Smartphones, travel time-use and attitudes to public transport services

Insights from an explorative study of urban dwellers in two Norwegian cities

Tom E. Julsrud

Jon M. Denstadli

1. Introduction

When the first generation of GSM mobile telephony was introduced in the early 1990s, use while travelling rapidly became a favourite activity. Not only could the user make calls on the way between home and work, where fixed-line phones were usually located, they could also exchange short text messages (SMS). The surprisingly fast uptake of texting (SMS) was a reflection of its usefulness as a communication tool aboard trains, buses and subways. Texting on the mobile phone was a way of being expressive in situations where other forms of communication were less appropriate (Ling 2004, p147). The exchange of short messages between family members and friends became habitual in dealing with boredom and in sustaining social ties while travelling on public transport.

Although still a favourite activity, texting has been greatly extended with the introduction of many other portable devices and services. Mobile phones and tablets utilizing an online connection to the Internet, i.e. "smartphones",[1] have given the traveller a much wider menu of communication services: exchange of emails, online gaming, watching movies and reading on-line news are among the opportunities now available for most travellers in urban areas. Moreover, an apparently endless stream of small-scale downloadable applications ("apps") is providing smartphone users with a wide range of dedicated services, many developed to meet the needs of travellers. These include car-sharing applications, public transportation ticket services, tourist city guides, and much more (Julsrud, Denstadli, and Herstad 2014). According to recent statistical surveys, there are over 3 million apps available from Apple and Google web-stores, 5–10 percent of them directly related to travel.[2]

Briefly, the mobile phone has been transformed from an instrument for talking and texting into a personal multi-media centre providing information on almost any kind of activity related to communication, navigation, coordination and entertainment.

---

[1] The term "Smartphones" is used for mobile phones equipped with an Internet connection. "Smart devices" refers to phones, tablets and other portable devices that have wireless access to the Internet.
[2] http://www.statista.com/statistics/276623/number-of-apps-available-in-leading-app-stores/

Empirical investigations have documented that access to mobile communication technology before and during travelling has a bearing on how passengers on public transport use their time. Activities once closely related to geographical place – work, education and leisure – have become increasingly fragmented into multiple smaller time-slots in many different places, including public transport carriers (Lenz and Nobis 2007, Alexander, Ettema, and Dijst 2010). Public transportation has become a "place" where different activities are carried out, and is an opportunity for multi-tasking with different degrees of complexity (Kenyon and Lyons 2007, Guo, Derian, and Zhao 2015). Moreover, mobile technologies seem to spur more frequent micro-coordination and spontaneous patterns of mobility (Ling and Yttri 2004, Rheingold 2002). Even though studies in this field are in their infancy, it seems fair to conclude that mobile communication tools are influencing the practice of travelling.

It is frequently argued that the new mobile technologies provide public transport facilities with advantages vis-à-vis the private car, since public travellers have "freed their hands from the steering wheel", using them instead on their Smart devices (Urry 2007). Mobile media seem to have the capacity to enrich travellers' time-use, given the opportunities embedded in Internet connected portable devices.

Even though several studies have found that mobile communication technologies influence the use of travel time, few studies have discussed how they actually influence general attitudes to public transport. For the most part it has been assumed that possibilities for enriched use of travel time in general *strengthen positive attitudes* to public transport. The alternative hypothesis – that mobile communication technologies make travellers more critical and demanding, e.g., due to the risk of interference – has so far hardly been explored through empirical studies. In this paper we intend to move this discussion further by investigating not only how new mobile technologies influence travellers' time-use, but also how use of mobile media are related to passengers' attitudes to public transport services.

2. Literature review

2.1 Mobile media – a blessing or a curse?

Material objects such as newspapers, clothes, bags, books and knitwear have always been mundane features of people's travel routines (Middleton 2011, Lyons and Chatterjee 2012, Jain and Lyons 2008). In most cases, these artefacts are brought along on the journey to give meaning and content to the travel time. As noted by Gasparini (1995), "the equipped traveller" will have better opportunities for a richer and more varied use of his/her time on board. This argument has been supported by empirical studies of travellers' use of time on public transport. For instance, in a study of UK train passengers, Lyon et al. (2007) found that every second traveller spent some of their time reading, while one in three spent most of their time doing so (Lyons, Jain, and Holley 2007). Travellers who had prepared for their (equipped) journey were in general more confident utilizing their travel time than those who didn't make any plans.

More recently, mobile communication technologies (from now on called "mobile media") have arrived as new and highly important tools that travellers have with them on their everyday travel. Compared to artefacts like newspapers and books, *mobile media enable a new and much more diverse set of activities*. This includes browsing on the Internet, exchanging text messages and emails, consumption of films and radio, use of social media, on-line gaming, and so on. Evidence is emerging that these new options are heavily used on public transport, alongside books and newspapers. In a study of train commuters in Norway, it was found that those with access to a mobile phone or lap-top generally had a more positive attitude to their journey (Gripsrud and Hjorthol 2006). Only 10 percent of commuters said that their travel time was wasted, and for those who had brought a PC on the trip the figure was even lower. A more recent Swedish study of 400 travellers on public transport found that most considered their time-use on the trip to be worthwhile. The most satisfied spent more time using ICT-based equipment such as laptops, mobile phones and Mp3 players. This suggest that there is a tentative positive relationship between amounts of ICT use and travel satisfaction (Vilhelmson, Thulin, and Fahlén 2011).

Studies suggest that the social and cultural context of place influences how mobile media are used. Talking on the phone is particularly difficult in settings where everyone is engaged in the same activities, such as in classrooms, theatres or conferences. Conversation on the phone is more easily conducted in other "open" public spheres, such as train stations or in shops (Campbell 2007, Turner, Love, and Howell 2008). Inside public transport carriers, however, voice communication tends to be deemed unacceptable (Ito and Daisuke 2003). A recent study of travellers in Vancouver, Canada found that the interior of the bus was decisive in the use of smart devices during the trip. Access to a seat on the bus increased the likelihood of use, while much noise had a negative effect (Guo, Derian, and Zhao 2015). These studies suggest that mobile media on the journey make the trip more pleasant and useful, although constrained by the particular physical and social contexts.

So, does having access to mobile media always give the traveller a more positive attitude to public transport? Active use of mobile media during trips suggests that this is the case. In other studies, however, it has been argued that these new portable communication devices give the traveller a more negative travel experience, particularly the constant interference and intrusion into their private space. This can, on the one hand, be related to an *increased risk of undesirable communication and interference*. For many passengers, travel time represents possibilities for resting, reflection and catching up on sleep (Mokhtarian 2005). The rapid uptake of mobile communication tools among travellers may limit possibilities for such "anti-activities" due to changing norms of constant accessibility. To a certain degree it is now expected that people can be reached by phone, messages or emails, even when they are on a journey (Fahlén 2013). The threat of being interrupted during travel, however, is not just from incoming messages or calls, not least it is disturbance from the communication activities of co-passengers, which for many people is annoying and stressing to overhear other people talking in public places (Ling 2004, Turner, Love, and Howell 2008).

In a qualitative study of university students and part-time working mums in the UK, it was documented that the mobile phone was actively being used to maintain a wide range of local and distant social networks while travelling (Line, Jain, and Lyons

2012). Yet, the active use of mobile phones while travelling had also led to a general blurring of the social boundaries between home and work, leading to a stronger perceived demand for being "constantly available" while travelling.

Use of mobile media while travelling may be related to *stress and overwork*. As suggested by Kenyon and Lyons (2007), use of ICT opens up possibilities for multi-tasking while travelling, conducting for instance work-related tasks or social interaction while travelling. Although this is seen in most cases as an efficient and convenient way to use travel time, it may for others trigger more negative feelings. A qualitative study of mobile workers travelling on trains found that they experienced continuous problems related to finding appropriate working spaces, noise from fellow travellers, etc. (Axtell, Hislop, and Whittaker 2008). Mobile workers were constrained by the local and technological facilities of the train, as well as by expectations and demands from the remote organizations where they worked. Axtell et al. concluded that:

"… the anytime, anywhere rhetoric perpetuated by the advocates and manufacturers of mobile technologies significantly underestimates how contextual factors (…) constrain the work task that mobile workers can carry out in locations such as train carriages." (p. 913).

In addition, some studies have suggested that individualized media use (i.e. texting and listening to music) may cause *isolation and reduced general feelings of well-being* (Turkle 2012, Kraut 1998). An experimental study of bus and train commuters in Chicago found that travellers who connected with others face-to-face during their trips felt in a better mood than those travelling in isolation (Epley, Schroeder, and Waytz 2013). Yet, this didn't go at the expense of the efficiencies of other activities that they were doing while travelling. The authors concluded that connecting with a stranger was more pleasant than sitting alone, but not less productive.

Clearly, these studies do not imply that use of mobile media deterministically will give travellers a negative attitude to public transportation, but it has provided some evidence that exaggerated use of mobile media on public transport modes may be related to interruption, stress and lower levels of satisfaction and well-being.

2.2. Attitudes to public transport services

During the past 50 years, the level of mobility has increased rapidly in most urban areas in Europe, and increasingly this has caused concern about car-use and its potential effects on emissions of greenhouse gases, traffic congestion and health (Banister 2011, Whitelegg 1997, Chapman 2007). To curb this development there is currently general consensus among urban planners, researchers and politicians that more of today's private car users should switch to public transport, bicycles or walking. Promotion of this shift needs to take into account the attitudes towards various transport services, including cars, public transport and opportunities for walking and biking (Beirao and Cabral 2007). A series of studies has revealed that travellers often display distinctively positive or negative attitudes towards the available modes of travel, and that such perceptions tend to influence frequency of use (Thomas, Walker, and Musselwhite 2014, Domarchi, Tudela, and Gonzáles 2008).

Key demographic aspect, such as gender, income and employment level has been documented to be related to attitudinal differences to public transport (Thompson and Brown 2006, Hjorthol 2002). Also social norms, life styles and values, (e.g-to environmental issues) have been found to have an impact (Crandall, Eshleman, and O´Brien 2002, Prillwitz and Barr 2011, Jensen 1999). Moreover, direct experiences with the public transport services have proved to be important. According to Gatersleben and Uzzell (2007), affective appraisals of the daily commute are related to instrumental aspects such as journey time, but also attitudes toward various travel modes. In their study of university employees, car commuters experienced their travel in connection with work as most stressful, while walking and cycling journeys were the most relaxing and exciting. Later studies have largely confirmed that cyclists and walkers appraise their travel more positively than car-users (Legrain, Eluru, and El-Geneidy 2015, Thomas, Walker, and Musselwhite 2014).

The specifications of the most important qualities of services are not straightforward, since people's ideas and perceptions of transport modes are often abstract and elusive and difficult to measure (Henscher, Stopher, and Bullock 2003, Guiver 2007). However, both *reliability* and *predictability* have proved to be particularly important

qualities, as well as frequency of departures/arrivals and comfort on board. Perceived environmental impact, in contrast, seems to have minor impact on traveller's attitudes towards the transport mode, according to these studies (Beirao and Cabral 2007, Friman and Gärling 2001, Whitmarsh 2011).

Recently, several studies have analysed attitudes towards public transport services based on larger segments of users (Anable 2005, Jensen 1999, Julsrud 2013, Ohnmacht et al. 2008). These studies have documented that the needs, behaviours and perceptions of public transport vary greatly between different groups of travellers. Travellers attitudes are often dependent on their experience with using the particular transport mode. Car users with little or no knowledge of available public transport services almost always display a more negative attitude than those who use these transport services regularly (Beirao and Cabral 2007, Ibrahim 2003, Domarchi, Tudela, and Gonzáles 2008).

Changing attitudes towards the use of public transport and cars can also be studied by observations of actual changes in users over time. In urban areas, a general trend in the past decade has been growth in the use of public transport, in particular among younger people. This group have tended to put off acquiring a driving licence and purchasing a car compared to earlier generations (Line, Chatterjee, and Lyonos 2012, Kuhnimhof et al. 2012, Hjorthol 2016). During this period, the younger population have been early adopters of new mobile technologies, and the most active users (Ling 2004). As such, one may speculate on whether there is a positive connection between use of new communication technologies and preference for public transport rather than cars. Yet there is no further empirical evidence that the technology among youths is actually related to a stronger interest for public transport.

2. Research question

As mobile media make a growing number of activities possible on buses, trains and other modes of public transportation, travel time is becoming more and more saturated with use of communication technologies. Experiences and attitudes

towards public transport services are therefore more and more coloured by the possibilities and threats coming from the new mobile tools. As described in the literature review, there is evidence suggesting that mobile media may enhance both positive and negative experiences and attitudes towards public transport services. To understand how mobile media may strengthen possibilities for more sustainable transport in urban areas, more empirically based knowledge about these relations is urgent.

In this paper we explore how attitudes to public transport services are related to use of mobile communication technologies, based on a sample of urban dwellers in two Norwegian urban regions. We explore different groups (i.e. user profiles) of mobile media user, and our central research question is the extent to which their patterns of mobile media use are related to attitudes towards public transport services in cities.

Following the first line of earlier research described above we might expect that active, habitual use of mobile applications and services would make public transport more attractive and useful for the most active users of mobile media. Since the mobile media provide travellers with an "added value" on trips, we would expect active users to display a positive attitude towards travelling on buses, trains and trams. In contrast, following the more critical part of the literature, we might expect intensive mobile media users to find that the stress, noise and lack of supporting services results in a negative evaluation of public transport. In the following part of the paper we scrutinize these questions further by use of a survey of urban dwellers in two larger Norwegian cities.

3. Data and methodological approach

3.1 Sample

The study is based on a survey of 1,650 travellers in two of the largest urban areas in Norway – Oslo and Trondheim. These cities have populations of about 600,000 and 200,000 inhabitants, respectively, and both have a well-developed network of public transport.

A web-based questionnaire was distributed during September–October 2013 in two different forms. First, users seeking travel information at the web site of the local public transportation providers were invited to participate in the study. A web-based questionnaire was accessible on computers and/or tablets and smartphones. Second, invitations were sent to regional members of the national association of car users in order to capture travellers with less intensive use of public transport. Although the representativeness of the sample can be questioned, the sampling procedure assured a mix of active and less active users of public transport in the two urban areas. As the objective of this paper was to focus on the experiences and intentions of public transport service users, however, informants who had had very limited experience from using public transport were excluded. A total of 1,215 informants were used for further analysis, all of whom had travelled by bus, train, tram or subway at least on a monthly basis. As indicated in Table 1, there was a majority of Oslo-based male travellers in the sample.

Table1.   Gender and urban region. Percent

	Oslo region (N=871)	Trondheim region (N=344)	Total (N=1215)
Male	62	50	59
Female	38	50	41
Total	100	100	100

The survey asked a series of questions about urban travellers' time-use while travelling, their use of transport modes, the technologies brought along on their journeys, their habitual use of mobile media and general attitudes to public transport services. The intention was to encompass not only travellers in the inner city region, but also large numbers living in the suburbs and surrounding municipalities.

3.2 Measures
Access to various types of mobile media brought along on the public transport journey was registered, including smartphones, GSM phones, tablets, computers and music players. To measure activity levels for the use of mobile media, respondents

with access to smart phones should specify activities usually engaged in while travelling. These included: calling, messaging, emailing, reading of news, use of social media, listening to music, reading books/journals, working/studying, playing, watching films, using navigation services, checking travel information and other services. Use was indicated by clicking the relevant activities. The items were used to construct user profiles based on an inductive (two-step) cluster analysis.

Attitude can be defined as "… a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor" (Eagly and Chaiken 1993, p.1). There are different ways of measuring *attitudes towards public transport services* (Murray, Walton, and Thomas 2010, Domarchi, Tudela, and Gonzáles 2008, Simsekoglu, Nordfjærn, and Rundmo 2015). In the present study, attitude to public transportation was measured by asking respondents to indicate unfavorable features of travelling by public transport. These included "too expensive", "low punctuality", "difficult to work/study" etc. (a complete list is given in Table 8). Respondents were to indicate whether each of the 14 items was considered a problem. The number of unfavorable features was added to form an overall attitude score (higher values indicate more negative attitudes).

To measure *travel frequency*, we asked how often respondents took the bus, tram, train and subway; daily, several times per week, 1–4 times per month or rarely/never. *Public transport mode* is measured by asking respondents to indicate how often they had used public transport in the past month for work, study, business or private trip, using the same four-item scale.

3.3 Analysis
The analysis consisted of three steps: First, a general overview of the urban dweller's use of mobile media on public transport was elaborated. To generate a better understanding of the different user patterns, *three segments of media users* ("user profiles") were identified by a two-step cluster analysis. In the second step, a logistic regression model was applied to analyse how the user profiles were related to the

attitudes to public transport services, and more closely the dimensions/qualities of public transport that had most value for each user group.

4. **Results**

4.1 Access to mobile media on public transportation

Mobile media are widely used among travellers, with only 2 percent not having any communication device with them on their trips (Table 2). Penetration of devices with an Internet connection is high; overall, approximately 80 percent usually carry a smartphone or other smart device on public transport. As expected, access to smartphones is strongly related to age; 90 percent of travellers in the age group below 30 are equipped with a smartphone. In the groups of older travellers, mobile phones without an Internet connection (GSM) are more widespread. These age-related differences in smartphone access are in accordance with several other empirical studies (Guo, Derian, and Zhao 2015, Selwyn et al. 2003). Occupational status reflects age differences with better access among students and workers compared to retired people. In general, public transport users are better equipped with smartphones and internet-based applications than are car users, in particular train passengers, There is also a tendency that those travelling more than 3 km to work/school to a greater extent bring along devices with internet connection.

Table 2. Access to mobile media on public transport travel, gender, age, social status and place of living social status. Percent.

	Smartphone/ Tablet/PC (N=1000)	Mobile without Internet (N=181)	No mobile (N=21)	Total* (1215)
Gender				
Male	82,1	15,1	2	100
Female	82,8	14,8	1,8	100
Age***				
< 30	90,9	8,4	0,8	100
30-50	89,4	7,7	3	100
50<	73,3	23,4	1,6	100
Status***				
Working	87,6	9,8	2,5	100

Student	91,9	7,4	0,7	100
Homekeeper, retired	59	36,4	3,3	100
Other	37,5	62,5	0	100
Place				
Oslo	83,5	13,8	2,3	100
Trondheim	80,5	18	0,9	100
All	82,4	15,0	2,0	100,0

[***] p<0.000, chi-sq.

Table 3. Access to mobile media on public transport travel and estimated use of travel mode and distance to workplace / school. Percent.

	Smartphone/ Tablet/PC (N=1000)	Mobile without Internet (N=181)	No mobile (N=21)	Total* (1215)
Daily travel mode				
Car	82,9	14,5	1,6	100
Bus	86,7	11,6	1,8	100
Train	90,5	7,9	1,6	100
Subway/tram	86,6	9,7	2,8	100
Distance home and workplace/School*				
Less than 2 km	74,4	22,2	2	100
3-9 km	85,7	12,1	1,3	100
10-19 km	84,1	13,9	1,7	100
20 km or more	82,8	14	2,9	100
All	82,4	15	2	100

[*] p<0.05, chi-sq.

4.2 Mobile media user profiles

Uses of mobile media services tend to cluster together in certain configurations and patterns, forming more or less stable groups of users. To identify homogeneous groups of users, a two-step cluster analysis was conducted based on the 15 items describing types of use of mobile ICT while travelling (see above). Clusters were constructed using a log-likelihood distance measure and Schwarz's Bayesian Criterion (BIC) was used to define the optimum number of clusters. Three clusters were located with a relatively weak but satisfactory degree of separation and cohesiveness (average silhouette measure = 0.2) (see Table 6).

The first group includes travellers who actively use smart devices on their trips. This goes far beyond talking and texting on the phone, and includes use of social media,

gaming, working, sending/reading emails, checking timetables and more. In general, these are travellers who actively exploit the possibilities embedded in the smartphones and smart devices for network building, entertainment and information-seeking. This group captures 32 percent of the sample, and it has a predominance of younger students and employed people (Table 7). In the following, we use the label *active users* for this group.

The second cluster includes travellers who use the most popular features on smart devices, such as social media and reading of news, in combination with exchange of text messages and mobile talk. This is the largest cluster; 44 percent of the sample and it has a majority of middle-aged men. In contrast to the former segment, this group of users less actively use media to check timetables, play games or to navigate. We use the label *passive users* for this group.

The third cluster includes users who either use the media sparsely, or not at all while travelling. To the extent that mobile media are used, it is for regular dialogue or texting. This group includes 24 percent of the sample, and compared to the former clusters has a large number of older travellers and people outside work or education (Table 7). Note that only 50 percent in this group have a smartphone device. The term *Low use* is applied for this group.
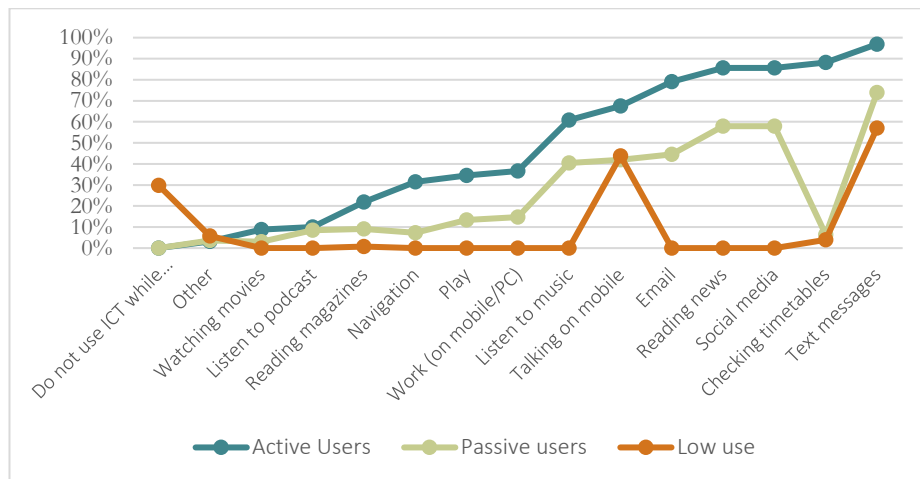

Figure 2. Mobile user profiles. Use of mobile media services. Percent

Table 6. Demographic information and ICT access for the clusters. Percent.

	Active user	Passive users	Low use
Age***			
>29	32	23	6
30-49	46	32	18
50<	22	45	76
Sum	*100*	*100*	*100*
Gender			
Male	57	62	44
Female	44	38	45
Sum	*100*	*100*	*100*
Status***			
Employed	75	71	55
Student	18	14	2
Retired/homemaker	7	14	40
Sum	*100*	*100*	*100*
Mobile media access***			
Smartphone/Tablet/ PC	96	92	49
Mobile without internet	3	8	44
No mobile			7
Sum	*100*	*100*	*100*

* p<0.05, chi-sq.

*** p<0.000, chi-sq.

4.4 Mobile media users and attitudes to public transport

Travellers' attitudes to public transport were measured by asking respondents to indicate unfavourable features ("barriers") of travelling by public transport. Figure 1 shows the distribution of answers. On average, respondents reported 2.4 barriers. 17 percent reported no barriers, and X percent five or more. Attitudes differ across the three user groups: average number of barriers reported are 2.88, 2.46 and 1.88 for *Active*, *Passive* and *Low* users respectively, suggesting that intensity of mobile media use is negatively related to public transport attitudes.
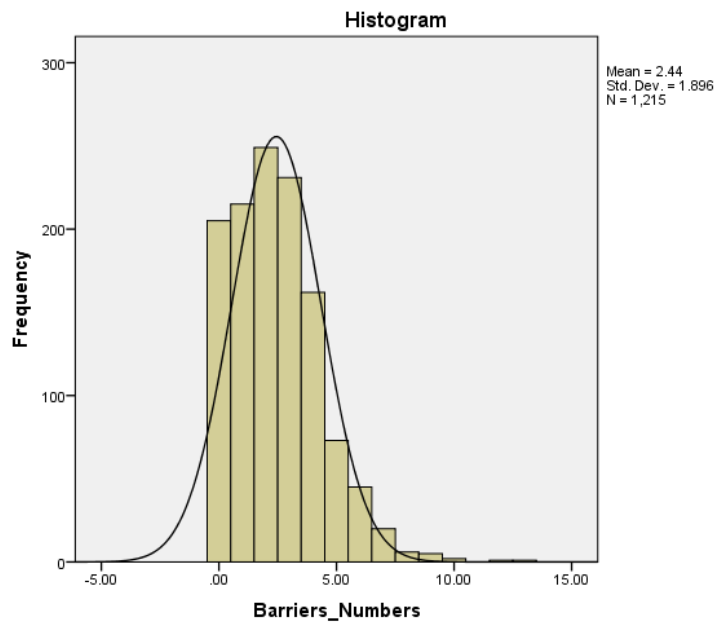
Figure 1. Frequency distribution of number of barriers for travelling by public transportation

In Table 9, attitudes is regressed on user type, distance to work/school, and traveler characteristics (frequency of public transportation ridership, age, and gender). Controlled effects confirm the descriptive statistics – coefficients for *Active* and *Passive* are positive and significant (*p*<.05). Moreover, results indicate a positive impact of distance, i.e., respondents commuting to work/school over longer distances report more barriers to public transport use. We have no information on the respondents' residential area, but long distance commuters generally live in areas where public transport services are less developed, which possibly explain this finding. Conversely, the number of barriers reported is negatively related to frequency of public transport use and age. Concerning the latter, younger passengers tend to be more critical, which could be expected given that *Active users* have a predominance of younger people. This finding corresponds to previous studies (cf. above). No differences between men and women are found.

Table 9. Linear regression – No. of barriers by media user type and traveler characteristics

Variables	B	Std. Error	t
User type[1]			
Active user	.583	.157	3.723*
Passive user	.291	.140	2.081*
PT frequency	-.270	.118	-2.284*
Distance	..216	..032	6.706**

Age	−.023	.004	−5.930**
Gender	.040	.110	.364
City	.002	.119	.015
Constant	2.505	.391	6.412**

[1])Reference: Low users

**p<.01; *p<.05

Adjusted R^2 = .100

Table 8 gives more detailed information on the significance of different barriers across user groups. Compared to the other groups, lack of opportunities for work and study on board is a main concern for *Active users*. Correspondingly, mobile media use is related to concerns about difficulties getting a seat. Noise and interruptions is less of a problem. Possibly, this may be due to smart devices with headphones being used to reduce the discomfort from noise (Guo, Derian, and Zhao 2015). *Active users* also highlight issues not directly related to the use of mobile media, such as high costs, poor punctuality, overgang and few departures. This suggests that active mobile technology users are highly involved in public transport issues. Demographic aspects such as age and social status may be important in understanding these differences, as public transport may be a more critical issue for young people and employed without access to a car. One may speculate whether the active (and more advanced) smart-device users have developed higher expectations for effective public transport due to access to applications revealing the timeliness and performances of various public transport providers, based on real-time information. *Low users* who rarely use mobile ICT, see fewer barriers and have more positive attitudes toward the existing services.

Table 8. Barriers to public transport use by mobile media user group

	Mobile media profiles		
Attitudes	Active user	Passive user	Low user
It is expensive**	38.4	33.1	22.0
Difficult to use timetable	3.9	6.6	4.4
Poor punctuality**	34.5	26.1	20.0
Too complicated ticket system	9.3	7.3	12.2
Too few departures to my destinations**	38.4	29.5	19.3
Noise and interruptions in the coupé	12.6	11.3	8.5
Difficult to work or study**	13.7	3.9	1.7
Feels unsafe	3.1	3.8	2.4

Difficult to get a seat*	33.8	31.6	21.7
Takes too long time compared to car*	40.7	40.2	28.5
Poor information on timetables	8.0	6.6	4.1
Other	6.4	5.1	6.8
Distance to stops too long	12.4	12.8	11.5
Need to change*	33.0	28.2	20.0
No barriers**	11.1	14.7	28.5

**$p<.01$; *$p<.05$

5. **Discussion**

Mobile media use has undoubtedly become important in how most travellers spend their time on public transport carriers (Jain and Lyons 2008, Lyons and Urry 2005). Consequently, the new mobile media also have a crucial effect on how travellers evaluate public transport services in general, both positively and negatively. In the little research done so far on the effect of smartphones and smart devices on travellers' attitudes to public transport, the results indicate both negative and positive effects.

In this explorative study of public transport users in two Norwegian cities, evidence was found that the most active group of mobile media users – a group of younger and middle-aged urban dwellers – bore the most critical attitudes to the public transport services. This group expressed, among other things, the need for better seating and opportunities for working and studying while travelling. In contrast, the group that rarely used mobile media on public transportation, expressed more positive attitudes (fewer barriers reported).

How can we interpret the critical attitudes of the most innovative and active smartphone users? First, it indicates that a new generation of "equipped travellers" are more demanding when it comes to public transport facilities. Passengers who wish to use travel time productively (e.g., check emails, news updates, make short calls) may end up being dissatisfied when unable to do so. Thus, the rapid adoption and use of smartphones seems to have triggered a "new demand effect" rather than an "added value" effect on travellers' attitudes to public transportation. This supports earlier works indicating that young people in urban areas tend to choose less car-dependent life styles than older generations (Line, Chatterjee, and Lyonos

2012, Kuhnimhof et al. 2012, Hjorthol 2016). It is also consistent with previous studies documenting that the physical and social environment on public transport influences the motivations for using mobile communication devices (Guo, Derian, and Zhao 2015, Campbell 2007).

As indicated in the literature review, however, more complicated sociological and psychological mechanisms may be at play; new expectations of always being accessible for communication with managers, colleagues (or perhaps even friends) may lead to frustration, stress and lower satisfaction with the journey. The smartphone may be involved in processes where time on public transport is no longer for relaxing, thinking or other "anti-activities", but for productive work. Thus, negative attitudes may emerge when there is any intrusion of work-related activities and communication during travel time. At this point our results are in accordance with studies finding that highly flexible work forms, relying on extensive use of mobile technologies, may lead to overwork, stress and boundary conflicts between professional and private spheres of life (McNamara et al. 2013, Nippert-Eng 1996, Line, Jain, and Lyons 2012).

Yet, we should be cautious not to exaggerate the harshness of the critique from the active smartphone users in this study. The number of barriers, used here as a measure to indicate a "critical attitude" towards public transport, is a relatively rough indicator of critique, and it may in fact also be interpreted as an expression of concern for the public transport services. *Active users* are the most frequent riders with public transportation, and in that respect they also have a strong interest in services being improved. Thus, there might be self-interest involved, where the active users are more critical because they hope to improve the services in their city. Overall, however, this does not distort the general picture that the most active smartphone users appear as the most demanding public transport users, and that they in this study indicated less satisfaction with the public transport services.

The results discussed above have implications for providers of transport services and policymakers. Even though the diffusion of smartphones among urban travellers seems beneficial in promoting public transport, the findings suggest that there is a risk of the most active smartphone users developing less positive attitudes to public

transportation if (or when) their experiences are not improved. Developing facilities that help urban travellers to improve their quality of travel time, for instance with better spaces for working and communicating, may be an undervalued strategy by which to strengthen public transport in urban areas.

6. **Conclusions**

This study has explored how patterns of mobile media use relate to overall attitudes to public transport. Our findings suggest that the rapid uptake of smartphones has created new demands, and that active mobile phone users are currently the most critical of all public transport users. In particular, they express a lack of opportunities for working/studying on board, and for better seating. Owing to limitations in the research data, we have not been able here to give deeper explanations for the critical attitudes. We have suggested, however, that mobile technologies are involved in ongoing changes in traveller's expectations for use of time while travelling. Higher diffusion of smart devices seems to initiate higher expectations for use of travel time on trains, buses and trams.

Given the rapid diffusion and use of new smartphones and applications among public transport passengers, as well as the omnipresent objective of reducing car traffic, there is a need for more research in this area. This should include extensive studies of how smartphones and other smart devices influence travel time use, as well as how it affects travellers' attitudes and expectations to public transport services. Increased knowledge in these matters would to help providers develop more competitive public transportation services. In a wider framework, this will include studies seeking to explore how mobile media are initiating changes in the meaning and role of mobility for different segments of users. Finally, future studies should aim at getting data from more representative samples than obtained in the present study to increase the external validity of the results. This study provides a point of departure for further investigation.

References

Alexander, Bayarma, Dick Ettema, and Martin Dijst. 2010. "Fragmentation of work activity as a multi-dimensional construct and its association with ICT, employment and sociodemographic characteristics." *Journal of Transport Geography* 18:55-64.

Anable, Jillian. 2005. "'Complacent Car Addicts' or 'Aspiring Environmentalists'? Identifying travel behaviour segments using attitude theory." *Transport Policy* 12 (1):65-78.

Axtell, Carolyn, Donald Hislop, and Steve Whittaker. 2008. "Mobile technologies in mobile spaces: Findings from the context of train travel." *International Journal of Human-Computer Studies* 66:902-915.

Banister, David. 2011. "Cities, mobility and climate change." *Journal of Transport Geography* 19 (6):1538-1546.

Beirao, Gabriela, and J.A. Sarsfield Cabral. 2007. "Understanding attitudes towards public transport and private car: A qualitative study " *Trasport Policy* 14 (6):478-489.

Campbell, S.W. 2007. "Perceptions of mobile phone use in public settings: A cross-cultural comparison." *International Journal of Communication* 1:738-757.

Chapman, Lee. 2007. "Transport and climate change: a review." *Journal of Transport Geography* 15 (5):354-367.

Crandall, C.S., A. Eshleman, and L. O´Brien. 2002. "Social norms and the expression and suppresion of predjucice: the struggle for internationalization." *Journal of Personal Social Psychology* 82:359-378.

Domarchi, Cristian, Alejandro Tudela, and Angélica Gonzáles. 2008. "Effect of attitudes, habit and affective appraisal on mode choice: an application to university workers." *Transportation* 35:585-599.

Eagly, A.H., and S. Chaiken. 1993. *The psychology of attitudes.* Fort Worth: Harcourt, Brace, & Janovich.

Epley, Nicholas, Juliana Schroeder, and Adam Waytz. 2013. "Motivated Mind Perception: Treating Pets as People and People as Animals." Objectification and (De)Humanization, Nebraska Symposium on Motivation

Fahlén, Daniel. 2013. "Restidens bruk och mening." Filosofie licentiat, Institutionen för ekonomi och samhälle, Göteborgs Universitet (CHOROS 2013:1).

Friman, M., and T. Gärling. 2001. "Frequency of negative critical incidentsand satisfaction with public transport services (I)." *Journal of Retail and Consumer Services* 8 (2):95-104.

Gasparini, G. 1995. "On waiting." *Time Sociology* 4:29-45.

Gripsrud, Mattias, and Randi Hjorthol. 2006. "Working on the train: from "dead time" to productive and vital time." *Transportation* 39 (5):941-956.

Guiver, J.W. 2007. "Modal talk: discourse analysis of how people talk about bus and car travel." *Transportation Research Part A* 41 (3):233-248.

Guo, Zhan, Alexandra Derian, and Jinhua Zhao. 2015. "Smart Devices and Travel Time Use by Bus Passengers in Vancouver, Canada." *International Journal of Sustainable Transportation* 9:335-347.

Henscher, D. A, P. Stopher, and P. Bullock. 2003. "Service quality- developing a service quality index in the provision of a commersial bus contract." *Transport Research Part A* 37 (6):499-517.

Hislop, Donald, and Carolyn Axtell. 2011. "Mobile phones during work and non-work time: A case study of mobile, non-managerial workers." *Information & Organization* 21:41-56.

Hjorthol, Randi. 2016. "Decreasing popularity of the car? changes in diriving licence and access to a car among youg adults over a 25-year period in Norway." *Journal of Transport Geography* 51:140-146.

Hjorthol, Randi Johanne. 2002. "Cultural aspects of the car and public transport. Men's and women's perception." *Raum Planung* (June):144-149

Ibrahim, M.F. 2003. "Car ownership and attitudes towards transport modes for shopping purposes in Singapore." *Transportation* 30 (4):435-457.

Igarashi, Tasuku, Jiro Takai, and Toshikazu Yoshida. 2005. "Gender differences in social network development via mobile phone text messages: A longitudinal study." *Journal of Social and Personal Relationships* 22 (5):691-713.

Ito, M., and O. Daisuke. 2003. "Mobile phones, Japaneese youth and the replacement of social contact." Front Stage/Back Stage: Mobile communication and the Renegotiation of the Social Sphere, Grimstad, Norway.

Jain, J., and G. Lyons. 2008. "The Gift of Travel Time." *Journal of Transport Geography* 16 (2):81-89.

Jensen, M. 1999. "Passion and heart intransport - a sociological analysis of transport behaviour." *Transport Policy* 6:19-33.

Julsrud, Tom Erik. 2013. "Activity-based patterns of everyday mobility: The potential for long-term behaviour change across five groups of travelers." *Journal of Environmental Policy & Planning* September.

Julsrud, Tom Erik, Jon Martin Denstadli, and Jo Herstad. 2014. Bruk av mobilt kommunikasjonsutstyr underveis. Hva skjer med reiseopplevelsen? In *TØI-rapport*. Oslo: Transportøkonomisk institutt.

Kenyon, S., and G. Lyons. 2007. "Introducing multitasking to the study of travel and ICT: examining its extent and assesing its potential importance." *Transportation Research Part A* 41 (2):161-175.

Kraut, Robert. 1998. "Internet Paradox: A social technology that reduces social involvement and psychological well-being?" *American Psychologist* 53 (9):1017-1031.

Kuhnimhof, Tobias, Ralph Buehler, Matthias Wirtz, and Dominika Kalinowska. 2012. "Travel trends among young adults in Germany: increasing multimodality and declining car use for men." *Journal of Transport Geography* 18 (2):238-246.

Legrain, Alexander, Naveen Eluru, and Ahmed M. El-Geneidy. 2015. "Am stressed, must travel: The relationship between mode choice and commuting stress." *Transportation Review Part F* 34:141-151.

Lenz, B., and C. Nobis. 2007. "The changing allocation of activities in space and time by the use of ICT - "Fragmentation" as a new concept and empirical results." *Transportation Research Part A* 41 (2):190-204.

Line, Tilly, Kiron Chatterjee, and Glenn Lyonos. 2012. "Applying behavioural theories to studying the influence of climate change on young people's future travel intentions." *Transportation Research Part D* 17 (3):270-276.

Line, Tilly, Juliet Jain, and Glenn Lyons. 2012. "The role of ICTs in everyday mobile lives." *Journal of Transport Geography* 19 (6):1490-1499.

Ling, Rich, and Birgitte Yttri. 2004. "Hyper-coordination via mobile phones in Norway." In *Perpetual Contact: Mobile Communication, Private Talk, Public Performance*, edited by J. Katz and M. Aakhus, 139-169. Cambridge: Cambridge University Press.

Ling, Richard. 2004. *The Mobile Connection. The cell phone´s impact on society.* San Fransisco: Elsevier, Morgan Kaufmann.

Lyons, Glenn, and Kiron Chatterjee. 2012. "A Human Perspective on the Daily Commute: Costs, Benefits and Trade-offs." *Transportation Reviews* 28 (2):181-198.

Lyons, Glenn, J. Jain, and D. Holley. 2007. "The use of travel time by rail passengers in Great Britain." *Transportation Research Part A* 41 (1):107-120.

Lyons, Glenn, and John Urry. 2005. "Travel time use in the information age." *Transportation Research Part A* 39:257-276.

McNamara, Tay K., Marcie Pitt-Catsouphes, Christina Matz-Costa, Melissa Brown, and Monique Valcour. 2013. "Across the continuum of satisfaction with work-family balance: Work hours, flexibility-fit, and work-family culture." *Social Science Research* 42:283-298.

Middleton, Jennie. 2011. ""I´m on autopilot, I just follow the route": exploring the habits, routines, and decision-making practices of everyday urban mobilities." *Environment and Planning A* 43:2857-2877.

Mokhtarian, Patricia. 2005. "Travel as a desired end, not just a means." *Transportation Research Part A, Policy and Practice* 39 (2):93-96.

Murray, S. J., D. Walton, and J.A. Thomas. 2010. "Attitudes towards public transport in New Zealend." *Transportation* 37:915-929.

Nippert-Eng, Christena. 1996. *Home and Work: Negotiating Boundaries through Everyday Life.* : University of Chicago Press.

Ohnmacht, T., K. Götz, H. Schad, U. Haefeli, and J. Stettler. 2008. "Mobility Styles in Leisure Time - Target Groups for Measures Towards Sustainable Leisure Travel in Swiss Agglomeration." 8th Swiss Transportation Research Conference, Monte Veritá, Ascona.

Prillwitz, Jan, and Stewart Barr. 2011. "Moving towards sustainability? Mobility styles, attitudes and individual travel behavior." *Journal of Transport Geography* 19 (6):1590-1600.

Rheingold, Howard. 2002. *Smartmobs. The Next Social Revolution.* New York: Perseus Publishing.

Selwyn, N., S. Gorard, J. Furlong, and L. Madden. 2003. "Older adults´use ofinformation and communications technology in everyday life." *Ageing and Society* 23 (561-582).

Simsekoglu, Özlem, Trond Nordfjærn, and Torbjørn Rundmo. 2015. "The role of attitudes, transport priorities, and car use habit for travel mode use and intentions to use transportation in an urban Norwegian public." *Transport Policy* 42:113-120.

Thomas, G.O., I. Walker, and C. Musselwhite. 2014. "Autonomy and travel behaviour – Grounded-theory analysis of mode choice with users of five different travel modes. ." *Transportation Research Part F: Traffic Psychology and Behaviour*:72-81.

Thompson, G.L., and J.R. Brown. 2006. "Explaining variation in transit rideship in U.S. metropolitan areas between 1990-2000." *Transportation Research Records* 1986:171-181.

Turkle, Sherry. 2012. *Alone Together. Why We Expect More From Technology and Less From Each Other*. New York: Basic books.

Turner, Mart, Steve Love, and Mark Howell. 2008. "Understanding emotions experienced when using a mobile phone in public: The social usability of mobile (cellular) telephones." *Telematics and Informatics* 25:201-215.

Urry, John. 2007. *Mobilities*. Cambridge: Polity.

Vilhelmson, Bertil, Eva Thulin, and Daniel Fahlén. 2011. "ICTs and Activities on the Move? People's Use of Time While Traveling by Public Transportation." In *Engineering Earth. The Impacts of Megaengineering Projects*, edited by Stanley Brunn, 145-154. London: Springer.

Whitelegg, John. 1997. *Critical Mass. Transport, Environment and Society in the Twenty-first Century*. London: Pluto Press.

Whitmarsh, Lorraine. 2011. "Scepticism and uncertainty about climate change: Dimensions, determinants and change over time." *Global Environmental Change* 21 (2):690-700.