kilometres (0.2 km per usage).

The potential to reduce existing parking spaces, was derived based on an analysis of the weekly usage patterns and the occupancy of alternative parking spaces at different times of the day and weekdays. For the most frequently used locations, 10 parking spaces offered by Parcandi can replace around 4 to 6 other parking spaces on an annual average. Around half of this change in demand relates to surrounding car parks, between 25% and 40% to parking spaces in the blue and white zones.

The following key insights and policy recommendations are drawn from those results:

- The flexible rental of parking spaces that were previously vacant or only partially used during a day leads to a decrease in demand for private and public parking spaces and thus offers the possibility for reducing the number of on-street parking spaces in the immediate vicinity.
- An important prerequisite for a potential reduction of on-street parking spaces in the surrounding area is that the flexibly rented parking spaces are used at times when there is high demand pressure for on-street parking. This usually applies in dense urban neighborhoods for parking spaces in the blue zone this is at night, for parking spaces in the white zone during the day. However, the observed occupancy rate of flexibly rented parking spaces in central locations is only between 10% and 40% at night, depending on the location and thus represents an underused potential for reducing on-street parking spaces. It is recommended to test new pricing schemes with modest prices for the rental of parking spaces between 8 p.m. and 7 a.m. This could motivate the local residential population to use the offer more often at night and thereby avoid parking search traffic.
- At present, Parcandi and other providers of flexibly rentable private parking spaces in urban residential neighbourhoods are limited to a few locations. To make a significant contribution to replace on-street parking spaces considerably more parking spaces which currently remain unused at night must be made available in dense urban residential neighbourhoods, new collaborations with property owners whose car parks are primarily used during the day, e.g. by commuters or for shopping should be sought and supported through adapting the legal framework that governs the usage of private parking spaces.

Literature

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