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Time Use during Activities and Trips – Potentials for Analyzing Future Travel and Activity Behavior

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Abstract

We carried out a survey with students on time use during activities and trips with upcoming fully automated vehicles (AV). Compared to current time used in public transit, in AV more attention-demanding activities will be undertaken. Shorter trips lead to use the time with less attention-demanding activities. Time use differences originate in the current mode. Using time in the vehicle for activities, people save time outside it. This is mostly done to extend previously existing activities or to spend more time at home. However, around 15% of the students will perform new activities, which leads to an increase of travel demand.

Keywords: Time use; travel demand with fully automated vehicles, activities while traveling

1. Introduction

In travel behavior surveys, the examination of trips and trip characteristics are an essential element. Generally, the analyses of behavior surveys consist of modal split, travel times and traveled kilometers among others. In some cases, activities are surveyed or determined as a spin-off of the trips, respectively. The combination of individual activities and trips lead to the whole picture of people´s daily actions. The trips are used in order to get behavioral key figures for planning purposes or as an input for travel demand models. For the forecast of travel behavior assuming slight changes in transportation supply and behavior, these data and methods are sufficient. If we assume major disruptive changes such as fully automated vehicles (AV) or the intensification of mobile office (e.g. working

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at home or while traveling), people´s daily actions might change fundamentally. If people can perform other activities during a trip (e.g. working or reading a book) and at the same time have the flexibility of car use, they could be able to organize their daily life in a different way compared to today. Giving an example: If people have the possibility to work in a car while commuting they do not need to work as long in the office as today and they are earlier at home and can perform other activities at home or elsewhere. In order to analyze the people´s time use and in the next step to forecast changes in travel and activity behavior, we need to know, how the today's travel time use of people looks like. Afterwards, we are able to predict changes in people´s behavior with new technologies such as AV or changes in working circumstances.

This case study was a methodically oriented pretest for a large-scale survey as base for a study on effects of private autonomous vehicles in travel behavior. Meanwhile the large-scale study is finished, and we are able to identify interesting results: Assuming that a very high share of autonomous vehicles is in the market, we expect high potential for increased for PT use in combination with shared transportation services. However, at the same time, increases in individual motorized traffic in terms of trips (+2.3%) and vehicle kilometers traveled (+6.8%) are expected. Based on the pretest, presented in this paper, the questions for the large-scale study could be optimized to obtain tailored responses on this difficult-to-survey topic. At the time of the pretest study, there were almost no research approaches and survey methods on the effects of autonomous vehicles. Our pretest helped us to identify pros and cons of different questions and survey methods on this topic.

In our pretest case study we focus on behavioral changes towards AV and surveyed the time use and travel behavior as well as related potential of these changes within a group of students. In this study, the target group of students is used because they often deal with new technologies and they are open minded regarding this issue, thus it is very likely to get useable answers. Furthermore, they are the main target group for the application of AV in 10 to 20 years, when the AV are fully developed and mass ready and the today´s students in the middle of their business life. The survey consists of two parts: First, students report their typical travel behavior including commuting trips to the education location and their time use. Second, the characteristics and functionalities of fully automated vehicles (Level 5) (SAE, 2018) are introduced to the participants. In the paper use AV for these fully automated vehicles. The students are asked what they would do during their trips and how this would affect their activities, if they are "transported" fully automated, e.g. if they perform more and other or longer activities. Further, the general attitudes towards new technologies are surveyed. The survey is carried out in two countries, Germany and Austria.

With this survey methodology and data, we are able to get a first idea, amongst others,

- how the time use in trips and activities look like,
- how changes in time use or activity scheduling due to AV may look like and
- if such a survey design is suitable to answer the question of changing travel time use or activity scheduling.

Over time, changes in time use within a trip are possible, due to new communication technologies, such as smartphones, powerful communication networks (4G, 5G), and the possibility to work or perform other activities at different places. In the near future the planned use of AVs fosters theses above mentioned issues because people do not need to attentive while traveling with cars as a driver. People using public transit (PT) are already able to perform other activities during the traveling process. The idea is to learn from these people and transfer the results to non-used PT travelers. But those people behave very different thus it is advisable to conduct a survey in order to analyses the general behavior during trips. Additionally, the situation in PT vehicles is very different to private cars, because one is more or less alone or with only a few passengers in a car and you can behave different in contrast to trips in PT vehicles. The situation in AV may allow to enhance more attention-demanding activities (e.g., mobile working) or privacy-demanding activities (e.g. sleeping) during trips.

The paper is structured as follows: First, we discuss existing (survey) data for their applicability to describe possible changes in travel behavior due to new technologies or new kinds of mobility systems and services. Second, we introduce the case study survey with the questionnaires, the survey content and the survey methodology. Third, we present the results of the survey. This is followed by the discussion of the possibilities and limits of the used survey method and a conclusion.

2. Data Sources

Impacts on travel behavior due to changes in the transport and mobility system are usually predicted based on representative national household travel surveys (NHTS). In Austria, the last NHTS from 2013/14 (Österreich-Unterwegs) is based on travel diaries. About 20,000 households took part in the survey and reported their trips on

two days (Tomschy et al., 2016). The travel diary collected trip-based data such as trip purpose, origin/destination, start/end time, trip distance, and travel mode(s). Household- respectively person-based data (such as availability of travel modes, vehicle ownership, socio-demographics) are also collected. As a result, an appropriate data set is available for working on (complex) transport related questions. Similar variables are collected in other NHTS. As a data base for the travel behavior of the German population the study Mobility in Germany in 2017 (Mobilität in Deutschland, MiD) can be used. In MiD, the data of an overall sample of more than 155,000 households were collected through a one-day travel diary (Federal Ministry of Transport and Digital Infrastructure Germany, 2017). Another data source is the German Mobility Panel (MOP) collecting information on people's everyday mobility (Zumkeller et al., 2011). MOP is a longitudinal survey focusing on travel behavior (one-week trip diary) as well as an odometer reading and fuel consumption in private households.

However, the data sources described focus on trips and therefore, the use of both all mentioned survey above is limited for questions in the context of fully automated driving. For example, the data contain no information on time use, for example, while traveling in public transit (PT) or as a car passenger. In this context, the individual travel satisfaction and peoples' transport-related attitudes and habits might be relevant. Furthermore, most of the travel data do not contain information on underlying reasons for mode use. This knowledge might be decisive, as automated vehicles cannot be treated as a regular transportation mode alternative, but something new. Ignoring this information may lead wrong estimations regarding the adoption of this new technology in the travelers' daily use (Guo et al., 2020). Other challenges are, that "typical" data from travel surveys do not contain information on routes or activity stages. This can, however, be an interesting aspect when it comes to simulation of AV.

In the assessment of automated driving, changes in the value of time assigned to travel (VTAT) and the value of travel time saving (VTTS) are of interest. The VTAT describes the direct benefit resulting from the time spent within a certain travel mode while traveling (can be positive or negative). It depends on the travel mode and characteristics such as comfort, reliability, safety, etc. and the opportunity to use the travel time in a productive way. The VTTS considers the loss in benefit due to traveling, because other activities cannot be undertaken during that time. Due to the increasing digitalization during the last years, it is apparent that the travel time loss is less highly valued compared to car driver trips, because the availability of mobile devices makes travel time more usable. Automated driving will set the car's VTAT to be more focused, because of the elimination of the driving task – similar to the use of mobile devices in PT. Travel time can be used for other activities and will be considered more advantageous (increase of VTAT, decrease of VTSS). Car use will become insensitive to an extension of travel time (for example due to congestion). These remarks clearly indicate, that additional data is needed when it comes to the question of travel time use and, particularly, how changes in travel time use due to automated driving might interact with or affect other activities of the people.

Many studies have been elaborated recently concerning the effects of autonomous vehicles on the VTTS, often based on discrete choice experiments, but also qualitatively using interview studies. The overall image is ambiguous. While there is a slight tendency towards the impression that using AV the VTTS lowers, at least for commuting trips (Moore et al. 2020, Correia et al. 2019, Steck et al. 2018, Kolarova et al. 2019, Gao et al. 2019, Zhong et al. 2020), some researchers state that the effect will not be too large as people still will prefer to perform activities outside the vehicle (Singleton 2019, Pudane 2019, Kolarova 2020). However, what activities are replaced by which others is often not examined.

Activity-based diaries could offer appropriate data if they also contain information on time use while traveling. However, at that state, there are no up-to-date national activity surveys in Austria. The last time use survey was conducted in 2008/2009 with 8,200 participants (Austrian Time Use Survey, ATUS). They had to report all of their activities (primary and secondary activities) lasting longer than 15 minutes in a diary for an entire day (Statistics Austria, 2011). Participants had to report if the activity is conducted at home or not, however, no in-depth information in terms of traveling (such as addresses or travel modes) is collected systematically as travel patterns are not in the focus of ATUS. Thus, there are several problems when it is used for analyses in the mobility context, e.g. trips are strongly underreported, therefore its suitability for analyzing travel estimates and behavior, is limited (Aschauer et al., 2018).

In Germany, the Time Use Survey (Zeitverwendungserhebung, ZVE) collects data on activities as well as travel and mode-use patterns over three days, within ten-minute intervals (FDZ, 2013). The last survey in 2012/13 included 5,000 households. Further, households report socio-economic and socio-demographic data. With the help of time plan sheets primary and secondary activities could be reported. However, similar to ATUS, no complete picture of travel patterns can be derived because activities shorter than 10 minutes are ignored. Furthermore, information on

geocoding and if activities are conducted at home or in vehicles or elsewhere is missing.
Other appropriate activity-based data sources do not exist in Austria and Germany. To summarize, both, typical travel survey data and time use survey data do not offer appropriate information in the context of our research questions. Furthermore, the specific activities that students (Gen Z) would perform in AV is not known yet.

3. Survey approach

In our survey on students, we focused on commuting trips from home to university, as it can be expected that all respondents perform it regularly and thus answers are comparable among the respondents. In the questionnaire we first asked the respondents to give information on their commuting trip to the university: habitual mode of travel, trip duration and trip length. If the usual travel mode is public transit (PT), hereafter the interviewees were asked for the activities they perform on this trip. This was done in a two-step approach: first, they were asked to choose which activities they perform among different categories, second, they were asked to give exact durations for these activities. Using plausibility checks we ensured that the time the respondents entered summed up to the total trip duration. The following parts of the questionnaire were used for all respondents. Respondents got a visual and textual description of a fully automated vehicle (Level 5). The respondents should assume that they could use it individually (not shared with others) and that the vehicle would provide a high level of comfort, including a reclinable seat, a huge flat screen and a table. See Fig. 1 shows the introduction of the AV characteristics to the respondents in detail.

English translation of the presented text

Now imagine that you would dispone over a novel car-alike vehicle. In the vehicle you would not need to drive by yourself, but it would accomplish the whole trip without your intervention (fully automated). Assume that the technology has been used successfully for several years, and that it is safe.

Furthermore, the vehicle has the following characteristics:

- You can dispone freely over the vehicle, and you can ride alone.
- There is plenty of space and a comfortable seat, which may be put into a reclined position.
- There is a huge screen with fast and unlimited internet access. Furthermore, a keyboard and mouse may be accessed by pressing a button.
- A table may be swung out.
- The vehicle is driving in an especially balanced way. While reading, no carsickness must be feared.

Please also orientate yourself by the following figure.

Fig. 1. Survey page introducing the AV

The respondents evaluated the vehicle based on several items using a 5-point Likert scale. Hereafter, they were questioned for the activities they would perform in the AV and the time for each activity. This was undertaken in the same manner as for the current activities with PT users, as explained above. Following, they were asked, if the time they would spend on in-vehicle activities, would (i) lead to a reduction of the time they would perform the same activities in other places, or (ii) if the in-vehicle time would be used “on top” (additionally) for other activities. Additionally, we asked how they would use the time saved, in the future. At the end, we collected sociodemographic data about the respondents. The survey was implemented as an online questionnaire.

The study took part from January to February 2020. We conducted the survey with a group of students of Bachelor's and Master's degree in the field of transportation and mobility at two different universities, one in Austria, one in Germany. 66 respondents completed the survey. Our sample consists of 45 students from the University of Natural Resources and Life Sciences Vienna (BOKU) in Austria and 21 from the Karlsruhe Institute of Technology (KIT) in Germany.

4. Survey Results

Despite the small sample size, the results are also of interest for automotive practice. There is not yet enough information about Generation Z in particular (born after 1995). As digital natives, they have new customer expectations of interior design and immersive digital experiences (e.g. gaming) in the car, which are only made possible by autonomous driving. The findings from this study can provide initial suggestions for product design in the pre-development phase. We assume that time use while travelling becomes more likely with increasing travel time. Therefore, in our analysis we focus on commuting time from home to university: Table 1 shows the characteristics of the current commuting trips of the students. In our study, 64% of the students have a travel time of 20 minutes or more. 30 minutes or more still have 35% of the students. This travel time can be used differently. For some travel modes, activities during the trip are limited due to the fact that this person has to concentrate on driving or cycling. 64% of the students in our sample use passive mobility and travel by bus, train or tram. These people can already use their travel time for other activities like reading or watching videos. The question arises, however, whether with the introduction of AV, travel time will be used differently in the future. For this reason, we asked about the current and future use of travel time when AV for commuting are available.

Table 1. Characteristics of the current commuting trips

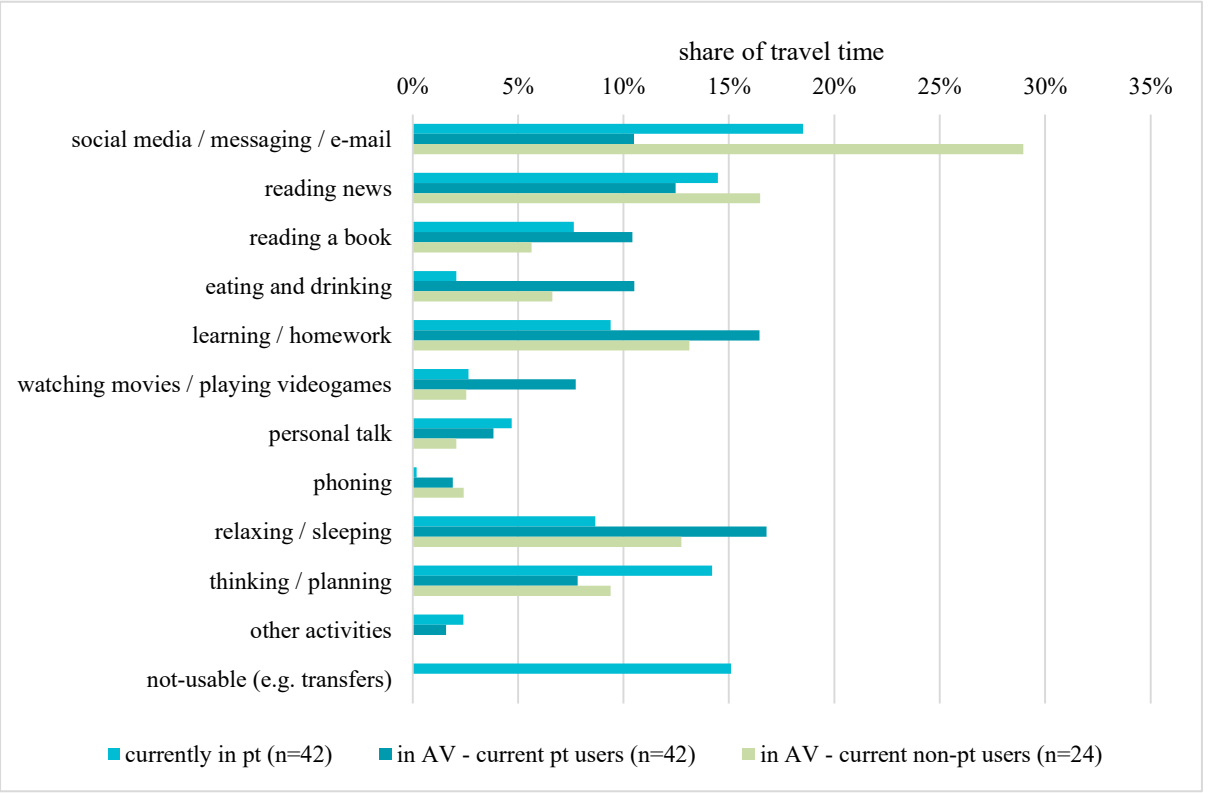
Variable	Categories				
	< 10 min	**10 - 19 min**	**20 - 29 min**	**≥ 30 min**	
Share of trip duration	12%	24%	29%	35%	
	< 10 km	**10 - 19 km**	**20 - 29 km**	**≥ 30 km**	
Share of trip length	77%	8%	2%	14%	
	Car as driver	**Public transit (rail)**	**Public transit (bus)**	**Cycling**	**Walking**
Share of modes for commuting	2%	53%	11%	29%	5%

n=66

AV can change the conditions for travel time use on the commuting trip. Therefore, we investigated to what extent the travel time use of the participants will possibly change in the future situation with AV. For the following analysis, based on the individual answers of the respondents concerning their travel time and the time spent for different activities, we calculated the share each activity is performed relative to the overall commuting trip. Figure 1 shows the average percentage of travel time use in the current and future situation. We visualized only the current travel time use of public transit (PT) users, because all other persons using modes where they have to concentrate on driving, walking or cycling (= concentration-demanding mobility). Currently, an average of 15% of travel time is also unusable for PT users (e.g. by transfer). It is assumed, that in the future situation, all people use AV, both, the current passive and concentration-demanding mobility users. Therefore, in the future all people can use this time for other activities during the commuting trip.

Differences in the type of activity should be taken into account, if changes in activities are considered. Some activities are demanding and you need to be focused to perform them; other activities are less demanding. People have only a limited capacity to perform attention-demanding activities. Distraction by other passengers makes it difficult to learn, read a book or think. Other less demanding activities such as messaging or social media are less problematic. There are still less demanding activities that are not carried out for other reasons, such as sleeping and eating, as these activities are presumably perceived to be more privacy-demanding.

Figure 1. Potential for changes in travel time use for commuting trips through autonomous vehicles



The results show a decrease in the share of time spent by current PT users for the less demanding activities such as social media, messaging and e-mail (Figure 1). An opposite effect can be seen for persons with a current concentration-demanding mobility for commuting by AV use. On average, they want to spend almost 30% of their new time on social media, messaging and email. This number is even higher than the use of such services by current PT users.

A positive effect is the increase in more demanding activities by current PT users through AV use for commuting. In the existing public transit system, they do not seem to be able to conduct these activities in such an extent. Such a change in travel time use would have a positive effect on time management of students. In particular, for the preparation of courses, an added value could be created for those students. An unexpectedly strong change can be observed for eating and drinking. Especially current PT users will use more time for these activities. The reason could be the increased privacy and comfort in future AV. This opinion is also confirmed by the increase in sleeping or relaxing time for commuting. Current non-PT users also see a potential advantage of AV in this case. An interesting result is also the increase of video games and watching movies while commuting to university. Only the current PT users would invest more time for this. Current non-PT users would get to a similar level as the current use of the PT users. The better-equipped AV compared to PT, as described in the survey, may lead to this increase. Statistical tests (t-test) show that using AV current non-PT users behave significantly different from current PT users in the activities of social media (95% confidence level) and watching movies (90% confidence level). The changes from PT to AV for current PT users are significant for all activities except reading news, reading book, personal talk and other activities (95% confidence level, paired t-test)

The activities performed are also dependent on travel time. For a more detailed assessment, we considered the different travel time classes. Table 2 shows the change of relevant activities. The activity learning increases in both time classes, for trips longer than 30 min by more than 100% (significant difference on 95% level between current use in PT and in AV). We do not see any difference in reading books in this travel time class between AV and PT, however, we see much more time spent on this activity for longer trips than for shorter trips (significant on 95% level). For the less attention-demanding activities, results show a similar picture as in Figure 1. In both time segments, the share of e-communication uses is shrinking (significant on 90% level). Watching videos and playing

games only becomes relevant for commuting with AV if the travel time exceeds 30 minutes (difference is significant on 90% level). For the more privacy-demanding activities, the results show a strong increase – the differences in both activities eating and drinking, as well as in relaxing and sleeping between spending time in PT and in AV are significant (on 95% level, except relaxing and sleeping in the larger than 30min time class). Time savings could also be achieved, if people can have e.g., a relaxed breakfast while commuting. With regard to potentials for future activity behavior, it is evident that travel time is increasingly used for attention-demanding and privacy-demanding activities in AV. Despite this is only a presumption of the participants of this survey, strong implications for future travel behavior may be interpreted.

Table 2. Comparison in share of travel time in different travel time classes

	Currently (PT users) 10 - 29min (n=20)	**In AV (all) 10 – 29min** (n=42)	**Currently (PT users) ≥ 30 min** (n=22)	**In AV (all) ≥ 30 min** (n=24)
Activities *(share of travel time in %)*				
attention-demanding				
learning / homework	12%	15%	7%	16%
reading a book	0%	6%	15%	15%
watching movies / playing video games	2%	2%	4%	10%
less attention-demanding				
social media / messaging / e-mail	22%	18%	14%	10%
news	19%	17%	11%	10%
privacy-demanding				
eating / drinking	0%	8%	4%	11%
relaxing / sleeping	7%	16%	10%	15%

In order to obtain further indications, we asked the participants whether they save the activities (which are performed while commuting) elsewhere. If a change in the travel time use in AV would also result in a relief in daily life for the participants, then this technical progress will have a far-reaching effect on people's activity behavior. Results show that non-PT users see AV as an opportunity to use travel time for e-communication and to spend less time on e-communication in the remaining time. The same applies most likely to book reading and phoning. For attention-demanding learning and homework, in several cases the time is added and less replaced. To what extent this really happens cannot be clarified conclusively at present. However, it would be a positive effect, even if it does not lead to any time savings. Current PT users save time mainly by checking news and making phone calls. This group also considers reading a book to be a relevant way to save time in the rest of the day.

Concerning activities, which are moved from outside the vehicle inside vehicle, it is furthermore of interest how this saved time is spent again. Therefore, around half of the survey participants who would save time due to performing activities inside of the vehicle were asked how they would spend their time instead (n=20). This was done using a multiple response answer type. 57% of the participants state, that they would spend more time at home, 43% would extend an existing out of home leisure activity and 19% would start a new out of home leisure activity. 10% would spend their time otherwise. While the results can only be seen as indicative, the survey indicates a tendency towards spending more time at home and extending already existing activities. It seems plausible that a higher percentage would extend previously existing activities instead of starting new activities, as the absolute time in question is relatively small, and smaller than the duration of most activities.

The possibility of changing travel time use is extensive. In the new situation, however, there will also be a process of adaptation, with out-of-vehicle activities increasingly being shifted to AV. Our study reveals important

implications for future travel and activity behavior. In summary, it is worth mentioning that attention-demanding activities benefit most of all from AV. However, several assumptions were given in the survey for the respondents and it remains to be seen whether in fact AV can, e.g., reduce lateral and longitudinal accelerations and thus reach such high travel comfort, as well as if the respondents would in fact behave as stated in the survey.
Finally, we compare the students from Austria and Germany. In our study, we asked German and Austrian students, which activities they would like to perform in AV in the future. In Figure 2, we analyzed the middle travel time class (10 - 29 min) of the two groups. German students often mentioned the use of e-communication and relaxing or sleeping. This is also due to the higher proportion of current cyclists in the German subsample. They change from concentration-demanding mobility to passive mobility through AV use. For the Austrian group, social media play not such a strong role. Among Austrian participants, following the news is mentioned much more often. Using travel time for learning is considered equally important in both countries. In general, the activity learning or homework is often mentioned by the participants. For attention-demanding activities, the differences between the countries are much smaller. The less demanding activities in this travel time class show large deviations as mentioned above. Statistical tests show that the differences are significant for phoning, reading news, social media and other activities (95% confidence level), as well as for relaxing and sleeping (90% confidence level).

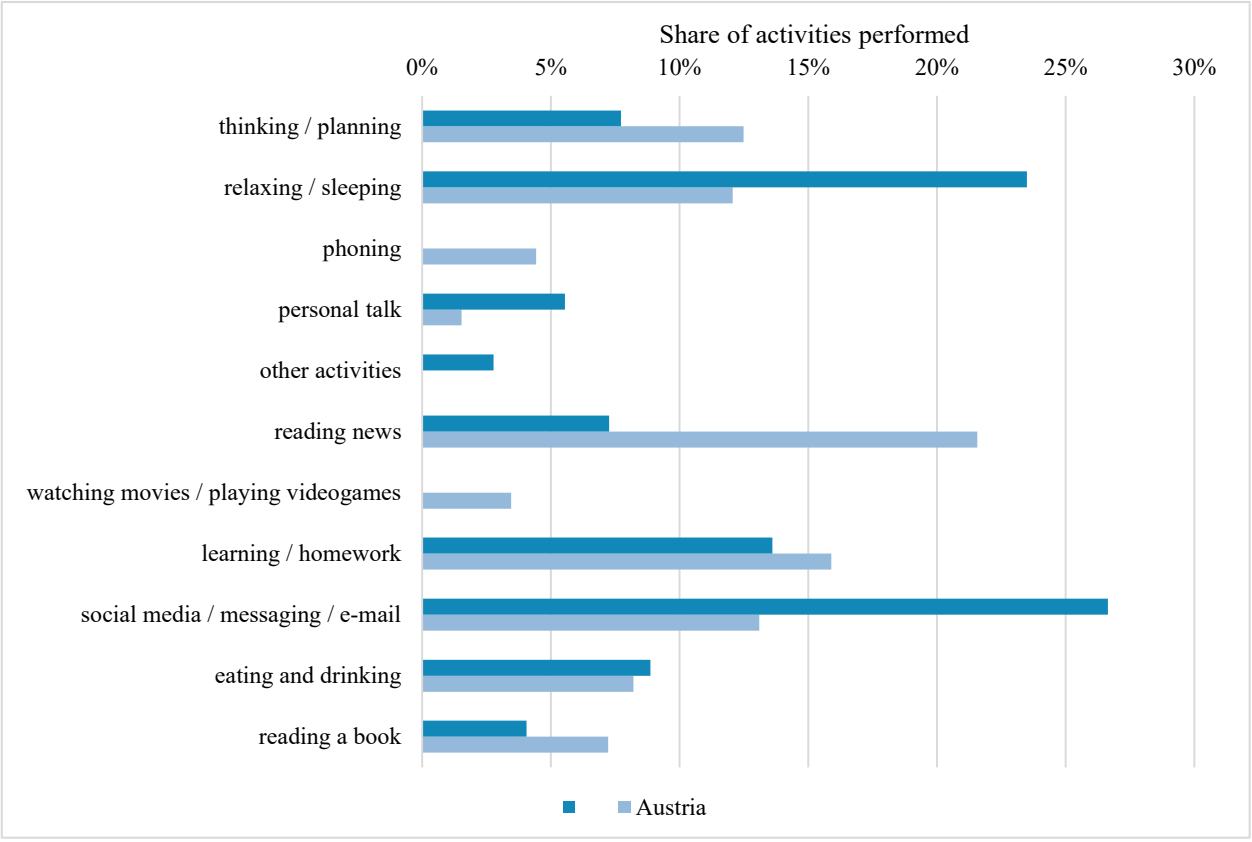


Figure 2. International comparison of activities performed in AVs in travel time between 10 to 29 minutes

5. Limitations and Discussion

Our survey is suitable for getting data about the future time use of travelers while traveling in AV. In more detail, it gives an impression how changes in travel time use due to fully automated driving might interact with or affect other activities of the users. However, there are some limitations of our study which will be addressed in the following.
In general, the overall topic of future time use in AV requires the design of hypothetical scenarios. Using a typical

trip of the respondents (commuting trip to university) should minimize the probability of unrealistic responses. Nonetheless, there is still the possibility of over-/underestimation of users' reactions on future technologies. Furthermore, it must generally be relied on the people's faculty of judgment concerning a currently non-existing situation. The results should, thus, be interpreted with caution.
It can be assumed that regular PT users might have a more realistic assessment of their future activities performed within AV. Cyclists, in comparison, might have more difficulties to empathize with the hypothetical situations presented in the survey as they, presumably, do not associate travel time with other activities than concentrating on traffic. But they may have experience of using PT for other trip purposes or for long-distance travel at weekends. Although typical PT users may have a more realistic perception of travel time use within the vehicles, at the same time, they might tend to project their picture of current PT-characteristics one-to-one on future AV. They therefore might underestimate, for example, the vehicles' high comfort. In terms of current activities while traveling it has to be considered, that eating is not allowed in some PT modes in Vienna, for example in the metro.
From a methodological point of view, it should be noted that only university students were included in the sample. It can be assumed that younger people are more open to technical innovations. Other surveys on attitudes towards automated driving show that younger age groups have a higher initial enthusiasm and less distrust compared to older age groups (Kantar Deutschland GmbH, 2017). Focusing university students does also lead to the low share of car-drivers in the sample. Furthermore, a high educational level might come along with a higher level of information in terms of automated driving. The respondents' level of information was not subject of our survey.
Some differences regarding the two settings (university cities) with respect to current travel patterns have to be considered. In the city of Vienna, Austria, cycling is not as popular as in Karlsruhe, Germany: Based on the national household travel survey in 2013/14, the share of cycling trips in Vienna at working days is 4% (Tomschy et al., 2016), whereas in Karlsruhe the share is 23% (Ministerium für Verkehr Baden-Württemberg, 2019). The main site of the University of National Resources and Life Sciences Vienna (BOKU) is situated on a hill making cycling challenging in one direction. Nonetheless, the students use the bicycle more often compared to the population in the city of Vienna: a travel survey amongst BOKU students in 2014 showed that 12% of their trips are cycling trips (52% PT, 16% car-driver, 20% walking) (Meschik, 2019). The mobility survey on students and employees of the Karlsruhe Institute of Technology (KIT) in 2017 shows that 47% of all students use bike for their daily trips (24% PT, 26% walking and 3% cars) (Institute for Transport Studies at KIT, 2017). When comparing these figures to the results of our survey it must be noted that these surveys considered all trips, not only trips to university.

6. Conclusion and Outlook

In this presented pretest study with students on time use during activities and trips in the background of upcoming automated vehicles (Level 5), we analyzed possible changes on travel behavior and time use. The survey was carried out in two cities, Karlsruhe and Vienna, with 70 participants and the students entered existing time use and assumed future time use as well as activities due to fully automated vehicles (AV).
Considering the above-mentioned limits of the survey, the results show that the potential target group of students with a commuting time of more than 30 minutes is 35 %. This means around one third of the students are able to gain some benefits of performing activities during commuting trips. Nowadays, 30% of students' travel time in public transit is used for homework or learning – 70% for other activities such as social media or reading news.
In our survey, we investigated shifts towards more attention- and privacy-demanding activities, such as learning, reading a book, watching a movie or sleeping when AV are used. In contrast, activities which are less demanding, such as following the news or social media/messaging, are expected to be undertaken less, compared to current PT users.
By performing activities inside the vehicle, people can save time outside of them. Thus, two effects on travel behavior may occur. First, students do not have any benefits of AV because their trips are too short for saving time in a senseful way and they spend more time for doing more or less the same activities. This leads to no changes in travel behavior. Second, people may start new activities with the saved time. Around 20% of the respondents indicated that they would start new leisure activities with the time saved. This implies more trips which leads to an increase of trips and more loads on the transportation networks.
Additionally, this pretest study, on the one hand, helps to get an idea how travel surveys in general have to be adjusted in order to observe such changes in travel and activity behavior regarding new technologies or changing circumstances. On the other hand, we can get an idea how our forecast tools have to be adjusted in order to include

future travel behavior correctly. In general, and in an early stage of research on AV, this study helps us to get information how to ask questions to survey travel behavior by using autonomous vehicles in PT and private car use. By adopting the key findings of this pretest, we have been able to make a tailored large-scale study on this issue. Today, the large-scale study is completed and in retrospect we were confirmed that the questions identified in the pretest led to very good results. This is a good sign for the practical relevance of the work.
Nevertheless, his pretest case study shows possible changes in travel behavior due to AV in the students' person group, that have a high impact on future mobility behavior. But we know from other data sources that the travel behavior of students is different from others, e.g. employed people. Further research based on this pretest study has included all age groups to get reliable results for the whole population. With this pretest survey we could ensure the used survey method has some limits, especially regarding future individual behavior assumptions of the participants, but it also has provided useful results for possible travel behavior changes and effects on future travel behavior.

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