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# Time-use in Automated Vehicles and Daily Activity Schedules: A Focus Group Study

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We investigate potential impacts of fully Automated Vehicles (AVs) on travellers' daily activity schedules. In contrast to previous work, we adopt a qualitative and exploratory approach, based on a series of focus groups. We observed a variety of behavioural responses, which we translate into conceptual maps. Hereby, we aim to enrich the debate about the potential effects of AVs on activity-travel behaviour and resulting mobility patterns.

## Research background

Automated vehicles (AVs) are expected to revolutionise transport systems worldwide, and consequently the shape and function of cities, the environment and other facets of our world (Milakis et al. 2017). It has increasingly been recognised that this revolution will not be due to the new AV technology in and of itself (that is, it will not be directly caused by AVs), but will rather be the result of fundamental changes in the human activities and the resulting travel behaviour. Nevertheless, **most existing studies into the effects of AVs either ignore the role of (changes in) activity-travel behaviour or represent activity-travel behaviour using oversimplified models.** More specifically, most studies routinely conceptualise the behavioural response to AVs in terms of a reduction of the penalty associated with travel time. This notion, which essentially frames the AV as being just 'a better car' overlooks key potential impacts on activity-travel patterns, which in turn are likely to be the main drivers of the AVs' higher order effects on mobility, cities, and the economy. Recent studies (Pawlak et al. 2015, 2017, Mokhtarian 2018, Pudāne et al. 2018) increasingly recognise that in order to do justice to the full range of impacts that may be anticipated when AVs are introduced to our transportation systems, it is necessary to adopt an activity-based, or time-use, perspective (Rasouli & Timmermans 2014, Kitamura 1988, Becker 1965).

The activity-based and time-use frameworks propose that individuals strive towards optimal or satisfactory utilisation of their available time considering a list of activities that they wish to perform, the locations where various activities can be performed, and the travel times to those locations. Given that a large subset of activities will be possible in the future AV, we can expect changes in time spent on activities at other times of the day, which in turn will impact travel and

location choices. However, the scale and form of these effects are unknown at present. Given this high level of uncertainty, there is a clear need for qualitative and exploratory research into AVs' impacts on travellers' daily activities; such research holds the potential to support and improve the development of more quantitative and confirmatory research endeavours. Although some qualitative studies (see references below) have addressed selected aspects of AVs (such as intentions to use the AV and activities that may be performed on board), the impacts on daily activity schedules have not been explored yet. Our study fills this knowledge gap by **exploring the potential impacts of AVs on travellers' activity-travel patterns using a series of focus groups.**

More specifically, we focus on the following topics:

1. The on-board time-use now and how it may change in the future due to AVs
2. The ways in which activities in the AV may influence the daily activity schedules of travellers
3. The ways in which activities in the AV may influence destination choice for other activities and residential location of travellers

## **Methodology**

For this study we conduct focus groups. Compared to other qualitative research approaches, such as individual interviews, focus groups allow participants to learn from, build upon and contrast each other's ideas (Kitzinger 1995). This is desirable for our study, as many participants may not yet have thought about the possible influence of AVs on their daily lives. In addition, previous studies show that focus groups can provide valuable insights on new transport technologies, see, for example, Kenyon and Lyons (2003) and Maréchal (2016).

This study builds on earlier studies, which have investigated various aspects of AVs using focus groups. In a report from the Institute for Mobility Research, Trommer et al. (2016) explore the activities that travellers intend to perform during the trips with their future AVs as well as the influence of those activities on the valuation of travel time. In a report from KPMG, Silberg et al. (2013) study attitudes towards the AVs and intentions to use them. Robertson et al. (2017) employs focus groups to study potentially unsafe driving behaviour using partially automated vehicles. We build on the successful experiences from these studies, but direct our investigation specifically into daily activity schedules of future AV-users. In the focus groups, we discuss questions such as the following: (1) *Imagine that you have an AV and can adjust its interior any way you like. What would you like to do while travelling and why?*; (2) *Do you think that performing activities in the AV, instead of outside it, could save you some time during the day? If yes, how would you use the extra time?*

All five focus groups have been conducted between September and November 2017. In total, we interviewed 27 participants, of whom most are car drivers or public transport users. The focus group discussions have been transcribed, and the analysis is almost finalised. We follow content analysis principles (Elo and Kyngäs, 2008) and present the outcomes in form of conceptual maps.

**Results**

One of the central themes in focus group discussions was the use of travel time now and the (expected) travel time use in the future with AVs. From the discussions emerged four distinct uses of travel time as well as a mechanism of adjusting the chosen activity to the on-board environment. These results are presented in Figure 1. Note that the figure applies to all modes; in this way, we can compare on-board time-use at present and in the future with AVs. Below the figure, a quote from focus groups illustrates each travel time use.

The uses of travel time can be ordered along two axes (see Figure 1): the time-flexibility of the chosen on-board activity (y-axis) and the facilitation level of that activity on board of AV or other modes (x-axis). Time-flexibility is understood as the freedom of choosing the time to perform the activity; the flexibility is restricted, if an activity need to be performed at specific time or has an approaching deadline. Activities with high time-flexibility were mostly associated with leisure or rest; however, sometimes these were tasks or chores with little time constraints, for example, administrative tasks. On the other hand, activities with low time-flexibility were mostly related to work, such as handling urgent situations via phone, participating in online appointments, and working while travelling in the office hours. Other inflexible activities related to personal/ household care, such as attending to a baby, morning routine in the AV, and rarely related to leisure.

Facilitation level is understood as the ease of performing the activity on board (x-axis). If the desired activity is poorly facilitated on board, but is inflexible, then the traveller often performs it anyway and bears the cost of doing so (it may be difficult or even dangerous to perform the activity on board, see quote 2). If the desired on-board activity is poorly facilitated but has high time flexibility, then travellers often replace it with another activity that is sufficiently facilitated on board of the chosen mode (arrows in Figure 1). Sometimes this mechanism was explicit in the statements of the participants (as in quote 1). At other times, the process could be unconscious and reduced to just selecting the best feasible and yet desired activity. When thinking of future travel with AVs, many participants imagined that the desired on-board activities would seldom, if ever, need to be replaced due to insufficient facilitation (as in quote 1). Travel time would become like ‘normal’ time: an extension of time for various flexible and inflexible activities (quote 3). In present, but even more so in the future, some activities may be enhanced by the travel environment (4 and 5).

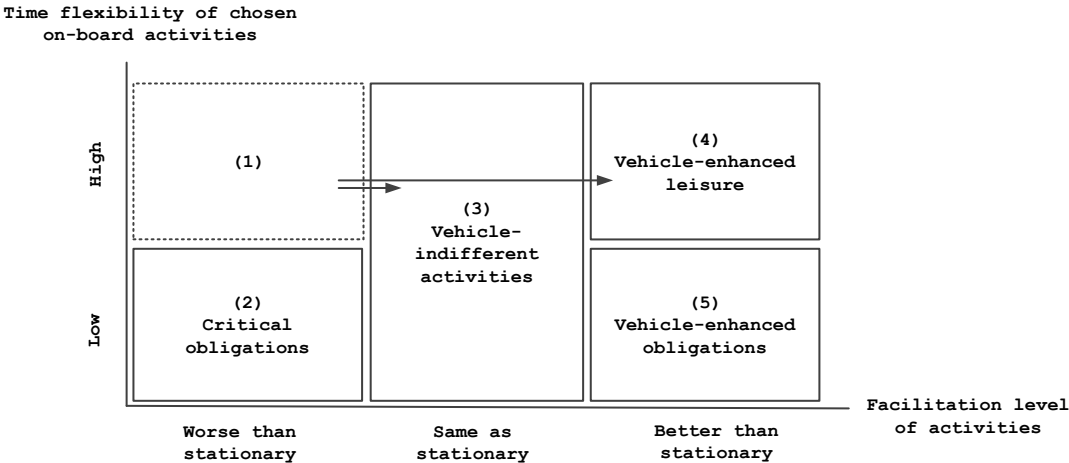


Figure 1: Conceptual map of the use of travel time

**(1):** *'I would like to use my time in public transport differently. But I often travel in the peak hours, I do not like to open my laptop, then you're on your cell phone for a bit, just on the internet doing nothing.'*

**(2) Critical obligations:** *'Yes, to my big shame, I have to admit that I send WhatsApp's behind the steering wheel, but I cannot avoid that, it's for my work. On my way, I make calls, I try to put it on Bluetooth, with calls, I usually do. But often my boss sends a WhatsApp to me, that's the only time I have contact with that man.'*

**(3) Vehicle-indifferent activities:** *'For me, it would be more efficient use of time (in an AV), your work time starts as soon as you get out of the door. On the other hand, your free time starts again when you step out of the door at work, or that last bit of work time you can do on your way home. That ultimately gives you more free time, so you can be more relaxed.'*

**(4) Vehicle-enhanced leisure:** *'In public transport I used to read quite a lot, more than when I am at home. (...) The aspect of moving and changing places makes me willing to read. (...) Travelling is an experience. Reading is an experience as well. It is a kind of travelling.'*

**(5) Vehicle-enhanced obligations:** *'I would make a pedicure studio in my (automated) car. (...) I always have to go to the customer with my suitcase, that is quite a heavy thing. Now, on the way, I could clean my things for the next client. A studio in an AV would save me a lot of time. Even energy. (...) The car then gets a completely different function.'*

The different uses of travel time in Figure 1 suggest different impacts of the on-board activities on the daily activity schedules. Most re-arrangements in schedules happen if inflexible activities are transferred to be performed on board: the shift either frees time for other activities in case of time pressure or re-arrangements are due to purposeful scheduling of activities to be performed while travelling (such as in quote 5). In addition, re-arrangements were often mentioned in the holiday plans: thanks not only to transferred activities (such as night sleep, quality time with family), but also relief of driving burden, many respondents were enthusiastic about being able to make long distance trips and combine that with active leisure activities at the destination (a finding also of LaMondia et al., 2016). Yet, more detailed analyses are still being developed of the various activity re-arrangements as well as the potential changes in destination and residential location choices in the AV-era, which were also discussed in the focus groups.

Besides covering the core topics of interest, focus groups sometimes advanced towards discussing other possible lifestyle changes in the AV-era. This yielded several interesting and unexpected insights. For example, respondents were concerned that the potential to use travel time productively could lead to more pressure due to higher expectations at work and elsewhere (which resonates with the reasoning of Ackerman and Gross, 2003). Furthermore, respondents anticipated increased social isolation and possible deterioration of health due to more door-to-door trips in the future. These discussions are yet being analysed and conceptualised in maps similar to the one above.

In conclusion, our work contributes to the rapidly increasing body of literature on AV-effects, by studying the impact of AVs on daily activity schedules of travellers and related aspects – and doing

so by using a qualitative, explorative research paradigm. We believe our results contribute to a more comprehensive and behaviourally rich understanding of travel and time-use in the AV-era.

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