Let's Talk About The Experienced Context: An Example Regarding Public Transport Information Systems

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ABSTRACT

This position paper aims to encourage researchers in the field of context-aware public transport information systems to incorporate human-centred approaches more deeply into their methodologies. Current context-aware systems in this domain often take a representational view and employ a data-first approach. Drawing on insights from previous work, we propose a distinction between the objective context and the experienced context. The experienced context incorporates interactions and perceptions to reflect better how we, as humans, experience the world. To measure this experienced context, we advocate for using qualitative research methods for HCI. To demonstrate this approach, we present the results of a focus group study on context in public transport. The results reveal that emerging experiences are shaped by a combination of various factors. These findings highlight the importance of incorporating user perspectives in designing context-aware systems. Therefore, in this paper, we take the position that if we want to improve the context-aware public transport information systems, we need to understand what travellers truly experience during their journey.

CCS CONCEPTS

• **Human-centered computing** → **User studies**; **HCI theory, concepts and models**.

KEYWORDS

context, public transport, intelligent systems, human-centred perspective

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1 INTRODUCTION

In recent years, Mobility as a Service (MaaS) has been gaining popularity in the public transport domain [e.g., 3, 6, 7]. Looking at different definitions, it could be described as *an emerging type of service that, through a joint digital channel, enables users to plan, book, and pay for multiple types of mobility services.* [15, 20, 22]. Travellers now face a growing number of options and must make additional decisions. This increases the complexity of journey planning. An effort to make sense of this growing amount of information may cause travellers to experience a state of information overload. In the end, this could negatively affect their travel experience. Luckily, more intelligent public transport information systems (PTIS) are being developed to assist travellers in planning their journeys.

One approach is to adapt these PTIS to the travellers' context, also known as context-aware PTIS. These context-aware PTIS can significantly support travellers in navigating all the different travel possibilities based on their current situation. Current examples of context-aware public transport information systems (PTIS) are often fixated on a data-first approach. We often see research focussing on adapting PTIS to a single or a combination of objective context factors, such as the weather or crowdedness [e.g. 23, 24]. Unfortunately, these approaches result in problems as the context they aim to capture and adapt to does not reflect the travellers' actual experienced context. A traveller experiences a context comprising various dynamic factors that are user- and situation-dependent [5]. For example, two travellers are waiting for the same metro. The system identified the journey as crowded. When notified about this, one of these travellers might prefer to wait while the other would rather accept his fate and take the crowded connection in order to make it to work in time. However, once temperatures rise above 30 degrees Celsius, the second traveller might also prefer waiting for a quieter connection as the combination of the temperature and crowdedness significantly impacts the comfort of the journey.

An objective context-aware system would suggest the same to both travellers in these situations. However, a system considering the experienced context is much better equipped to make appropriate recommendations. Therefore, we postulate that to improve a traveller's experience, it is essential first to understand what this experience consists of. In this paper, we aim to encourage a more human-centred approach when creating context-aware PTIS. With the goal to provide travellers with context-aware travel support that matches their expectations, we take the position that research needs to investigate the traveller experience and only then determine what context to use for adaptation for which users and in what situations.

This position paper is structured as follows. In Section 2, we outline related work. Section 3 exemplifies for researchers how a more human-centred approach can benefit the context-aware PTIS. Section 4 provides an example study to stress the additional importance and possible outcomes.

2 RELATED WORK

The concept of context is considered complex and challenging to define. Based on an often-used definition of context, it can be described as *"any information that can be used to characterise the situation of an entity"* [1]. However, already in 2004, Dourish proposed an extended view of context [5]. This paper emphasises that context should be viewed as a feature of interaction and that it does not objectively exist but is actively managed and created. This stance is compared to the commonly used representational view, where context can be seen as a sum of objective features.

In public transport, we see the notion and importance of context. Mohan, Klenk and Bellotti [19] and Grison, Gyselinck and Burkhardt [12] showed how situational-related factors such as trip purpose or weather could influence transportation mode choice. More recent research by Grison, Gyselinck and Burkhardt [13] explored which factors are related to the experience of route choices in public transport. They showed the importance of contextual factors related to a journey's efficiency and pleasantness. Additionally, Hörold, Mayas and Krömker [16] and Chen and Qi [4] showed how at the different steps of this travel chain, the context influences the information needs of PTIS users. Grison, Burkhardt and Gyselinck [11] do imply that factors such as seat availability, overcrowding, noise, and the possibility of reading or listening to music can influence the experience of comfort.

Seeing the importance of context, several examples of PTIS exist that aim to adapt to a travellers' context [e.g., 2, 8, 10, 14, 17, 18, 23, 24, 26–28]. Some research focuses on individual context factors such as weather or crowdedness, aiming to create systems that adapt to these context factors and provide information accordingly. For instance, Wisetrip [24] is a journey planner that considered factors including real-time event data and information on extraordinary conditions (e.g., strikes, extreme weather and disasters) and provided alerts and replanning options accordingly. Additionally, others also involve the user and, for instance, their behaviour and preferences. Systems like Hydra [18] use several geographical, metrological and temporal contextual factors and combine these with user behaviour and preferences to provide route recommendations. Al-Rahamneh [2], for instance, makes use of user preferences and interests as well as contextual factors such as weather conditions, pollution levels and pollination levels to provide travellers with intelligent mobility solutions.

Yet, a closer look at the literature on PTIS reveals some shortcomings. We observed that these researchers often use a data-first approach and seem to have a more representational view of context. Here, context-aware systems are often created without first understanding the interactions that form the context that travellers experience in real-world situations. Hence, they do not incorporate the traveller's view from the start. The system may eventually not match the traveller's expectations as they do not align with how humans perceive the world. As humans, we use a combination of bottom-up combining stimuli and top-down processes to perceive sensory stimuli and experience the world [25].

Inspired by the concept of perception found in cognitive psychology combined with the work of Dourish [5], we propose a distinction between the objective context and the experienced context. We define the objective context as a separate context factor or the sum of these factors. The experienced context, on the other hand, incorporates interactions and perceptions formed by knowledge, skills and previous experiences. We argue that it is essential to focus on first understanding the traveller and their experiences before creating context-aware PTIS. Only when the experienced context is understood an accurate representation can be implemented to truly improve the travel experience.

3 HUMAN-CENTRED APPROACHES FOR UNDERSTANDING THE EXPERIENCED CONTEXT

As previously highlighted, a better understanding of the experienced context is needed before determining how to implement context for adaptation. While it is not our view that a perfect context-aware system can be created at this moment in time, we do think that improvements can be made by considering the human perspective first. In our opinion, more qualitative methods need to be employed to achieve this. These methods include interviews, focus groups, observations, contextual inquiries or diary studies. These methods can then help in identifying context factors and allowing participants to elaborate on their experiences is needed to uncover underlying interactions that lead to their experiences. For example, the critical incident technique [9] can be used in either interviews or focus groups [12]. With this method, factors can easily be extracted and discussed.

Additionally, a mixed methods approach could be valuable. For instance, context factors can be identified through quantitative methods such as surveys and diary studies. Follow-up interviews can then be used to further elaborate on these factors. In all these approaches, uncovering underlying interactions that lead to emerging experiences is important.

4 EXPERIENCED CONTEXT IN PUBLIC TRANSPORT: A FOCUS GROUP EXAMPLE

To illustrate the value of qualitative methods when addressing the travellers' context, we will shortly discuss a part of the results of a focus group study. For the purpose of this position paper, we will only focus on the results in regard to experienced context, as it is aimed to serve as an example.

The focus group study aimed to understand what contextual elements travellers experience that influence their door-to-door public transport travel. Focus groups were selected as a method as it allows to have direct conversations, can encourage group discussions while exploring different perspectives, and participants can get inspired by each other's stories.

4.1 Sample

A total of 41 participants were recruited using the panel of the Netherlands Railways (NS) [21]. For demographics, see Table 1.

They were screened on their travel frequency and were required to travel at least once a week. The focus groups were conducted at four locations in the Netherlands to obtain a broad view of different areas. Participants were distributed as equally as possible over the focus groups in terms of age, gender and level of education. Participation was voluntary and compensated by a day card for the Dutch Railways. At the start, participants were asked to read and sign a consent form regarding their participation, processing of gathered data and recording of the session.

Table 1: Demographic summary of participants who took part in the focus groups

Group	Area	Size	Gender			Age			
			F	M	O	Mean	StDev	Min	Max
FG1	Utr	7	4	3		46.9	12.1	23	62
FG2	Utr	7	2	5		46.9	13.7	28	65
FG3	Ein	5	1	4		42.6	17.3	18	62
FG4	Rot	4	2	2		50.1	15.2	35	67
FG5	Rot	7	2	5		58.9	10.6	40	68
FG6	Zwo	6	0	5	1	43.8	18.8	19	61
FG7	Zwo	5	3	2		53.0	8.0	39	58
Total		41	15	26	1	49.0	13.9	18	68

4.2 Method

The critical incident technique [9] was used during the focus groups. This method was selected to obtain rich, qualitative information about significant situations that impacted participants' travel experiences. The session consisted of three rounds and the average duration was 1.5 hours. First, three pieces of paper were placed on a wall. Each of these papers had a travel step written on them: "before the trip", "during the trip" and "after the trip". Participants were then asked to consider their most *recent and memorable* public transport trips. They were asked to write down on a post-it note the different context factors, e.g., the circumstances, the environment and other factors that positively or negatively influenced their travel (experience). They were asked to place the post-it notes below the corresponding travel step. After approximately ten minutes, we reviewed a sample of the post-it notes and asked participants to elaborate.

Second, we replaced the travel steps with context categories (e.g., spatial context, temporal context). This was to provide participants with new inspiration. Participants were asked to reposition their post-it notes below the context categories they felt they belonged to. If the stories of other participants or the categories on the wall had inspired them, they were also allowed to add new context factors. Next, they were asked to elaborate on the placement of their post-its and the newly added context factors.

Last, participants were given three stickers and asked to place them on the post-its with the context factors they thought were most important to them. After the session was wrapped up and the participants were thanked.

4.3 Results and discussion

The focus groups resulted in 398 post-it notes and 861 minutes of video recording. After each focus group, all recordings were transcribed and anonymised. After anonymisation, the recordings were deleted. Frequently mentioned topics were communication, facilities, fellow travellers, staff, time and the indoor and outdoor climate. Additionally, the focus groups resulted in a codebook consisting of structured context items. For the purpose of this paper, we will not discuss all identified individual context factors in detail. Instead, we want to highlight the results showing the experienced context, which was observed in the stories participants shared. The results revealed that participants' experiences were often formed by a set of interacting context factors. Here, the state of some factors also played a vital role.

Participants' stories showed that the *experienced context* could be separated from the *objective context*. The experienced context emphasises the combination of context factors and properties, as illustrated by the following quote:

> *"It was a day with much snow and during COVID-19. A tiny little train arrived at the station, and everyone was sitting in first class. Two hundred people tried to get into a train made for 50, so it was crowded."*

Here, the traveller experienced the journey as crowded due to the train's capacity, the number of people, the fact people came to the first class, and the ongoing pandemic.

Additionally, how context is experienced depends on a specific individual. For instance, referring to a check-in gate, one participant mentioned:

> *"Here we have those fine, low ones. But when I sometimes arrive in Amsterdam, you have those big prison gates. I feel really locked up, I find it very unpleasant."*

Whereas another refers to the same check-in gate:

> *I like [..] that they can't jump over it. I'm really annoyed, it's everyday that I see them hopping over here.*

Thus even when discussing a relatively simple and static context factor, such as a check-in pole, travellers may experience them differently. Hence, we observe that context factors in the public transport domain cannot be viewed as a sum of objective features as done with the representational view of context.

In the experienced context, new constructs can emerge—e.g., the perception of safety, ambience or comfort. To illustrate, the perception of safety can emerge from the location, time of day, lighting, staff presence and other people's behaviour. These results show that for certain situations, context factors should not be considered independent from each other. The setup of focus groups allowed participants to share stories and engage in discussions uncovering some of these underlying interactions.

4.4 Limitations and Future work

As previously mentioned, the experienced context was not the primary goal of this focus group study. Therefore, additional work is needed to further explore the concept of the experienced context in public transport. Yet, the current focus groups serve as a first step in uncovering underlying interactions and provide a suitable methodological example for future work. It should, however, be noted that the critical incident technique is known to be prone

to recall bias; participants' experiences could have changed over time. Therefore, we encourage future research to consider this and complement the focus groups with another method, such as diary studies, to understand the travellers' experiences even better.

As a follow-up step, it is our intention to identify impactful situations in public transport travelling for which we further explore the experienced context. A mixed-method approach will be suitable here. Through interviews or contextual inquiries in which participants discuss the impact of different factors on their experience, the experienced context factors and their underlying relations could be uncovered. Afterwards, an additional survey study would allow us to quantify these relations.

The presented study suffer from some other limitations. First, we recruited our participants through the Dutch Railway panel, as it consists of a heterogeneous sample. Yet, diversity regarding educational background and residence area could still have been better. Future research could broaden this understanding of context in door-to-door PTIS by recruiting more people with practical education, from the countryside, and from other countries. Second, our sample solidly consisted of participants from the Netherlands. Hence, we are aware that some results are prone to cultural bias. The subjective nature of the experienced context would mean that for different regions, the factors could be experienced differently. Therefore, we encourage more research in different regions to cover these cultural differences.

5 CONCLUSION

In this position paper, we aim to encourage future research to have a more human-centred perspective when creating context-aware public transport information systems to improve the traveller experience. Instead of approaching context as a representational problem, we emphasise that to improve the experience of context-aware public transport information systems; it is essential to understand not only *what* the context is but also how it is experienced and perceived from an interaction point of view. Various qualitative research methods for HCI could be used to achieve this. Ultimately, a deep understanding will help us design context-aware PTIS that aligns with how we truly perceive the world around us.

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