

Modeling Bus Travel Experience to Guide the Design of Digital Services for the Bus Context

Full Paper[†]

Elina Hildén
Pervasive Computing
Tampere University of
Technology
Tampere, Finland
elina.hilden@tut.fi

Kaisa Väänänen
Pervasive Computing
Tampere University of
Technology
Tampere, Finland
kaisa.vaananen@tut.fi

Simo Syrman
Built Environment
Aalto University
Espoo, Finland
simo.syrman@aalto.fi

ABSTRACT

To make public transportation more attractive, it is important to design for pleasurable travel experience. Intra-city bus transportation has broad potential for utilisation of novel digital services beyond travel information. To enhance the travel experience of buses, services should be developed focusing on positive user experience. The aim of this study was to investigate the elements of bus travel experience and associated passenger needs. This paper presents the findings of a three-week qualitative field study with ten regular bus passengers. Derived from the findings, we present Bus Travel Experience Model and related passenger experiences and needs, with an emphasis on digital services. The model is based on the central user experience elements: the passenger – user, the bus – context, and the system, including both the public transportation system and the system of mobile services. The model can provide guidance for design and evaluation of future digital bus traveling services.

CCS CONCEPTS

• **Human-centered computing~Interaction design theory, concepts and paradigms** • Human-centered computing~Empirical studies in interaction design

KEYWORDS

Intra-city buses, user experience, digital services, Bus Travel Experience Model.

1 INTRODUCTION

Cities worldwide are facing the need to reduce emissions by decreasing the usage of private cars. Thus, the role of public transportation and other mobility services are becoming ever more important. As policy makers seek ways to encourage and support the widespread use of public transportation, it is important to develop transport services so that they are seen as a desirable option for the large audience [5, 7]. In order to gain popularity, public transportation providers and planners should consider passengers' needs and expectations regarding intra-city travel activities [2]. It is important to focus on the users and their experiences, and thus develop human-centered solutions that make the service experience feel logical, desired, and competitive. [20]. Digital and other supplementary services can add value to the passengers' travel experience [2] and thus make public transportation more desirable.

Travel behavior and trip satisfaction are widely studied in the transportation literature, whereas travel experience has been left with relatively little focus [2, 3]. Travel comfort is studied across travel modes – from trains to airplanes. However, the characteristics of the trips conducted for instance by plane and bus differ a lot. Intra-city bus trips usually lack the terminals and lengthy boarding procedures making them more closely interwoven to the everyday life context. Existing studies of bus travel experience, such as Carreira et al. [3] focus on quantitative methods and explore travel experience mainly from the usability and functionality perspectives. Qualitative studies of bus passengers' experiences are largely missing. Bus is an interesting service context to study, since it contains services both in the physical realm, i.e. the actual transportation system, and in the digital sphere, i.e. the digital services in the bus, bus stops and on the passengers' mobile devices. Studies of intra-city bus context from the aspects of experience and service design are scarce. In this study, we probe both traditional buses and electric buses as novel vehicles that are currently spreading to bus markets. The

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present study investigates elements of intra-city bus travel experience, and the passengers' needs for potential traveling services. By *travel experience* we mean the subjective experience a person has when using the transportation system and the associated traveling services. By *traveling services*, we refer to *digital services that can support or enrich the travel and the associated activities*.

The goal of the present study was to investigate how people experience the intra-city buses in a medium-sized Nordic city, Tampere, Finland, and what are the elements that impact passengers' travel experience. As opposed to earlier research on surveying functional benefits [2, 3], we study qualitatively the pleasurable experiences [16] related to the bus journeys. With this goal, the study aims to gain design-relevant insights on how digital services can support public transportation. To gain such understanding, we organised a three-week long field trial with ten regular bus users in the city of Tampere. Thus, our research question is: *What are the elements of travel experience of intra-city bus journeys?*

As a result, we gained understanding of the needs for digital services people have related to the elements of the travel experience. The findings reveal passenger needs for potential digital services arising from the variety of contextual factors, such as the social context of the bus. Based on the study findings we have formulated a *Bus Travel Experience Model* that presents the elements of travel experience based on the well-known UX models addressing the areas of User, Context and System [11, 15]. This a novel experience model for an important context of use. The model can help designers understand the complexity of bus travel by synthesizing the experience insights in the bus context.

2 RELATED WORK

We present related work on travel experience, and studies on digital services in the bus context.

2.1 Travel Experience

According to Carreira et al. [2], travel experience in the context of public transportation is a result of the holistic view of the transportation service, including the different experience components: the customer's affective, cognitive, physical and social responses to the service. Several studies [e.g. 7, 23] have found that public transportation users are generally the least satisfied compared to other modes of transportation, such as private car drivers and cyclists. Also, amongst different public transportation modes, the bus users were least satisfied [22]. However, a qualitative interview study conducted by Hildén et al. [13] found that participants were generally pleased with the current travel experiences with the local busses in two major cities in Finland – Helsinki and Tampere. The study examined the trip satisfaction by comparing the experience of the local public transportation services to the participants' previous experiences of public transportation internationally. It is

natural that the satisfaction rates of public transportation systems vary locally [26], and the reasons for that can be drawn from multiple factors. External factors such as the timetables, state of the vehicles, safety and the accessibility of public transportation have a strong impact on the satisfaction rates. (ibid.) The more experienced the bus users are, the more positive they tend to value bus as a travel mode [12, 26].

Passengers' traveling behaviour, and thus also the experience of traveling, is changing with the mix of transport modes and the services offered in them [28]. Furthermore, trip satisfaction is affected not only by the external trip factors but also person's internal factors [27]. Travel behaviour is influenced by spatial, socio-economic and personality components (ibid). A qualitative study conducted by Carreira et al. [2], investigated the travel experience of two types of mid-distance bus journeys: touristic and utilitarian trips (intercity transportation). In their study, they focused on the experience factors, such as social environment, service interface, retail atmosphere, assortment, price and retail brand; and experience components (cognitive, sensorial and emotional responses) impacting the travel experience.

2.2 Digital Services in the Bus Context

Passengers in a bus are opportune targets to be entertained and informed about journey related aspects [5]. Unless passengers travel with a companion, they often interact with their mobile devices when conducting short distance journeys [5]. Thus, the context of public transportation has potential for digital services, like location-based services via travelers' mobile devices or other information channels [6]. However, transportation is no longer just about moving from an origin to a destination, but a way for the passengers to encounter different service channels; such as off-board services (services that are used outside of the vehicle), on-board entertainment or information before, during or after the bus trip [3]. A study by Carreira et al. [2] found that bus passengers often looked for digital services and new technologies that could enhance their bus travel experience. In order to understand the demand in different travel settings, the service providers should get familiar with the travel experience and its forming factors [24].

Several studies have been conducted focusing on the real-time travel information in varying channels. The studies reveal that by providing good travel information systems to passengers, the usability of public transportation can be enhanced [4]. However, developing the usability and efficiency of travel activities does not always increase the passengers' travel experience – since having access to real-time travel information is just a base for successful bus trips, on which other services can build on and add further value [5]. In their study, Foth et al. [5] focused on micro activities – social, entertainment, observational, travel, and routine – performed by bus passengers during commute and how these activities impacted the travel experience. Similar studies have been

conducted showing that people spend their time at bus stops and in the bus by listening to music, using social media applications, and by reading newspapers and books or simply relaxing [e.g. 18]. So far, it has been mostly left to the passengers to entertain themselves [5].

3 METHODOLOGY

To gain deep insights about bus journey experiences, a qualitative field study approach was chosen. Ten participants participated in the three-week study that included a self-documentation period of bus trips using diaries and semi-structured interviews in the end of the field period.

3.1 The City

The study was conducted in Tampere, Finland. The city region, including the neighbouring municipalities has close to half a million inhabitants. This city was chosen because of its public transportation infrastructure is limited to buses and thus, focusing on studying the travel experience of buses was straightforward.

3.2 Bus Journeys and Buses

By intra-city bus journeys, we mean journeys conducted within the intra-city area, including the neighbouring municipalities. Since the study was conducted in a project that studies electric buses, we aimed at including journeys on the bus line that is operated by electric buses. The bus line is short, only 4,5 kilometers, and runs through the city and its main streets. Other bus lines in the city vary between 3,0 and 37,2 kilometers. The studied journeys included traditional diesel and hybrid buses as well as electric buses. Traditional buses were from early 2000s to 2016 (with an average age of 7-8 years) and have usually 40 seats. The electric buses are manufactured by Solaris and they have 30 seats. These buses started operating in the city in early 2017 – three months before we started our study. The most perceivable differences between these bus types is that electric buses are more silent, have more floor space and more rear facing seats. All buses have a LED screen displaying the following stop, and most buses also have a screen displaying advertisements of events and local businesses. All the buses within this study were low-floor or low-entry city buses.

3.3 Participants

Ten regular bus passengers were recruited for the study. Since the study aimed at including the bus line with electric buses, the participants had to be passengers of that specific bus line. In order to incorporate different viewpoints to bus travel experience, participants of different age, gender and background were recruited through advertisement in local electric buses and in social media. The selected participants – eight females and two males – ranged from a young student to a senior citizen, with average age of 37,1 (range 22-61). The

participants included a wide variety of occupations: students, unemployed, workers, freelancers and people on parental leave. All participants of this study are frequent bus users: nine use public transportation at least four times a week, where one uses city buses 2-3 times a week.

3.4 Self-documentation with Bus Travel Diaries

We chose two complementary qualitative methods for the study: diaries and interviews. The diary method is inspired by cultural probes [8] for data collection. Diary as a long-term self-documentation tool is a practical tool to enrich the conventional qualitative methods, such as in-depth interviews and field observation [21].

The data collection in our study consisted of a three-week self-documentation period with a paper-based *Bus Travel Diary*. The participants were asked to fill in the diary of altogether nine journeys each. The questions focused on three main themes: Attributes of travel experience, Impact of the bus environment, and Activities during the trip – to gain holistic understanding of the bus travel, and the elements of travel experience. Among other things, the diary asked about the participants' feelings during the bus trip: *stressed, social, confident, awkward, relaxed, luxurious, annoyed, worried*, and *“other”* – based on the previous work by Hilden et al. [13]. The diary also included a reflection page of the documentation period that focused on the elements of bus travel that had biggest impact on the participant's travel experience. Since the study was conducted with specific interest on electric buses, we also gathered feedback on the electric buses, as well as ideas on how to improve them.

3.5 Reflective In-Depth Semi-Structured Interviews

Interviews were used to collect deep, reflective insights of the bus travel experience. After the three-week self-documentation period, the participants were interviewed in groups of 2-4 people. The interviews were reflective, semi-structured in-depth interviews. Four interview sessions were organised: one session with four participants, and three pair interviews. The sessions lasted 1-2 hours. The interviews were video and voice recorded for transcription and analysis. The interview themes were closely related to the ones in the Bus Travel Diary. The themes were: *General questions of the diary study, Questions regarding electric buses, General questions regarding travel experience*, with questions regarding traveling by bus and the elements impacting the experience most; *Questions regarding activities during the bus ride and the use of digital services* focusing on activities people conduct during bus travel, their mobile service usage and the preferred content on the bus screens.

3.6 Data Analysis

The Bus Travel Diaries were transcribed and tidied up in Excel. Data was received from 87 bus trips (one participant documented only six trips instead of nine). The interviews were transcribed and thematically coded and analysed [9] by four researchers. To answer our research question, we first grouped the interview data according to the main UX elements [11]: the *user* or the passenger (52 data items), the *bus context* (142 data items) and the *bus-related service system* (77 data items). Furthermore, data related to context were analysed according to the contextual dimension suggested Bradley and Dunlop [1]. The data was further analysed bottom-up to form the main findings within these main themes. An initial analysis of diary data revealed its consistency with the interview findings, and thus the presented findings are primarily derived from the interviews. Distinct diary findings are mostly related to passengers' inner states, and they are indicated separately in Findings.

4 FINDINGS

This section addresses our research question: *What are the elements of travel experience of intra-city bus journeys?* The elements of bus travel experience are presented below according to the structure of the commonly used UX model [11]. A synthesized overall view of the findings is presented in Figure 1 in section Bus Travel Experience Model.

4.1 User – Passenger

One of the main elements impacting the travel experience is the “user” or the passenger himself. This element includes the aspects that are “inside” the person. The subthemes within this theme are *Mood and Feelings*, and *Values and Motivations*.

4.1.1 Mood and Feelings

People often consider their mood during bus travel “normal” or they feel that they function “automatically”. Mood is affected by the individual’s internal mindset and thus might have very little to do with the actual bus journey. However, a negative bus experience may ruin the otherwise positive mood. The diary data revealed that the most common feelings regarding the 87 conducted bus trips were: relaxed (45/87), confident (23/87) and social (20/87). There was often no explanation given for the positive mood, or it was linked to experiences outside the bus trip. When negative feelings were mentioned, the reason was in many occasions the bus, the driver or the other passengers. The following moods and feelings were central in bus trips.

Automatic or empty-minded. Participants stated that since traveling is part of everyday life it has turned into a routine that happens automatically. *“Usually the bus trip is automatic. You step into the bus, sit down and kind of zone out – you don’t really see or hear anything”* (female, 35), *“almost every bus ride ends up being a sitting coma”* (male, 61).

Stressed. Participants stated that they feel stressed when the bus is too full, late or the route is unfamiliar. *“If you don’t know the area, not even a single landmark, you are just like *whaat*”* (female, 42). Participants traveling with kids were stressed especially when they had to travel with a stroller, since buses have limited space for those. However, there is a solution for this matter: *“If you are first one with a stroller at the bus stop, you get to go in first. This is why we usually leave 10 minutes before the bus comes. This way we are the first ones at the stop”* (female, 33).

Relaxed. Since the bus ride experience is often considered *automatic*, it allows the passengers to relax. Participants stated that they usually just sit quietly and zone out. Many participants were listening to music during bus travel, to isolate themselves from the bus context: *“I often just want to put my headphones on and get deep in my thoughts”* (female, 35).

Unsocial. Even though feeling social was often mentioned in the diaries, in general people prefer having their personal space in the bus. *“Usually I’m more like ‘please don’t notice me’ so that they (others) wouldn’t start a conversation”* (female, 42). Participants stated that listening to music and immersing oneself with the mobile phone are good ways to isolate oneself from the others, and hence they do that to communicate the willingness to be alone.

4.1.2 Values and Motivations

Public transportation, including bus travel is considered ecological, carefree, affordable, quick and easy way to move around in the city. New technologies utilized in the modern buses might also motivate people to use bus transportation.

People value public transportation mainly for being *ecological and environmentally friendly* option. Green values were overall common but highlighted even more when comparing the electric bus to the diesel buses. *“I consider myself extremely lucky since the electric buses are part of my everyday route. I love them even more because of the symbolic value”* (female, 32).

Bus travel is carefree. Compared to private cars, riding a bus is effortless and often carefree. There is no need to worry about parking, driving, fuelling or paying the insurance fees. Especially in the Nordic countries people value warm ride during the winter, without the need to heat up and clean the car from snow and ice every morning. Also, since you do not need to drive, there is more time to do something else. *“I can spend the time reading or sleeping, and that wouldn’t be possible if I would drive to work”* (female 33).

Quick and easy. Public transportation is often quicker than other modes of transport when traveling in a city. For instance, there is special lanes for buses so that they do not get stuck in traffic. Often you are not even allowed to drive with a private car in a city center, and in addition you do not need to look for a parking spot. Public transportation is also *affordable*. Compared to owning a car, using public transportation is a

cheaper option, since you do not have to pay for the gas, parking, insurance etc.

New technologies motivate people to use public transportation. Especially for people who are technology driven, new types of buses seem desirable. For one of the participants, buses were a hobby in their family. "The electric bus line does not go where we live, which is a shame. The new interior layout and all the technology interests [us all]. We've ridden all of the new electric buses" (female, 35).

4.2 Context – the Bus

The following presents the study findings related to *social context*, *task context*, *temporal context*, and *physical context* according to the contextual dimensions by Bradley and Dunlop [1].

4.2.1 Social Context

The main elements derived from the study data impacting the social context are the fellow passengers, the bus driver, and the possible travel companions. The passenger's social context is experienced remarkably differently depending on if one is traveling with a companion or alone.

Fellow passengers are the single most impacting element to the travel experience. *"The pool of fellow passengers is always different [and] you usually don't even pay attention to them. However, at worst they can ruin the whole trip."* (male, 22). For instance, a big group of elementary school pupils traveling in the same bus may make the whole trip a chaotic experience. This relates to the "unspoken rules" of bus travel, such as making space for fellow passengers or having travel cards ready when entering the bus, speaking too loudly, using inappropriate language, or littering the bus. Some participants were annoyed with families with small kids. However, most participants were understanding regarding children with bad temper.

Disruptive behaviour or suspicious people may cause feelings of insecurity. Even though passengers usually feel very safe in the bus, there are times when they feel insecure due to some ill-mannered people. Situations with disruptive behaviour are rare, but very distinctive and unforgettable. Such people, and even a suspicion of that may ruin the trip. *"On my way home from work, there was a guy sitting behind me and he seemed a bit too troubled. It felt really uncomfortable, and thus I was on the alert the whole trip"* (female, 35).

Social encounters with unfamiliar people cause varying effects. Encounters with very talkative people made some participants feel uneasy. Participants who were travelling with kids had experienced situations where other passengers had given nasty comments regarding the kids, for instance when the child was crying. Some participants mentioned situations where they had got lost and had to ask guidance from other passengers. *"It was horrible, since I had to ask from a random person where is the correct bus stop"* (female, 33). However, some participants told

that they tend to socialize with the fellow passengers. *"I prefer talking to other people, since I don't use mobile devices in the bus"* (female, 32). Usually the social encounters with unfamiliar people were related to helping out the tourists to find the correct route. *"Tourists often ask me for guidance. If you look friendly you become a walking information desk"* (female, 42).

Bus driver's willingness to serve and help, as well as greet the passengers are part of a good travel experience. All participants agreed that it is important to get a greeting from the driver when entering the bus. However, as one participant stated *"Overly excited drivers annoy me especially in the morning. It's the time when I'm the least positive"* (female, 33). The participants also stated that it would be nice to get direction or help from the driver in situations where you are unsure where to go, or when to get off.

The driver has an important role of making the bus feel safe. Several participants brought up that it often seems that the driver is not focusing on the events happening inside the bus. *"It would be good if the drivers wouldn't allow disruptive behaviour at all and would kick out the badly behaving people faster"* (female, 27).

Traveling with a companion and traveling alone cause different experiences. *Being social when traveling with kids* – the participants who travelled with kids pointed out that the travel experience and the activities during the trip are remarkably different compared to the bus trips they make alone. When traveling with kids you are more social towards your kids of course, but also to other people.

4.2.2 Task Context

The task context of short distance buses consists of elements related to the habits and activities people have in the bus. This theme includes three subthemes: *Actions and routines*, *Peak hours and traffic jams*, and *Driver's actions*.

Actions and routines make traveling easy and relaxing. *Bus as a familiar action context made the traveling activities easy, relaxing and carefree.* For some, bus journeys were considered personal quality time. *"It takes half an hour for me to get to work and during that time I've learned to 'reset' myself completely"* (female, 50). For the participants traveling with kids, bus was sometimes considered a more convenient choice. *"With a double stroller, it is easier to take the bus. Otherwise you have to first fold the stroller, then pack it into the car with all the other stuff and then – once you have reached your destination, unpack everything"* (female, 33).

Familiarity of the route affects the travel experience and the activities during the trip. It is easier to relax during familiar routes, whereas when traveling on unknown bus lines one must be more aware of the surrounding environment and observe the bus route with the help of journey planner applications. Hence, the unfamiliar routes are often more stressful and allow people to focus on and do less activities.

Selecting seats. Some participants stated that they prefer certain seats in the bus, for instance a seat from the front or facing the front to avoid getting nauseous. The reason could also be socially motivated: *"I never sit on the rear facing seats, because I don't want to stare inside the bus full of people"* (female, 42). The best option for many was to get to sit alone, without anyone sitting next to them. Many people also have regular seats. For one participant traveling with kids, it was important to get to sit in the quartet (two seat rows facing each other) so that they could all sit together. *"We often take the bus 33, because there's always seats. In that bus, there's always the same people and I think they have started to save the quartet for us, since they know that we are three kids and me. It's always free when we enter the bus"* (female, 35).

Peak hours and traffic jams impact the choice of the bus line. Some participants stated that during the peak hours they choose less crowded bus lines. For some people, the crowded buses were unpleasant and stressful experiences: *"I become anxious in a crowded bus. I might start panicking if the crowd blocks my way out"* (female, 35). Many also stated that they try to avoid traveling at all during the busiest time of the day because they dislike crowded buses.

Driver's actions. Specifically, *the driving style* is important to the experience and the possibility to conduct tasks in the bus. The new electric buses were smooth and in the hands of skilful driver very pleasant experiences. The electric buses also include screens showcasing the energy flow based on the driver's actions. Several participants had noticed this screen and gotten genuinely interested in the technology.

Driver's attentive actions have a great impact on the way people feel about buses. One participant traveling with a stroller told how some drivers seem to ignore the signals for stopping the bus. *"I started to wonder if I'm not pushing the button correctly"* (female, 33). The participants also shared situations where the doors had been closed before they had exited or entered the bus, causing very unpleasant situations.

4.2.3 Temporal Context

Time of day impacts the passenger's mood, motivations and activities. According to the diaries, traveling to leisure activities was related to a more positive feeling also with the bus trip. *"I often use my phone when I travel to work in the mornings. I like to read and check the news before the day starts. This is not as important when I'm going home in the afternoon"* (female, 27).

Length of the trip impacts the nature and traveller's activities. Short trips (less than 10 minutes) are more often spent on passive activities, such as listening to music or simply relaxing. Longer trips (more than 10 minutes) provide a setting for task that require focus and immersion such as reading books and emailing, but also sleeping.

4.2.4 Physical Context

The physical context themes of intra-city buses consist of *Air quality, Cleanliness of the interior, Soundscape of the bus, and The state and model of the vehicle.*

Air quality is crucial factor considering a pleasant travel experience. Poor indoor air is often the result of faults in the air condition. Especially old buses tend to smell, whereas the new models are smell-free. The smell of fumes and diesel are absent from the electric buses, making them more pleasant vehicles to ride with. Fellow passengers can also cause strong smells, due to personal hygiene or use of perfumes. Indoor temperature can be challenging to control, making the bus an unpleasant environment at times.

Cleanliness of the interior is not only the matter of visual appearance but also a hygiene factor such as temporary mess. *"I've seen vomit in a bus many times and still the bus has been in traffic normally"* (female, 42). The new buses are cleaner, less smelly and they feel more hygienic.

The soundscape of the bus is the combination of the noise caused by the vehicle and the fellow passengers. The sound of the motor was perceived different in the new electric buses and the older buses. The electric bus is silent, which is considered pleasing whether you are inside or outside the vehicle. The alert and warning sounds – for example the sound of the stop button differ in different bus models. In some buses, there is no sound at all, making it challenging for the passenger to know whether their signal is registered. On the other hand, silent bus ride brings out the other sounds. Since the electric buses are silent, other sounds and noises are easier to hear and spot, which has its downsides: *"Now you can hear what other people are talking in the bus"* (female, 42).

The state and model of the vehicle affects several things. Smoothness of the ride is better in the electric bus, providing a more relaxing experience. *"If you have ridden an old bus earlier that day and then you take the electric bus, it almost feels luxurious experience"* (female, 34). The layout of the seats differs in different models and brands. In the buses of Tampere, the usual layout is that all seats are facing front, except the one row in the quartets. However, in the new electric buses the layout is different: half of the seats are rear facing. This feature was disliked. *"It is awkward when you have to stare each other the whole trip"* (male, 22).

4.3 System

In this study, the *system* is considered to consist of firstly, the public transportation system, including bus transportation and related information and secondly, the mobile services and applications used by the passengers.

4.3.1 Public Transportation System

Travellers' experience of the bus transportation system is firstly affected by availability of convenient bus lines. The participants of our study were generally pleased with the bus lines of the city of Tampere. *Timetable* impacts the accessibility

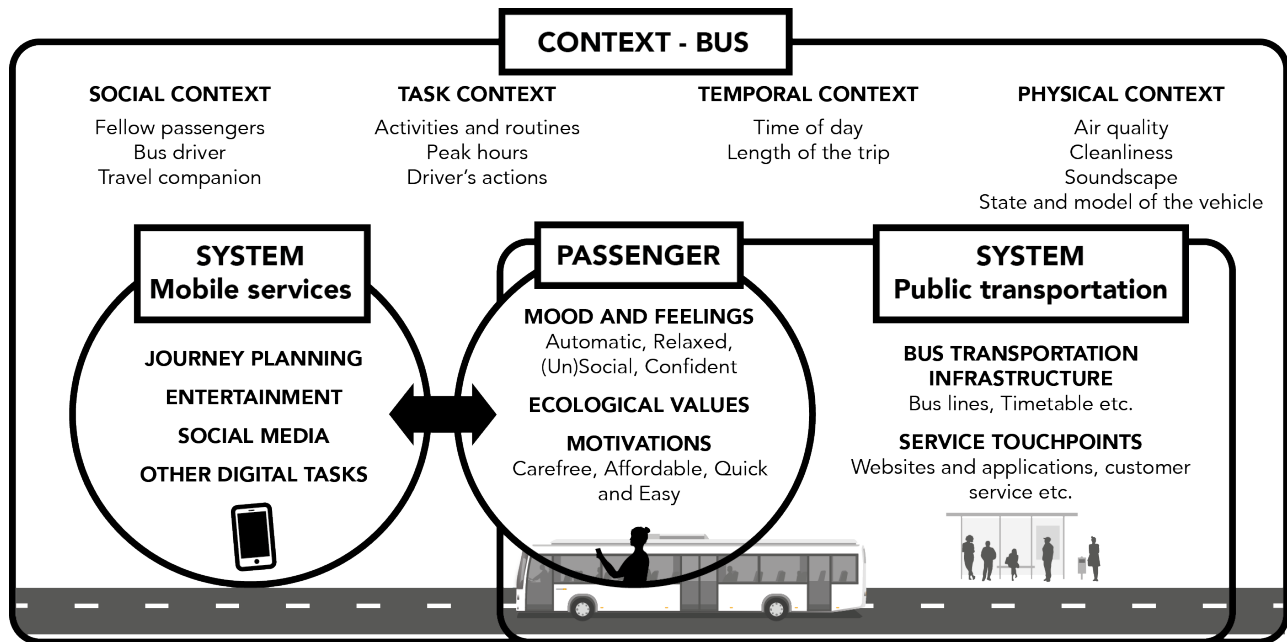


Figure 1. Bus Travel Experience Model derived from our field study findings.

and usability of the transportation system. Especially participants working in shifts stated that the timetables are sometimes limiting their ability to use public transportation services, since the buses do not run in the early mornings. Participants also complained about buses being late or too early, causing them to be late from appointments. *Exceptional situations*, such as a technical fault that causes the bus to stop its journey, stick in the passenger's memory for a long time. The participants of our study expressed interest to know the cause of such situations.

Communication of travel related information takes place via different channels. *Information at bus stops* in Tampere is mainly in the form of paper timetables and bus line maps. Only the stops in the city centre have digital screens showing the next buses. Participants hoped to see more of the digital screens also in other bus stops. However, the paper schedules and maps were still considered important for their ability to show overview. Also, *"during winter time it would be good if you don't always need to check everything from your mobile phone"* (female, 42).

Information about changes. The city of Tampere is currently in the middle of tram construction and thus there are a lot of construction zones in the city affecting the bus lines and locations of bus stops. This situation reveals the need to communicate the upcoming changes so that the passengers can easily access the information.

Information screens in the buses. All the buses in Tampere have a LED screen inside in the front of the bus that should show the

next stop. However, they are not always on and sometimes they are showing the stops with delay. Participants hoped that the screens would not only show the next stops but also a map with the current location.

Feedback. Participants were hoping to get improvements to the local transportation company's feedback system. *"It would be nice to have the possibility to give feedback via journey planners and other applications provided by the transportation company"* (female, 42).

4.3.2 Mobile Services

Journey planners. Even when traveling on familiar routes, several participants mentioned using journey planners to follow the route, schedule and location of connecting buses. *"I have the journey planner open when I'm in the bus. I like to follow the map and see where the blue dot (the bus) is, how many stops there is before my destination, and so on"* (female, 27). As expected, people also used journey planners to plan their daily schedules related to bus travel.

Entertainment applications. *Listening to music or other audio content* such as podcasts or e-books when traveling by bus is common. *Reading newspapers, magazines or other content* is another area of digital consumption. *"When I travel alone, I often check the news and social media. It's my private time when I can focus and immerse myself with the content of the articles"* (female, 35).

Social media and messaging. *Checking emails and other messages* was very common during the bus journeys. *"I tend to check the email in the bus. It's a perfect 15-minute slot for such*

small tasks" (female, 35). The traveling activities vary a lot whether traveling alone or with a companion – like with kids. *"If I don't have the stroller and kids to worry about, I spend the whole journey with my phone: email, Facebook, basically anything. I'm so immersed that I sometimes even might forget to press the stop-button"* (female, 33).

Other digital tasks conducted during the bus ride. Most of the participants stated that they utilise the travel time to "get things done", whether checking emails or planning the grocery shopping for the week. *Other digital activities to fill the idle time* include activities, such as making shopping lists or book keeping, and studying languages.

Important note regarding the system of digital services is that **there are "non-users"** who do not use mobile devices at all or use them rarely when traveling. For some, the reasons were social *"I like to see the people and the scenery. I rather interact with the fellow passengers than with my mobile device"* (female, 32). Another motivation is to have screen-free time, for example if work is heavily digital. Thus, these passengers rely more on the selection of on-board digital services showcased on the public screens.

5 BUS TRAVEL EXPERIENCE MODEL

We synthesized Bus Travel Experience Model (see Figure 1) from our study findings. The model visually communicates the holistic view of the elements of travel experience from the passenger's perspective. The model and related findings are aimed to be utilised both as source of ideas for the design of new digital services, and as a structural basis for UX evaluation of the services. Following the structure of Findings, the model is based on the user experience definition by Hassenzahl and Tractinsky [11] and the contextual dimensions by Bradley and Dunlop [1]. The motivation of using this structure also for the model is its relevance for HCI researchers and designers. Below, we summarise the main parts of the model and present related user needs and exemplary digital service ideas that arise from the study findings.

5.1 Passenger

The passenger has internal attributes that affect the travel experience. These attributes include a variety of moods and feelings, such as stress – relaxation and sociability – unsociability; ecological values; and motivations of being carefree, affordable, quick and easy, controllable and for some people, technological novelty. Passenger is a potential user of the digital services, both mobile services and services offered inside the bus or bus stop.

5.1.1 User Needs and Digital Service Ideas

Digital services can decrease the passengers' stressful feelings with better communication of journey related information, and by enabling communication with fellow passengers for the ones willing to socialise.

Ecological or green values were considered important in public transportation. This value was highlighted especially when traveling by modern vehicles that run with electricity. Thus, the energy consumption of vehicles could be visualized and communicated to the passengers, even in real time. This could even result more people being aware of the environment. The same channel could also be used to promote other ways to green or ecofriendly lifestyle.

Being affordable and saving money. People value public transportation not only because of the green values, but also because it is an affordable option compared to private cars. Thus, the heavy users of public transport could be rewarded with better prices or for instance an online lottery based on the travel card usage. This could motivate people to use the services more and also create a "fun-factor" to the mundane everyday routine.

Novel technology experiences can satisfy curiosity and increase self-esteem of technology-savvy passengers. The transportation field is expected to change drastically within the following years. In the middle of the transition towards modern and more holistic mobility services, the modern buses – such as electric buses – should be utilized to communicate the technological shift that enables better travel experiences. This could be supported for instance, by presenting *new types of displays and interaction techniques in the bus*, such as playful gesture-based interactions.

5.2 Context

The bus context strongly relates to social behaviour of fellow passengers and the driver. Task and temporal contexts contain practical journey elements, and especially following the routines supports positive travel experiences. Physical context is an essential hygiene factor but can also "make or break" the travel experience.

5.2.1 User Needs and Digital Service Ideas

There is not much one can do to change the behaviour of fellow passengers, nor the way the driver acts. However, services could be developed to *enhance the elements of the social context*. For many participants of our study, the travel experience was better when they felt social during the bus trips. Of course, passengers also often want to be left alone. Thus, services enabling **subtle social interaction** could be developed for people who are willing to socialize with fellow passengers, for instance via digital message board.

Getting guidance was stated important when traveling to unknown destinations. Support was expected from the driver, who is often occupied with other driving related activities, and thus is not able to act as a travel guide. Hence, to enhance the travel experience and make people feel more confident, technological solutions could give guidance without burdening the driver with interruptions. *A virtual driver could provide the passengers with guidance* regarding route information,

timetables, connecting bus lines and other questions the passengers might have.

For many, one of the major dislikes was to travel on a crowded bus. Some participants even stated that they try to choose less crowded bus lines or avoid traveling at all during peak hours. Thus, services that enable passengers to **avoid peak hours** could be developed. Journey planners or other applications could be developed to *show the actual or predicted crowdedness of the vehicles* to enable more even spread of passengers. Cooperation with large traveller groups, like schools, could help in predicting the crowdedness. **Getting a seat**, or even a specific seat, is important for some people. Sensor technology could be utilized to measure the available seats, or for instance, the stroller space in the vehicle.

Regarding the physical context, air quality or bus model have a huge impact on the **pleasurable atmosphere and travel environment**. Several participants told that they might start feeling nauseous inside the vehicle if the bus is too crowded or the inside climate is not fitting to their preferences. To prevent that and turn the travel experience into a pleasurable one, *sensor technology* could be utilized in measuring several dimensions inside the vehicle: air quality, the amount of people, temperature etc. This information could be then *visualized and communicated to the passengers*.

5.3 System

The system consists of two quite separate systems which, if designed well, form a coherent travel experience from the passenger's perspective. First, there is the *bus transportation system* with the transportation provider's infrastructure and service touchpoints, such as travel information services both online and on-board in the public screens of the buses. This is the essential functional factor that must fulfil the essential user needs for bus travel. Second, there are *mobile services* that can bring various pleasurable experiences to the bus travel. These services may be accessed on the passengers' own mobile devices. Developing these additional digital services may be the source of novelty and attractiveness in bus journeys. Almost all passengers are interacting with their mobile devices and entertain themselves with social media, music, games etc. provided by a variety of service developers.

5.3.1 User Needs and Digital Service Ideas

Passengers' needs for pleasurable experiences relate to journey planning, entertainment, social media and other digital tasks such as information search. Taking into account the model's other elements can help produce new, bus-specific digital services taking inspiration for instance, from the contextual dimensions of the bus. Positive travel experience could be further supported for example by **immersion in the surrounding environment**. Passengers' interest towards the scenery and surrounding local environment could be supported by information about attractions, local businesses, or, for instance the history of buildings with Augmented Reality

solutions. Also, **services for passengers who do not use mobile devices** should be developed. For example, the public screens in the bus could be utilized to visualize the following stops or providing relaxing entertainment.

6 DISCUSSION

Several studies have been conducted on travel experience [e.g. 2, 5], trip satisfaction [27] and travel behavior [28]. Even though travel experience and travel comfort have been studied across travel modes – such as trains and aircrafts – the findings and insights are not directly transferrable to the intra-city bus transport. The characteristics of long-distance journeys differ from short distance intra-city bus journeys: duration of the trip, frequency of travel, type of the vehicle, and even the act of planning and preparing for the trips are different. Thus, we argue that our study reveals themes and insights that contribute to and provide holistic understanding of short distance bus journeys, activities people conduct during those trips, and the elements that impact the travel experience. Carreira et al. [2] studied the travel experience of mid-distance bus journeys (intercity transportation) of touristic and utilitarian trips aiming to define the experience factors and components impacting the travel experience. Our findings are in line with some of the results of Carreira et al. [2]: The social context – the fellow passengers and the driver have a central role in the forming of the travel experience. Since travel experience is impacted by several elements, i.e. the transportation service provided, the vehicle, the physical facilities for waiting (bus stops), and even by the safety conditions, the improvement of public transportation services requires a holistic approach. Hilden et al. [13, 14] found that the feeling of being in control is one of the basic needs for successful traveling. Their studies also reveal that relaxation is a central experience desired by many short distance bus passengers. Providing the passengers with modern technology may evoke further experiences such as curiosity and pride, and thus make travel a pleasurable experience [14]. Additionally, Hilden et al. [14] propose that emphasizing the ecological choice can be accounted for in the design of digital services in electric buses. Our findings are in line and extend these studies by providing more detailed descriptions of the passengers' experiences and by covering the studied factors more extensively.

6.1 Modelling the Bus Travel Experience

In this study, we developed Bus Travel Experience Model that visualizes and concretizes the building blocks of passengers' travel experience. In its current form, the model emphasizes the significance of digital services in the broader service context of public transportation. We based the model on previous UX models [11, 15] to form holistic view of the current experience of bus passengers. However, with such model that consists of separate blocks and factors, the elements are overlapping and more connected to one another than can be

presented in the visualisation of the model. For example, the mood of being social (or asocial) is connected with the social context and the driver's actions could be seen also as part of the system. Also, the relation between the two systems, Public transportation and Mobile services, is not entirely distinct. The System of Public Transportation is mostly managed by the transportation provider, and hence is the collection of both physical and digital – the infrastructure and the designed service touchpoints – that form the *customer experience* of the specific transportation provider. However, the model can help gain understanding of the “whole” and aid in the design of its elements, and the interactive travel services. Our partial focus on studying electric buses may have some effect to the Bus Travel Experience Model. In specific, the ecological viewpoint and findings on the physical context may have been emphasised because of this. However, we believe that the elements themselves are relevant also for any types of buses in intra-city travel. Similarly, since the study focused on intra-city buses, the findings are affected by the characteristics of short distance journeys. However, some of the findings can also be seen relevant in mid- or long-distance intercity bus transportation. For example, the social and physical contexts may be significant also in the longer bus trips.

The qualitative methods – Bus Travel Diaries and semi-structured interviews – worked well in the context of our study. The diaries enabled the study participants to document their experiences during bus rides and thus we believe that we gained reflective and insightful interview data after the three-week self-documentation period. The data we got from the Bus Travel Diaries was largely in line with the interviews. However, we found that the travel diary was especially valuable for the documentation of passengers' inner state, as it captured also the immediate emotional responses compared to the more rationalised opinions during the interviews [26]. As all experiences, also the travel experience is subjective, and thus what eventually matters is the long-term impression that people have regarding their travel experience. Thus, we consider that taking the interview data as our primary source of analysis was justified.

6.2 Limitations and Future Work

The study was limited in the number of participants who represent only the public transportation users of the city of Tampere. While both men and women were included, the overrepresentation of women in the sample reflects the widely observed gender difference in travel mode use [25]. Also, the city has a relatively simple transportation system compared to larger cities which may have trams, metro and competing bus companies. Still, we believe that the developed model's structure is valid also in other types of contexts, but naturally to make its details valid “universally”, similar studies would need to be run in different types of cities. However, most cities especially in Europe are not metropolis but rather similar medium-sized as the city of our study. Hence, we believe that

the results of this paper can be utilized also in other cities and other countries. The cultural context in this study is a socially homogeneous Nordic city, which cannot be separated from the overall travel experience. However, the eroding status of public transport in the face of growing car mobility is a global phenomenon. It has been shown that digital services have a role in rebranding the bus service and making it attractive for professional travellers [17].

This study was a part of a three-year research project *Living Lab Bus*, in which we have also conducted a similar study in another Nordic city. In our future work, we are planning to combine these findings and create personas for short distance bus passengers. We are also planning to utilize the Travel Experience Model to map out specific needs for different personas and generate novel digital services ideas that would make their travel experience more pleasurable. Eventually, with our research results we aim at helping make public transportation more attractive option in city travel.

CONCLUSION

In this paper, we presented the findings of a three-week qualitative field study with ten regular bus passengers on bus travel experience. Based on the findings, we synthesized the Bus Travel Experience Model that describes the central experience elements – user, context and the system – for intra-city bus journeys. This novel model can help designers understand the complexity and holistic view of bus travel context. Thus, the Bus Travel Experience Model together with the field study findings can guide ideation and evaluation activities when designing new digital services focusing on attractive bus travel experience.

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