**Activity-travel Behaviour in the Automated Vehicle-era: A Focus Group Study and a Time-use Model**

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**Anne’s story**

Before purchasing her AV, Anne used to wake up at 7:00 to get ready (shoes, eat breakfast) depart at 8:00, and reach work at 9:00. She contemplated visiting a swimming pool in the morning, but did not want to get up earlier to do so. In the evening, she used to leave her work at 15:00, head home, for a 30-minute nap, and drive to meet her friends at 20:00. She often felt very working-lenge, but did not want to miss out on her evening activities.

Now, Anne’s company allows employees to do their morning work in their AV’s. Anne leaves home at 8:15 and arrives at the office at 9:15. About 30 minutes of her journey she spends eating breakfast; in the remaining 30 minutes she replies to work emails. She takes the gained hour in the morning to visit a swimming pool. In the evening, Anne stays out at her house and half at work. She stays in her AV, which drives her straight to the meeting with friends.

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**Focus Group Study**

Who: TU Delft students and employees (1 group), Dutch working population who commute with car or PT (6 groups)

Scope: fully automated vehicles, mostly privately used. 100% safe, secure, available, customizable

**Focus group participants expected that...**

1. travelling in an AV would change

   - the pleasure of travel – for better or for worse
   - the feasibility of on-board activities, which would probably increase.

   The exact characteristics of AVs and travel in it will determine the scale and magnitude of these changes.

2. ...gained the freedom of new on-board activities, they may or may not perform new activities on-board.
   
   In addition, the chosen on-board activities may have different priority levels – mandatory activities (work, sleep, meals, personal care, scheduled appointments) or optional activities (e.g., hobbies without appointments, time to contemplate). Four types of on-board activities emerge.

3. ...gained of mandatory activities the AV [type 1] could save time and relaxes time pressure. However, the possibility to use travel time productively could also increase the expectations and pressure to work during travel. This pressure could be either formal (from a manager) or informal (peer pressure). Alternately, the expectations and saved time could balance out and restore the initial, pre-travel time pressure.

4. their daily travel demand may increase, remain unchanged, or even decrease, depending on activity needs and current feasibility. However, many participants indicated that their non-daily travel demand might increase by accepting further locations for activities, performing long trips more often, or by watching their travel mode from plane or train to AV for longer-distance trips.

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**Time-use Model**

Time-use theory (started by Becker 1965) postulates that individuals allocate their time to activities so that the utility is maximised while respecting time and money constraints.

We use this framework to build a model that incorporates the activity transfer, saved time and re-arrangement effects (see Anne’s story above). To do so, we split the ‘activities’ component from the time-use theory into three parts: stationary activities, on-board activities and travel. The three parts relate and interplay with each other as shown:

Activity transfers are inherent in this interplay on-board activity may ‘replace’ stationary activity and ‘gain’ time. The gained time is optimally assigned to other activities (and/or travel).

**Our model:**

\[
\max \left( \sum_i \left( \sum_j y_{ij} + \sum_k \left( \sum_m z_{ijk} + \sum_l y_{ijkl} \right) \right) \right) \psi \left( t + \sum_i n_i \right).
\]

subject to:

1. Time of Stationary activities + Travel = Total time
2. Time of On-board activities during any trip = Trip time
3. Shares of each activity (in different locations) sum up to 1 or 0
4. Define flag: activity is at least partly performed stationary
5. Define flag: activity is at least partly performed on-board during a specific trip
6. Shares of each trip (in different modes) sum up to 1 or 0
7. Define variables

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**Short answers to**

1. Are our modelled effects of activity transfers identical in the behaviour of PT users?
   - We believe not (although data is necessary to verify it). AVs are expected to facilitate activities better, especially mandatory activities (e.g., work, sleep) which may lead to more activity transfers.
   - Hence, it is especially crucial to apply our model for predictions of travel behaviour in the AV-era.

2. Should our model be added to models of higher order choices, such as residential location and vehicle type in the AV-era?
   - Yes. The activity transfer effects (presented in our model) are crucial for location choices, including the residential location. E.g., longer, further travel may be preferred for certain activities, as such as taking a nap in the example of Anne. Activity transfers are conditional on activity facilitation and therefore potentially an important factor in the choice of vehicle type (for purchase/rental).

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**Ask me for more**