How does Mobility as a Service (MaaS) influence travel behavior?
Passenger transport is changing
Discussion on impact is ongoing and net effects are unclear

- Efficiency
- Sustainability
- Equity
- Safety
- Working conditions
Observation


vs

Observation


Emerging question from a societal perspective

How to *integrate* emerging mobility options with public transport and *incentivize* sustainable use?
Mobility as a Service (MaaS)
Mobility as a Service is not (entirely) new

“The Mobility Manager accomplishes its goals by linking together all travel modes – bus, taxi, vanpools, express bus, specialized services, carpools etc. at an informational level and, in most cases, at a transactional level as well”

US DoT, 1991, p. 16
In: Mulley (2017)
Conceptualizing Mobility as a Service: Elements

App

Platform integration

Bundles
Conceptualizing Mobility as a Service: Topologies

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Integration of societal goals (policies, incentives)</td>
<td>Full oper., inf. and trans. integration across modes for all journeys</td>
<td>Subscription bundle plans</td>
</tr>
<tr>
<td></td>
<td>Bundling/subscription, contracts</td>
<td>Some modal combinations offer a fully integrated exp.</td>
<td>Single account, single platform</td>
</tr>
<tr>
<td></td>
<td>Integration of booking &amp; payment</td>
<td>Some journeys offer a fully integrated exp.</td>
<td>Multi-modal travel platform (inf. integration), mode-specific accounts</td>
</tr>
<tr>
<td></td>
<td>Integration of information</td>
<td>(Some) operational and/or transactional integration</td>
<td>Multi-modal PAYGO (payment integration), mode specific platforms</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Informational integration across (some) modes</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Single, separate services</td>
</tr>
</tbody>
</table>

One example of “high-level” MaaS in practice: Yumuv (Switzerland)
How does MaaS change travel behavior?
Quantitative empirical evidence from 3 cities

Sydney (AU) 2019-2020

Augsburg (DE) 2018-today

Zurich (CH) 2020-today

Trip

MOBIL

FLAT

yummuv

All means of transport in one app – also combined in your subscription
Quantitative empirical evidence from 3 cities

Sydney (AU) 2019-2020

Augsburg (DE) 2018-today

Zurich (CH) 2020-today

All means of transport in one app – also combined in your subscription
Sydney – trial overview

- **Called Tripi (supplied by SkedGo)**
- **Enabled trip planning, booking, payment, invoicing**

- **Public transport, Uber, Taxi, Car share, Car rental**
- **Booking data available during trial**

- **IAG employees**
- **Pre- and post-trial survey and interviews**

- **Nov. 2019 – April 2020**
- **Sydney, Australia**
Sydney – app
Sydney – trial overview

- Called Tripi (supplied by SkedGo)
- Enabled trip planning, booking, payment, invoicing

- Public transport, Uber, Taxi, Car share, Car rental
- Booking data available during trial

Digital Channel App

Suppliers

Customers

Trial Period

- IAG employees
- Pre- and post-trial survey and interviews

- Nov. 2019 – April 2020
- Sydney, Australia
## Sydney – bundles

### Nov 2019

**Pay As You Go**
- No Monthly Fee
- No Discount

**Opal**
- No Discount

**Uber**
- No Discount

**Taxi**
- No Discount

**GoGet**
- No Discount

**Thrifty**
- No Discount

### Dec 2019

**Fifty50**
- $50/month
- 50% off every trip
- $3 off every ride

### Jan 2020

**Saver25**
- $25/month
- 25% off every trip
- 15% off every ride
- 15% off every ride
- 15% off every ride
- No Discount

### Feb 2020

**Green Pass**
- $125/month
- Unlimited trips
- 15% off every ride
- 15% off every ride
- No Discount
- No Discount
Table 1
A first master design for MaaS bundles.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
<th>Examples</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Necessary design dimensions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modes</td>
<td>Modes of transportation included in the bundle</td>
<td>Public transportation, carshare, (e-)bikeshare, e-scooters, taxi, car rental, ride-hail</td>
<td></td>
</tr>
<tr>
<td>Metrics</td>
<td>Way in which the mobility budget/entitlement and consumption of a mode is measured</td>
<td>Time-based (minutes, hours, days), distance-based (km, miles), trip-based (number of trips)</td>
<td></td>
</tr>
<tr>
<td>Geography</td>
<td>Area of validity</td>
<td>Single city, multiple cities, country</td>
<td></td>
</tr>
<tr>
<td>Market segment</td>
<td>Entity the bundle is designed for, and whether the bundle can be shared</td>
<td>Individuals (residents, tourists, commuters, seniors), households, employee groups</td>
<td></td>
</tr>
<tr>
<td>Subscription cycle</td>
<td>Period of single recurrence of a subscription</td>
<td>Weekly, fortnightly, monthly; calendar or rolling</td>
<td></td>
</tr>
<tr>
<td><strong>Complementary design dimensions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discounts</td>
<td>Type and granularity of rebate</td>
<td>Trip-based (20%/$5 off each trip), budget-based (subscription fee or top up $50, pay $45)</td>
<td></td>
</tr>
<tr>
<td>Caps</td>
<td>Limit to discounted trips/entitlements depending on the metric, also referred to as budgets</td>
<td>Time-based (30 h/trips up to 30 min), distance-based (30 km), trip-based (10 trips)</td>
<td></td>
</tr>
<tr>
<td>Add-ons</td>
<td>Non-transportation services included in the bundle</td>
<td>Parking, coupons (e.g., shopping, accommodation, restaurants, food delivery)</td>
<td></td>
</tr>
<tr>
<td>Customizability</td>
<td>Bundles can be pre-defined by the mobility broker or personalized by the users</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Roll-over option</td>
<td>Transfers unused credit to the subsequent time period</td>
<td>NA</td>
<td></td>
</tr>
</tbody>
</table>

Sydney – key results with regards to travel behavior

- **Data**
  - Monthly bundle choice
  - Private car kms (GPS trackers)
- **Method**
  - Model bundle choice and car kms jointly as discrete-continuous choice model

- **Key publications**
Sydney – key results with regards to travel behavior

• Data
  – Monthly bundle choice
  – Private car kms (GPS trackers)
• Method
  – Model bundle choice and car kms jointly as discrete-continuous choice model
• Results
  – **Bundle subscribers reduce monthly car kms**
    – An increase of a bundle choice probability by 0.1 unit (from 10% to 20% for example) is predicted to reduce average monthly private car kms by 29 kms, from an average of 434 to 405 kms
    – If scalable, this yields a substantial reduction in car kms

• Key publications
Sydney – contributions and future work

Contributions
• Fully transparent trial from design to implementation to impact assessment and lessons learnt
• Quantitative empirical evidence on actual bundle uptake and induced changes in travel behavior

Future work
• Scalable beyond specific customer group (IAG employees)?
• Substitution effects between modes (and net effect on car-based travel)?
Quantitative empirical evidence from 3 cities

Sydney (AU) 2019-2020

Augsburg (DE) 2018-today

Zurich (CH) 2020-today
Augsburg – overview

- Launched in stages
  - Initial trial ("Mobil-Flat"): 01.10.2018 – 30.09.2019
  - Expansion ("Mobil-Flat S/M"): since 01.10.2019

- Real product

- Goal for municipal transport provider: learn about travel behavior under the influence of a subscription bundle

Augsburg – uptake
TABLE 1 MaaS bundles offered in Augsburg.

<table>
<thead>
<tr>
<th>Dates</th>
<th>Pilot</th>
<th>Mobil-Flat S</th>
<th>Mobil-Flat M</th>
</tr>
</thead>
<tbody>
<tr>
<td>End</td>
<td>10/2019</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Public Transportation</td>
<td>Unlimited (zones 10 and 20)</td>
<td>Unlimited (zones 10 and 20)</td>
<td>Unlimited (zones 10 and 20)</td>
</tr>
<tr>
<td>Carshare</td>
<td>30 h / unlimited km</td>
<td>15 h / 150 km</td>
<td>30 h / unlimited km</td>
</tr>
<tr>
<td>Bikeshare</td>
<td>Unlimited &lt;=30 min rides</td>
<td>Unlimited &lt;=30 min rides</td>
<td>Unlimited &lt;=30 min rides</td>
</tr>
<tr>
<td></td>
<td>Current</td>
<td>-</td>
<td>83 € (2020)</td>
</tr>
</tbody>
</table>
## TABLE 2
Estimation results for mixed effects model.

<table>
<thead>
<tr>
<th>Fixed Effects</th>
<th>Estimate</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>1.97</td>
<td>82.29***</td>
</tr>
<tr>
<td>Mobil-Flat Pilot</td>
<td>0.57</td>
<td>8.19***</td>
</tr>
<tr>
<td>Mobil-Flat M</td>
<td>0.61</td>
<td>16.17***</td>
</tr>
<tr>
<td>Mobil-Flat S</td>
<td>0.31</td>
<td>3.91***</td>
</tr>
<tr>
<td>COVID-19</td>
<td>-0.28</td>
<td>-5.34***</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Random Effects</th>
<th>Std. Dev.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>0.72***</td>
<td></td>
</tr>
<tr>
<td>Month</td>
<td>0.09***</td>
<td></td>
</tr>
</tbody>
</table>

- **N observations**: 28189
- **N individuals**: 2504
- **N months**: 33
- **$R^2$**: 0.40
- **RMSE**: 0.88

**Notes:** *** : p < 0.001, ** : p < 0.01, * : p < 0.05

Mobil-Flat subscriptions increase carsharing consumption

COVID-19 reduces carsharing consumption

---

Augsburg – lessons learnt and future work

- Reductions in private car use cannot be interpreted as sustainability increases per se as interdependencies with other modes have to be accounted for
  - How does carshare substitute other modes (e.g., private cars)?
  - What is the net effect (i.e., car-based travel)?
Augsburg – lessons learnt and future work

• Reductions in private car use cannot be interpreted as sustainability increases per se as interdependencies with other modes have to be accounted for
  ➢ How does carshare substitute other modes (e.g., private cars)?
  ➢ What is the net effect (i.e., car-based travel)?

• Comprehensive data on travel behavior with all modes (private car, public transport, walking, cycling, carshare, …) is essential to evaluate changes in travel behavior

• Missing data on any mode (Augsburg: private car travel) creates gaps that hinder conclusions on meaningful topics (e.g., net effects, sustainability)
Quantitative empirical evidence from 3 cities

Sydney (AU) 2019-2020

Augsburg (DE) 2018-today

Zurich (CH) 2020-today

MOBILE

FLAT

All means of transport in one app – also combined in your subscription
Zurich – research design

- Booking data
- Contextual data (e.g., weather)
- Shared mobility vehicle availability
Conclusions
Conclusions

- MaaS has several key components (app, platform, bundles)
- Bundles (not pay-as-you-go) have the potential to induce changes in travel behavior
- Bundle design is key (input ~ output)
  - Lots of free e-scooter minutes → lots of e-scooter use (at the expense of other modes)
- When conducting pilots: data is key (e.g., does carsharing substitute private car kms?)
  - Comprehensive (tracking) data on travel behavior with all modes
  - Treatment group and control group
  - Booking data to correct for “new modes”
- Research on behavioral implications is far from done
  - Comprehensive evaluation of bundle components on travel behavior → Yumuv/Sydney trials
  - Niche or game changer? → Augsburg trial
  - Business model? → Who pays for what?
Key publications summarizing our experience from three trials

• MaaS bundle design

• Influence of MaaS on travel behavior
Thank you for your attention!

Link to preprints of all papers: research.daniel-reck.de
Contact me via email: reckd@ethz.ch