



# 'Wayfeeling': Navigating through emotional and sensorial responses in public transit

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## ARTICLE INFO

### Keywords:

Cognitive maps  
Emotional design  
Multimethod  
Transit behavior  
Wayfinding

## ABSTRACT

Users of public transit tend to avoid certain routes because they dislike particular aspects, or gravitate towards a particular mode because it is familiar, or because it "feels right". This type of navigation can be described as 'wayfeeling', or letting one's senses guide the way. The concept of wayfeeling is integral to understanding how public transit space is used, and underscores the importance of emotional wellbeing within these spaces. But how does one determine what wayfeeling is and when it is being performed? The aim of this paper is to illuminate how emotional wellbeing affects navigational behaviors through the act of wayfeeling. The study uses participant experiences of a Destination-Task Investigation (DTI) in Munich's public transit system. Included in the DTI, participants were asked to draw their navigational journey, and then asked to highlight the sections they found positive, neutral, and negative. The study revealed that the act of navigating a transit space evokes strong emotional reactions from participants, especially as they had more negative experiences in transfer areas, and felt more positive in familiar spaces. Most importantly, negative events during the DTI overshadowed the overall perception of their journey which lead to an overall negative opinion of their experience.

## 1. Introduction

When we think about public transit, seldom do we consider the influence the space has on our emotional wellbeing. We often consider these spaces as a means to get from Point A to Point B; however, they also function as places of social interaction, and immediately upon entering them, we are required to rely on our senses and feelings to make navigational decisions. Moreover, transit spaces can be incredibly intimidating and overwhelming for many individuals, leading to a high anxiety and stressful experience which affects one's overall emotional wellbeing (Balaban et al., 2017; Chang, 2013; Cox et al., 2006; Haake et al., 1984; Natapov et al., 2015; Peponis et al., 1998; Stankiewicz and Kalia, 2007). Emotional wellbeing, as defined by Huppert (2009), emphasizes the positive feelings experienced in one's daily activities and describes feeling good (primarily encompassing positive emotions such as happiness, engagement, contentment, and confidence), and functioning effectively (involving the developing of one's potential, having control over one's life, coping with normal daily stress, and working towards a goal), as the basis of the term. While both researchers and

practitioners have paid close attention to transit environment and infrastructure design (Adey 2008; Jensen, 2014; Jensen and Lanng, 2016; Merriman and Pearce, 2017), and research has begun to hone in on the effects of positive experiences in individual memory (Baumeister et al., 2001; Bebbington et al., 2017; Carstensen and DeLiema, 2018), transit users' emotional wellbeing within these two contexts have not been at the forefront.

In order to help with decision making processes, especially in critical and stressful situations, we rely on our surroundings for navigational cues (Chang, 2013; Haake et al., 1984). In parallel, we internally sense the situation resulting in an emotional outcome and response. In light of this, wayfinding networks have become essential elements in public transit systems by providing spatio-temporal guidance for passengers through design techniques that include light, color, sound, and texture (Fendley, 2016; Rodrigues et al., 2018; Scollon and Scollon, 2003; van der Hoeven and van Nes, 2014). The intention of the wayfinding system is to provide navigational assistance to maintain positive user experience. While practitioners have good intentions when implementing wayfinding systems within transit networks, there are aspects of the

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system that are often overlooked or neglected during the design and implementation process – leading to user retention issues later on (Fendley, 2016; Fu et al., 2018).

### 1.1. An overview of wayfinding

The term wayfinding was originally coined in 1960 by Kevin Lynch, in his book *The Image of the City*, and can be defined as a purpose-filled act that involves decision making and problem solving to get from an origin to a destination (Allen, 1999; Arthur and Passini, 1992; O’Neill, 1992). Wayfinding research has primarily focused on behavioral, environmental, and spatial factors within urban environments (Allen, 1999; Arthur and Passini, 1992; van der Hoeven and van Nes, 2014; Golledge, 1999; Lynch 1960; Montello 2001, 2005; Weisman, 1981). Research has predominantly focused on the understanding of how individuals behave during wayfinding tasks and what this means for individual decision making (Chen et al., 2009; Jiang and Liu, 2009; Lynch, 1960; Timpf, 2002). Cognitive decision-making processes differ from person to person, and therefore cultural affordances and learned behaviors are important to help understand human navigational strategies within wayfinding networks (Brugger 1999; Clayton et al., 2017; Foster and Afzalnia, 2005; Li and Klippel, 2016; Lin et al., 2019; Montello, 2007; Scollon and Scollon, 2003).

Complex urban environments (hospitals, university campuses, and airports) have been a central theme in wayfinding research, as our senses become heightened when we are actively navigating through these environments (Chang, 2013; Haake et al., 1984; Rodrigues et al., 2018; Schuster, 2012; Stankiewicz and Kalia, 2007). Researchers have more recently become interested in wayfinding behaviors within public transit environments, particularly users’ understanding of navigational systems (Bohte et al., 2009; Brakewood et al., 2014; Gountas and Gountas, 2007; Lai and Chen, 2011; St. Louis, 2014; Olsson et al., 2013; Urry, 2007; van Lierop, 2021), including the context of ICT and smart mobility (Cisterna et al., 2021; Guidon et al., 2020; Line et al., 2011; Narimoto et al., 2018; Urry, 2007), within these environments.

When individuals are faced with unfamiliar environments, they rely heavily on their surroundings and navigational tools to give guidance in order to reach their destination (Lynch, 1960). Navigational tools such as maps, informational boards, station design techniques, and smartphones, all contribute to user behavioral and decision-making patterns within wayfinding networks. The smartphone, for example, has recently become popular as a users’ navigational aid and has contributed to a shift in user navigational behavior to a more customizable navigational process, externalized from the existing physical wayfinding and transit network (Ferri et al., 2021). Although access to navigational technologies has become ubiquitous in navigational activities, studies have highlighted that individuals continue to navigate through transit spaces based on familiarity and comfort (Afrooz et al., 2018; Garling et al., 1981; Marchette et al., 2011; Wiener et al., 2009).

### 1.2. User interaction in transit environments

Environmental psychology describes the state of mind or feeling an individual has when interacting with their surroundings. It focuses on the effects the environment has on the individual’s behavior, as well as the perception that the individual has of the specific environment, and how design can help to inform and even change behaviors within these settings (Bell and Sundstrom, 1997; Bell et al., 2001; Chang, 2013; Dornëy, 2005; Haake et al., 1984; Moser and Uzzell, 2003; Sundstrom et al., 1996; Wisner et al., 1991). Terms such as ‘emotion’ (a neuro-physiological response to a specific event (Ekman, 1994)), are typically excluded from transit design research, but play a key role in users’ emotional wellbeing and their acceptance of wayfinding systems in a public transit network (Damasio, 1996).

The human experience is key to the way designed spaces function, and is at the center of the design process (Carreira et al., 2014; Carpman

and Grant, 2002; García-Catalá et al., 2020; Kim et al., 2021). According to Carpman and Grant (2002), the human experience (including that of the social and psychological experience) is important in terms of designed space, as space can influence and encourage certain user behaviors and emotions.

In June 2021, the Bavarian State Ministry for Housing, Construction and Transport released the “Zugang zur Bahn” (“Access to the Railways” in English) policy document. This policy was created to guide future design practices to help improve accessibility and user retention for the state’s many public transit networks. In creating this document, the state recognized the importance of user emotional wellbeing in public transit spaces through space legibility and design upgrades (BSWBVRO, 2021). This document underscores the increasing shift in policy towards an awareness to personalized user experiences (Mulgan, 2013), and that how we feel in certain urban environments can determine the way we interact with our surroundings, and in turn, can perpetuate both positive and negative attitudes which impact user retention (Carreira et al., 2014; Cox et al., 2006; Diab and El-Geneidy, 2015; Diab et al., 2015; Dornëy, 2005; Evans and Wener, 2007; van Lierop et al., 2018; van Lierop et al., 2021; Vuchic, 2005). How individuals feel in specific urban environments can also reveal a lot about the effectiveness of public transit spaces and wayfinding design for researchers and practitioners alike.

### 1.3. Navigating the senses

As one travels through public transit space, one experiences different feelings and emotions based on how they sense the space (Balaban et al., 2017; Chang, 2013). Navigating through complex environments involves a variety of human senses (e.g., sight, sound, smell, etc.), all of which are important to take into consideration with public transit design and user emotional wellbeing (Carpman and Grant, 2002). All senses help individuals process their understanding of the space, as well as their expected behavior within that space. For example, a certain smell or sound may trigger a positive or negative reaction from an individual resulting in behavioral and/or emotional shifts by the user (Ekman, 1992, 1994). Of course, some triggers are intentional, such as an alarm bell which alerts individuals of an ongoing emergency. Other senses may be triggered unintentionally, but are completely avoidable. For example, poor lighting down a dark corridor may affect an individual’s perception of the space and cause them to adjust their route.

A passenger can be triggered both negatively and positively in certain atmospheres and spaces (Chan et al., 2014; Damasio, 1996). These cognitive images are then internalized and connected with a particular navigation activity and associated emotion, which affects an individual’s overall experience (Gray, 2001; Kim et al., 2021; Lynch, 1960). If an individual decides to avoid a certain bus route because they have had several negative experiences when taking it, this affects their decision-making and route choice patterns throughout their overall journey.

### 1.4. Defining ‘wayfeeling’ within the context of this study

*Wayfeeling* was coined by the researchers to emphasize the importance of emotional wellbeing in transit wayfinding settings, and came through observing participants in this study who attempted to maintain a consistent level of positivity throughout their transit experiences. The term is used in this study to underscore the importance of emotional and sensorial responses within user behavior patterns in public transit. The term combines ‘wayfinding’ (as previously defined) and ‘feeling’, which can refer to both the physical condition of feeling, as well as the mental experience of an emotion directed towards an object (Goldie, 2004; Lane et al., 2002). *Wayfeeling* can be defined as, using one’s senses to maintain positive emotional wellbeing while navigating. The term captures the subtle nuances of individual navigation, varied perception, and unique emotional experiences in the wayfinding process that have

been overlooked in wayfinding research thus far. Wayfeeling also helps to adjust the understanding of wayfinding within a transit network as it helps to shed light on how users utilize the transit space, their emotional wellbeing while navigating through the space, and how this affects perception and usability of the transit system as a whole.

The term helps place this study under the larger umbrella of mobilities research, and within the branch of wayfinding that focuses on behavioral and emotional responses in public transit by addressing the otherwise overlooked importance of emotional wellbeing in navigational settings (Iftikhar et al., 2020). The present study therefore provides further insights into the nexus of wayfinding and emotion in public transit environments.

This paper builds on the gaps in wayfinding research described above and aims at illuminating how emotional wellbeing affects navigational behaviors through the lens of wayfeeling. To reach this goal we asked three questions: (1) Where do participants experience strong emotional reactions in a transit system? And why?; (2) How does participant emotional wellbeing impact navigational decisions?; and, (3) How does wayfeeling impact a participant's perception of transit spaces? In doing so, the paper contributes to a better understanding of user behavioral patterns and how to improve wayfinding and public transit design, which has significant relevance for both researchers and practitioners.

## 2. Materials and methods

A holistic research approach when looking at user behavior and emotions in public transit space is needed to garner a thorough understanding of what individuals think and feel in these spaces and why they make certain navigational decisions. Carpmann and Grant (2002) highlight the importance of a people-centered approach in research and methods, which, when directly applied to wayfinding research, helps to highlight user behavior in public transit spaces. During the last twenty years in mobilities research, qualitative mobile-interviewing techniques have gained significant importance and have become more flexible in structure as they allow for first-hand, *in-situ* accounts directly from the participants (Sheller and Urry, 2006; Büscher and Urry, 2009; Levy, 2001; Kazig and Popp, 2011). Drawing on Rivlin (2002) and Sundstrom et al. (1996), who state multimethod research is common in the field of environmental psychology (including field settings, case studies, quasi-experimental design, and unobtrusive observation), multimethod research can therefore be applied to mobilities research, including this present study.

This exploratory study addresses the gap of emotional and sensorial research within the branch of behavioral wayfinding literature using a multimethod approach to qualitative analysis, including field observations, think-aloud protocols, and semi-structured interviews. Particular emphasis was put on emotional wellbeing through participants of a Destination-Task Investigation (DTI) within Munich's public transit system and how they used wayfeeling during their experiences. The DTI was comprised of two parts: (1) a destination-task activity, where participants were sent out from an origin to a destination whilst thinking aloud about their experience; and, (2) a map-based interview following the destination-task activity. During the map-based interview, participants were asked to sketch a map based on what they could remember from the destination-task activity. Participants then highlighted the map where they remembered feeling positive, neutral, and negative.

### 2.1. Participants

Twelve participants, from different cultural backgrounds, took part in the explorative study. Participants were found through a call for volunteers and subsequent snowballing of individuals. The selection process considered a participant's background, age, and transit usage which allowed for a broad picture of wayfeeling. However, this led to a bias in participant selection as all participants were highly educated and between the ages of 25 and 45. Nevertheless, this provided

comparability through focusing on early to middle-aged individuals who had basic transit system knowledge. All participants had lived in Munich for at least one year at the time of the study and were familiar with the Munich public transit system: most of them used it on a daily basis, while only one participant indicated they used it seasonally (Fig. 1). Seven identified as male, and five identified as female. As the main investigator is native English speaking, interviews took place in English. All participants had an intermediate, advanced or a native-speaking level of English and were able to express their thoughts and experiences accordingly.

Before starting the DTI, participants indicated how often they took Munich public transit, their most frequently used transit modes, and the preferred mode. This data provided a starting point to grasping the participants' familiarity with the various transport modes in Munich. Learning the about preferred mode allowed the researcher to observe if participants leaned towards familiarity/comfort (positive feelings) during the DTI.

### 2.2. Research location

The study took place in Munich, the capital of the German state of Bavaria. The city is Germany's third largest, and is home to a robust public transit network that services over 1.5 million passengers a day (MVG, 2022). Munich's public transit system is ranked as one of the most robust public transit systems in Europe. The system itself consists of 95 km of underground tracks, 79 km of trams tracks, and a bus network consisting of 467 km with 67% of residents claiming to be regular daily users (MVG, 2022).

The DTI started at Haidhausen in the east end of the city (P1), passed through a mid-point stop at Karlsplatz/Stachus (P2), and ended in the west end of the city at Schloss Nymphenburg (P3) (Fig. 2). Participants were requested to take any form of public transit, consisting of: Bus, Tram, U-Bahn (subway/metro/underground), or S-Bahn (suburban railway). When required, participants were also permitted to walk in order to reach destinations. Participants could consult any form of navigational aid they felt necessary (smartphone, maps, information booth, asking for help, etc.).

### 2.3. Data collection

#### 2.3.1. Observed emotions

During the DTI, participants were asked to reach two destination locations, while only using the Munich public transit system. Participants were shadowed by the researcher and recorded as they navigated through the public transit system to the two locations. The researcher asked the participants questions while they navigated in order to garner further detail into why they chose certain routes and modes, and how they felt in these public transit spaces. Periodically, the researcher would ask the participants how they were feeling, and ask that they indicate an emotion or a feeling to describe their experience in that particular moment.

#### 2.3.2. User perceived emotionality

In the map-based interview following the DTI, participants were asked to describe their experience through drawing and sketching. During the interviews the participants produced cognitive/sketch maps of their journeys, detailing aspects of their experiences (Fig. 3). These maps gave the researcher a window into the participant's mind as the map helped to reflect their understanding of the public transit system, and helped to pinpoint significant moments during the DTI. The point of creative art by the participants allowed for exploration in communication of emotions and feelings that are otherwise difficult to communicate through words (Reason, 2010), and not necessarily to get a precise depiction of the transit environment (Klippel et al., 2006). Aside from two, all participants felt comfortable drawing their experiences as a cognitive map (one participant felt easier to write her experience as a

Name	Gender Identity	Nationality of Participant	Public Transit Frequency	Frequented Modes	Preferred Mode
Lita	Female	Denmark	Daily	B S U	S
Samuel	Male	Germany	Daily	T S	S
Marek	Male	Slovakia	Monthly	B T	U
Tobias	Male	Spain	Daily	B S U	U
Amy	Female	U.K.	Daily	B T S U	T
William	Male	Canada	Daily	B U	T
Trevor	Male	Germany	Monthly	S U	U
Felix	Male	U.K.	Daily	B T S U	S
Mina	Female	Germany	Weekly	B U	T
Serena	Female	Greece	Daily	B U	U
Raye	Female	Germany	Seasonally	U	T
Simon	Male	Taiwan	Daily	B U	⊘

● Bus    ● Tram    ● S-Bahn    ● U-Bahn    ● Not Applicable

Fig. 1. Participant frequency and desired transit modes in Munich’s public transit system.

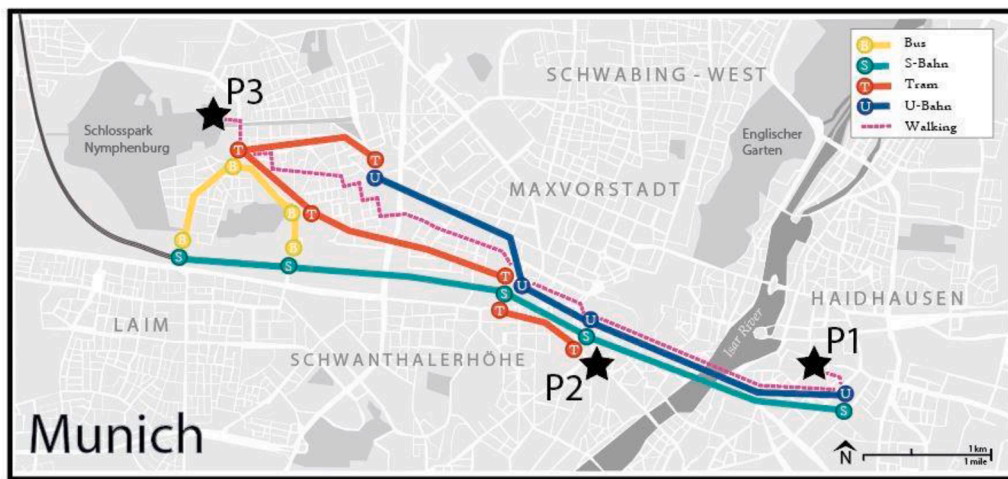


Fig. 2. The DTI route options for participants.

step-by-step list, and another felt it easier to draw images of important experiential moments). The participants were then asked to indicate verbally and with colored markers on their drawings where they found positive (in green), neutral (in yellow), and negative (in red) during their experiences.

Participants were allowed to use the three colors in any section of their maps. For instance, if participants found that a certain part of their journey was neutral with intermittent positive moments, they might use a yellow line with dotted green spots to indicate this experience.

2.4. Data analysis

Data collected through the DTI was recorded through both audio and video, transcribed and further categorized with MAXQDA. Data from the DTI were then visualized on a Customer Journey Map (CJM) to help understand the participant’s experience in a linear and chronological order. A CJM is a visual story-telling tool that takes a complex and multifaceted situation and presents it in a simplified and intuitive manner for research analysis and communication (Kolko, 2015; Zemke and Bell, 1989). It is a graph that allows a researcher to view in detail how an individual (typically a customer) interacted within a certain space, and is advantageous to a researcher as it can help pinpoint specific emotional experiences in time and space, while simultaneously giving an overview of all physical elements within the experience (Bucolo and Matthews, 2011; Chen and Chou, 2015; van Lierop et al., 2019). For this study the CJM was an important tool as the researcher

was able to overlay multiple situational, emotional, and locational data onto one graph which helped in developing a wayfeeling analysis.

The concept of the CJM was modified slightly to fit the analysis requirements of this study. The modified-CJM took the premise of a CJM, however the structure included several additional layers: time, space, navigational tools used, participant-determined emotional state, and observed emotional state (Fig. 4). These layers also corresponded to specific participant quotes in order to give situational context. The researcher was able to examine the personalized experience of transit space that would otherwise be overlooked in a survey or questionnaire. The modified-CJM also allowed for a direct comparison of both the observed emotionality, and user-perceived emotionality, as data collected from the interview and cognitive maps were overlaid on the modified-CJMs. This allowed for interlinkages between an observed experience, and the participant’s perceived experience.

Quotes on the modified-CJM not only indicate key emotional words, but key-phrases, as sometimes the intention of the wording of the participant’s quote provides an insight into how a participant experienced a particular event during their DTI. For example, a participant may indicate their negative experience through a groan or an “ugh” and then stating something sarcastic like “isn’t this great?” – where the word emphasizes the opposite intent of its meaning. This vocalization is interpreted (and further clarified with the participant) as a negative response to their experience. In this moment, a particular word was not used to express the emotion, however the sentiment was understood as negative. This was important for the researcher to be vigilant about

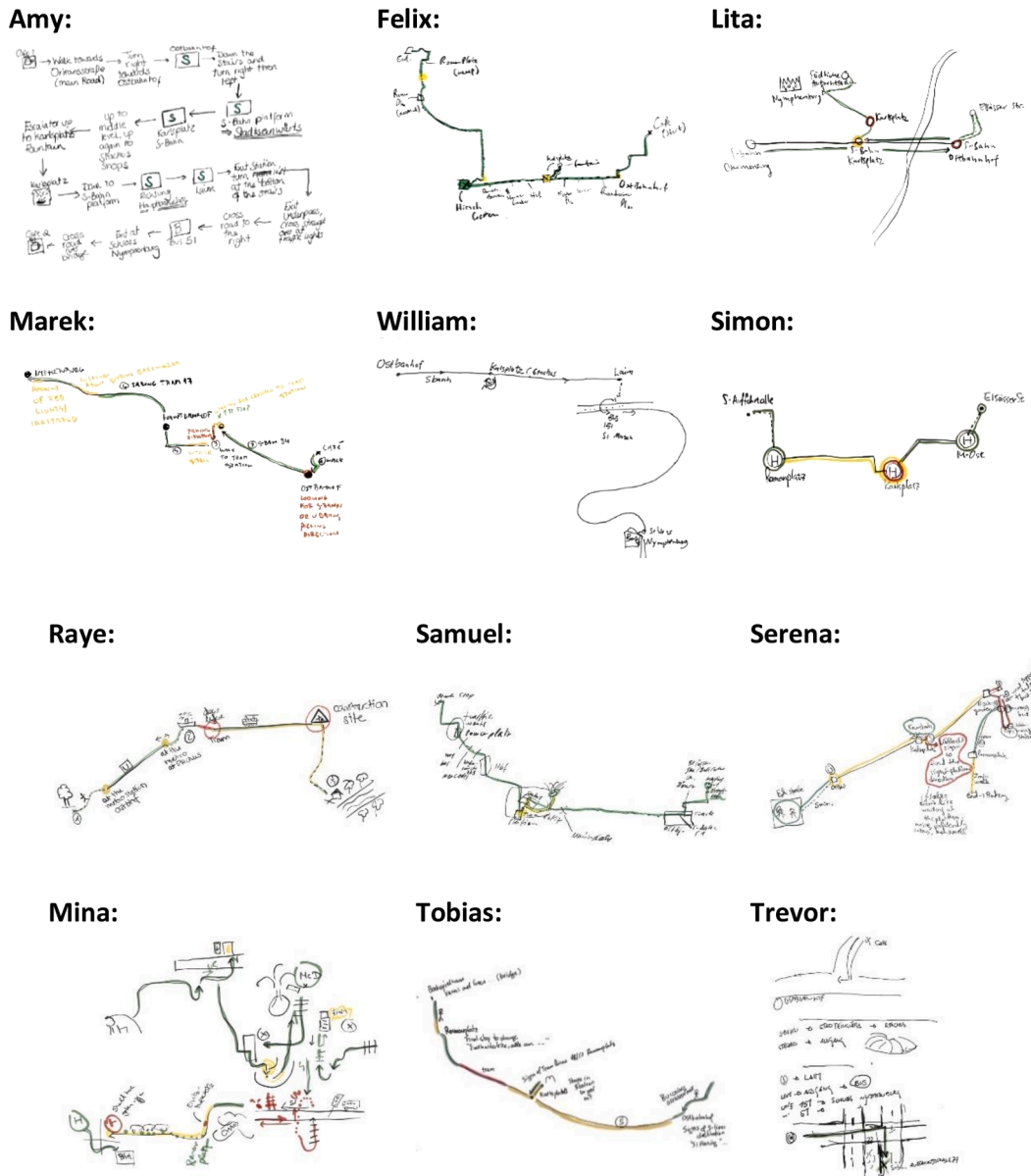


Fig. 3. Participant Cognitive maps with red-yellow-green color coding.

during the analysis of the emotional experiences. The experienced emotions were then plotted on the modified-CJM and compared with the participant’s perceived experience as indicated on their cognitive map. This is seen as the dotted blue line (observed emotion) and orange bars (user indicated emotion) on the modified-CJM.

3. Results

Analysis of the observed DTI experience against the cognitive maps and individual modified-CJMs resulted in several key findings. The findings are organized into two categories: (1) *In-situ* Experience and (2) Retrospection.

3.1. In-situ experience

During the DTI, participants used four different modes (S-Bahn, U-Bahn, Tram, and Bus), and several mode choice combinations. In the first half of the DTI (P1 to P2), participants had the choice of taking either the S-Bahn or the U-Bahn. During the second half of the DTI (P2-P3) participants had a larger variety of options in terms of mode choice

(S-Bahn, U-Bahn, Tram, and Bus), plus the ability to combine modes to reach their destination. Mode and route choice was determined by the participant completing the DTI (Fig. 5). Mode choice was often based on preference, convenience, or instruction (from locational maps or a smartphone).

In order to indicate a positive, neutral, or negative experience from the DTI activity, common words and actions by the DTI participants were grouped into three categories according to the observed situations. Typical descriptors used by the participants helped the researcher determine whether an experience was either negative, neutral or positive (Fig. 6).

Participants experienced a plethora of emotional reactions during their DTI experiences; however, participants had stronger emotional reactions (very positive or very negative) in four settings found throughout the DTI route. They included: Transfer Areas, Aboveground/Belowground Spaces, Onboard Transport Modes, and Unfamiliar Spaces.

3.1.1. Transfer areas

Areas of transfer played a significant role in the DTI. These are spaces within the public transit system where users connected between

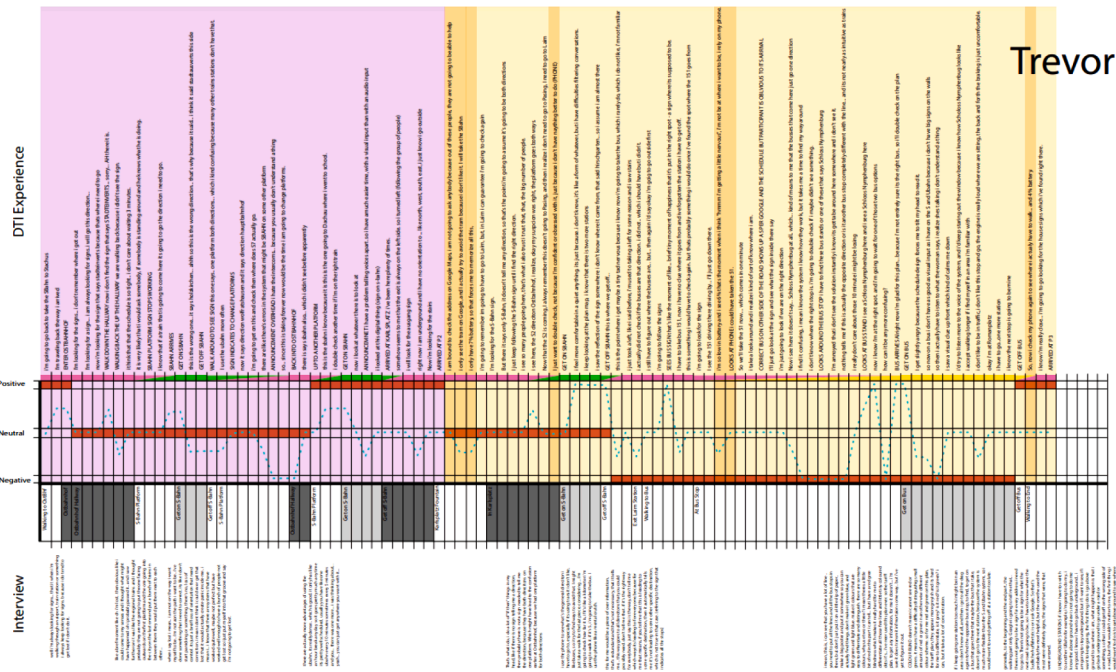


Fig. 4. A modified-CJM used in this study – the example of Trevor.

Name	Mode Choice (P1-P2)	Mode Choice (P2-P3)
Lita	S	T
Samuel	S	T
Marek	S	T
Tobias	S	T
Amy	S	S B
William	S	S B
Trevor	S	S B
Felix	S	S B
Mina	U	S B
Serena	U	S B T
Raye	U	T
Simon	U	T

B Bus    T Tram    S S-Bahn    U U-Bahn

Fig. 5. DTI mode choice per participant for the first and second part of the route.

different modes, waited for arrivals and departures, and were critical points of contact between other public transit users (e.g., station platforms). Participants experienced greater negative emotional reactions in these spaces (Fig. 7).

When just looking at negative emotional reactions from participants during the DTI, most negative reactions are grouped around transfer areas. Participants referred to the sense of searching and sense of confusion in transfer areas that gave them the most negative feeling. William mentions: “I found switching between modes the hardest part”. Participants indicated that these locations were not intuitive enough for them to know exactly where to find their connections causing a delay while navigating.

Participants mentioned the added confusion of choosing the correct

platform from a variety of potential options. An additional sense of pressure was felt by some participants due to the presence of surrounding transit users around them. These participants revealed that crowded platforms added to a feeling of being watched or judged by those around them. Several participants indicated that when these spaces are crowded this increased the tension and anxiety of navigating through the space. Marek, a DTI participant, mentions his dislike for crowds: “I don’t like crowds. People tend to react in a stressful way in crowded spaces. It can be an illogical and disorganized feeling”.

Some participants indicated that they preferred not to transfer between modes and chose to take slower or less desirable transit modes (e.g., the bus), even if it meant taking longer to get to their destination. For example, Tobias stated “Number of transfers is important. It’s better to just get in, and then get out at your stop”. Several participants indicated that not having to transfer was more relaxing than having to find a connection in an unknown space. While looking for a bus connection, DTI participant Trevor stated: “I find it confusing, I mean, I know the system, I know how [it] work[s], but it takes me a [sic] time to find my way around”. The longer participants found themselves in these transfer areas, the higher the likelihood for a negative emotional response.

3.1.2. Aboveground/Belowground spaces

In Munich, transit spaces are found both above- and belowground, and typically display a diverse set of navigational and wayfinding devices, including transit maps, schedules, electronic signage, and wayfinding landmarks. These spaces also include transfer areas (e.g., transit stations and transit platforms).

Participants indicated more negative emotional reactions in aboveground spaces, whereas, participants were more likely to experience positive emotional reactions in belowground spaces (Fig. 8). Trevor, for example, revealed his discomfort with navigating multiple bus stops in one location (while aboveground): “I find it confusing. I know the system. I know how they work. But it takes me so much time to find my way around [the station]”. Participants referred to the difficulty at aboveground stations in finding the right location for the stop, or exact stopping location of where their mode arrives - especially when there are several options to choose from that are using the same stop. William, mentioned his difficulty deciphering which direction he should be standing in order to catch the right bus: “Am I in the right place? Is this

Positive	Neutral	Negative
Awesome	Bored	Annoyed
Confident	Calm	Bothered
Easy	Fine	Confusing
Excited	Neither here, nor there	Dislike
Good	Okay	Don't Know/Understand
Great	So-so	Frustrating
Happy		Hate
Like		Impatience
Nice		Nervous
Relief		Not Intuitive
		Uncomfortable

Fig. 6. Categorization of typical descriptors and key-phrases.

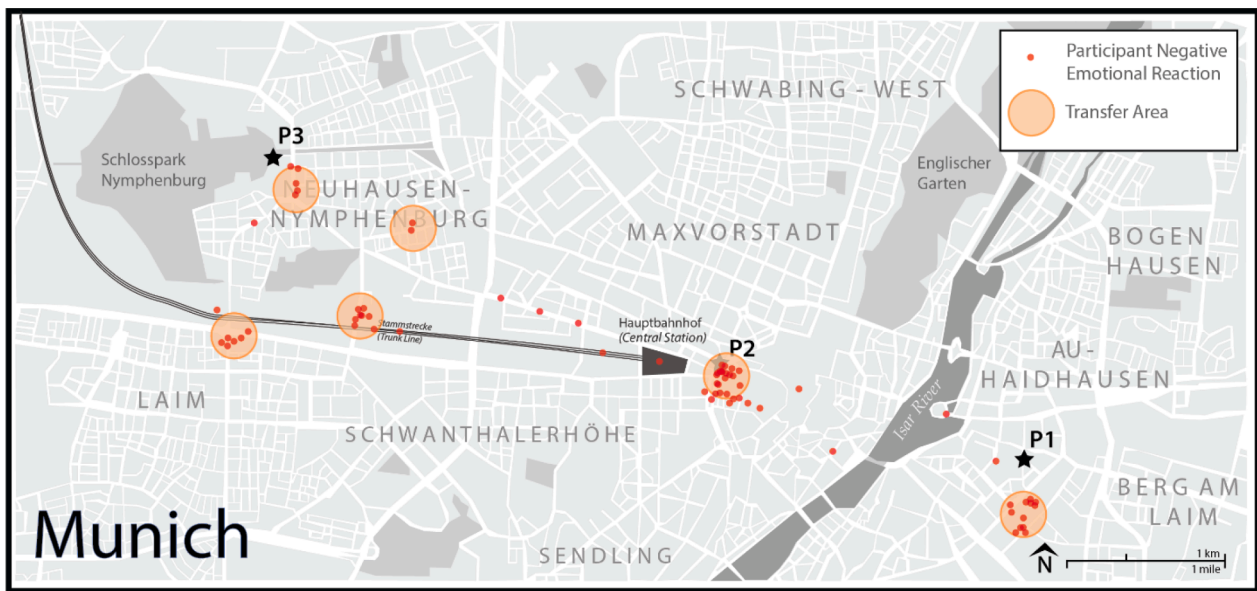


Fig. 7. Negative emotional experiences along the DTI route.

the right direction for the right vehicle?”.

Participants transitioning between both above and belowground (e.g., from Tram to U-Bahn, or vice versa) experienced stronger negative emotional responses. William referred to the confusion surrounding these spaces: “I saw stairs to go up and outside. But I didn’t see any signs. That’s what I need so I know which direction to go when I get outside. It gave me anxiety not knowing where I was going”. Overall, participants’ positive experiences in belowground stations outweighed their negative experiences, whereas negative reactions outweighed positive reactions in aboveground stations.

### 3.1.3. Onboard transport modes

Onboard transport modes include the bus, tram, S-Bahn, and U-Bahn. The space within different transport modes is designed as a mobile passenger waiting room, with seating, standing, and walking space, windows, and both audible and visual wayfinding devices.

Once onboard a transit mode, participants were found to have more positive emotional experiences - citing movement, comfort, and being “on the way” to reach their destination. Participants indicated positive experiences whenever they felt like they were moving towards their destination regardless of speed, timing, or mode choice. Mina, a DTI participant, referred to a feeling of “making progress” when onboard

transit: “I know I’m on the right train. I know when to get off. I know where to go. I feel like I’m making progress”. More positive reactions were indicated during time spent onboard transit than negative (Fig. 9).

Participants referred to the ease of sitting on transport, not having to wait to get moving – while on the tram, DTI participant Marek mentioned the sensation of moving towards his destination which gave him a positive feeling: “I am happy to move. I don’t like waiting”. Participants added that being able to see around them, and find landmarks helped them to feel as if they were getting closer to their destination which gave them a comforting sensation. Participants mentioned the sense of relaxation and alleviation of pressure of having to navigate the system themselves, and the value in the downtime while sitting on a moving vehicle, allowing them to prepare for the rest of the journey. Felix, a DTI participant, felt positive when sitting on the S-Bahn on his way to P2: “We are on the right train and I know where we are going. I am pretty confident I know what’s happening”.

### 3.1.4. Unfamiliar spaces

Memory and confidence played a large role in the outcome of participants’ journeys. When participants were faced with familiar locations or mode choices, this helped to increase positive emotional experiences. However, when participants were faced with areas

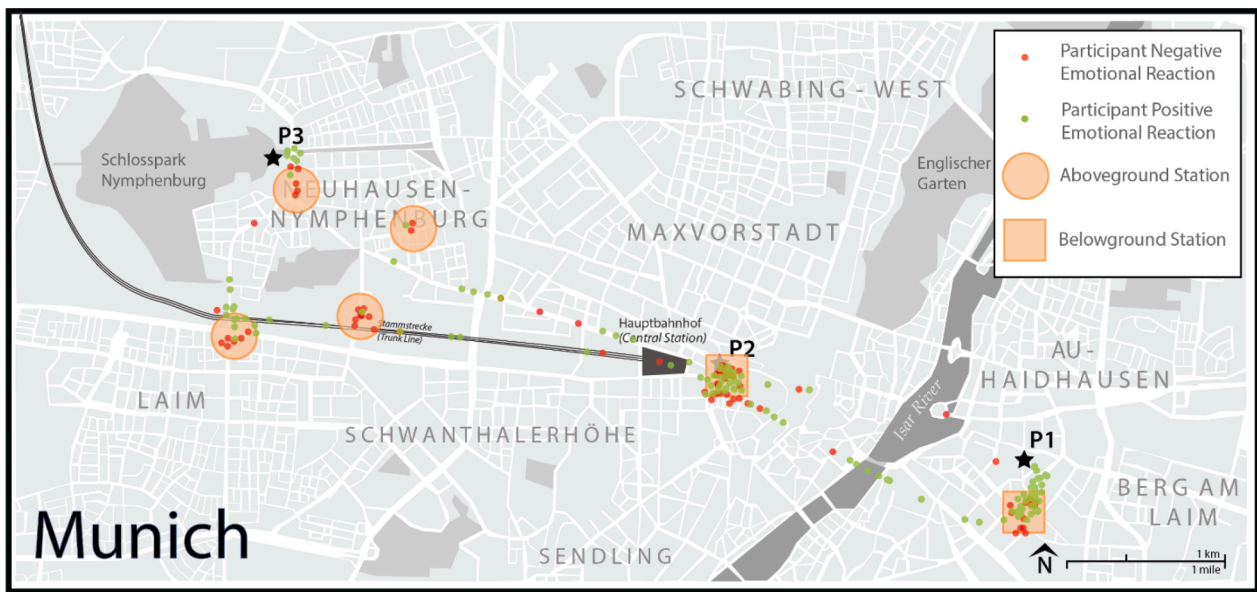


Fig. 8. Positive and negative emotional experiences along the DTI route.



Fig. 9. Positive and negative emotional experiences along DTI transit mode corridors (bus, tram, S-Bahn, and U-Bahn).

unfamiliar to them or changes at places they actually know (e.g., changes due to a construction site, a temporary bus stop, or a new station they had never been before) this led to more negative reactions from participants.

Mina, while searching for a bus stop was in a location she was unfamiliar with. Mina indicated that this increased her anxiety as she did not know where to go: “I’m feeling stressed. I am checking the map I don’t know where to go for the bus. I am a bit mad because I thought I would see the sign after I came up the stairs”. Her frustration in the situation made her double think her actions and unaware of her surroundings. Because of this, Mina ended up missing her bus connection. Similarly, while transferring between S-Bahn and bus, Serena was also faced with a temporary bus stop. She indicated she had never been here before and was unsure where the bus stop for her specific bus was exactly: “I think I found the sign... But it doesn’t say my bus number. Google also does not mention this bus here either”. Serena mentioned that she had located the bus sign but could not find her exact bus at this

stop. Eventually out of panic, Serena gets on the wrong bus. She eventually recognized she was going in the wrong direction and decided to get off the bus and to find another mode. After wandering the streets looking for a different transit option, she eventually chose the tram as she found it more familiar and easier to navigate.

### 3.2. Retrospection

When participants looked back on their entire journey, there were moments that stood out in their minds as being important or memorable. These moments affected the overall perception of a participant’s journey and their overall opinion of the transit network.

Participants were often affected by a single event during their DTI that determined whether or not a section of the journey was deemed a positive, neutral, or negative experience. For example, DTI participant Tobias, while sitting on the tram, indicated a moment during his journey where the tram felt slower than expected: “Now I feel like there may



have been a faster route. I feel like there are too many stops. Maybe bicycle could have been faster". Aside from this remark, the majority of Tobias' journey on the tram was observed as positive. However, when it came time to draw the cognitive map – Tobias indicated his entire tram journey as a negative experience citing delays and annoyance as the reasons why.

Participants that experienced one significant negative experience revealed that it affected their entire transit experience. Whereas, in contrast, it took several, continuous positive experiences during the DTI to be reflected as a positive event on a participant's cognitive map.

Participants who had more neutral moments throughout their DTI would often use positive language to describe their overall experiences, with negative caveats in regards to their surprise towards the transit system. For example, stating they didn't expect it to go as smoothly as it did, or that they were surprised more negative events didn't occur.

#### 4. Discussion

Our study showed that the act of navigating a transit space evokes strong emotional reactions from participants. As a result, participants initiated wayfeeling into their wayfinding processes during navigation. The strong emotional reactions are linked to certain locations, behaviors, and significant events experienced within the transit environment.

##### 4.1. In-situ experience – locations

To answer the first research question – where do participants experience strong emotional reactions in a transit system? And why? – we explored emotional reactions of participants in locations across the DTI. We focused our attention on four specific areas where stronger emotional (such as very positive or very negative) *in-situ* responses occurred, these included: Transfer Areas, Aboveground/Belowground Spaces, Onboard Transport Modes, and Unfamiliar Spaces.

Negative emotional responses by participants were primarily found in transfer areas. The top three emotions indicated were confusion, annoyance, and frustration. Our findings revealed that participants' heightened anxiety in transfer areas was due to poor layout and lack of visible wayfinding devices, leading to an overarching sense of confusion. The longer participants found themselves in these transfer areas, the higher the chance there was for a stronger negative emotional response. These results are consistent with prior research finding that individuals tend to avoid crowded or overwhelming transit spaces due to the negative feelings they foster (Balaban et al., 2017; Chang, 2013; Cox et al., 2006; Haake et al., 1984; Natapov et al., 2015; Peponis et al., 1998; Stankiewicz and Kalia, 2007). Additionally, the sense of continued searching within these spaces contributed to higher negative reactions from participants – which emphasizes a feedback-loop from participants, where the space fosters a negative emotional response, adding to a sense of confusion and anxiety, which increases a chance for a negative reaction. These negative reactions underscore the importance of well communicated design within complex environments. Scholars have associated spaces with clearly communicated design increases the potential for positive user attitudes and overall experience (Carpman and Grant, 2002; Carreira et al., 2014; Cox et al., 2006; Diab and El-Geneidy, 2015; Diab et al., 2015; Dornéy, 2005; Evans and Wener, 2007; van Lierop et al., 2018).

Communicative design is emphasized in both designed space but also the location of the space. For example, belowground transfer spaces, where participants experienced more positive emotional responses, provides clearly outlined navigational instruction, and anticipated behavior is afforded for those who have used the transit system before, which creates a predictive and easily navigable environment. Scholars have discussed the importance of affordances and readable spaces, resulting in an expected behavior within space and a user's sense of "understanding" the space (Jiang and Liu, 2009; Natapov et al., 2015; Scollon and Scollon, 2003). This sense of known expectation and

predictability increased comfort among participants which increased positive emotional responses. Additionally, belowground transfer areas also provide an environment with less external distractions for users as these spaces are enclosed, typically with one mode usage per space, and are only used by other transports users in this space which emphasizes the expected usage behavior within the space.

In these spaces participant emotional responses were typically positive as the environment supports an expected behavior, which in turn helps users feel good about their transit experience. The emotional responses then fluctuate once the users leave this environment. This could be seen from participants when transitioning between different physical spaces within the transit network, such as moving between above- and belowground spaces which added a heightened stress levels, due to a change in design and an increase in complexity of aboveground environments. This further confirms the literature surrounding design in complex environments and user movement between outdoor and indoor spaces (Chang, 2013; Jiang and Liu, 2009; Stankiewicz and Kalia, 2007).

Once onboard a transit mode, participants were found to have more positive emotional experiences which were increasing alongside the movement of the vehicle in the perceived right direction. Both observed and perceived emotionality was favorable for participants, citing movement, comfort, calm, and relief as the most common emotions. Scholars have shown that the sense of relaxation and alleviation of pressure of having to navigate the system, and the value in the downtime while sitting on a moving vehicle, increased allowing them to prepare for the rest of the journey (Clayton et al., 2017). Additionally, it has been observed that being able to find landmarks and "know where one is" helps to further increase positive emotional experiences and comfort within navigational tasks (Caduff and Timpf, 2008; Clayton et al., 2017; Gray, 2001).

##### 4.2. In-Situ experience – a changing navigational behavior

To answer our second research question - how does participant emotional wellbeing impact navigational decisions? – we explored participant reactions to their feelings and their reflexive understanding of their emotional responses. Underscoring our findings for participants' emotional responses in transfer areas, is the adverse effect of users feeling negative in transit spaces, in that, some participants were aware of how transfer areas and the act of transferring engender negative experiences. Because of this, they would rather avoid this particular aspect of the system, even if it meant taking a slower transit mode, or inconveniencing themselves. This finding lines up with previous research which has shown that individuals prefer familiar spaces, routes, and modes as it leads to a sense of comfort (Olsson et al., 2013). Moreover, the combination of transferring and the physical complexity of the location directly impact a user's stress and discomfort (Chang, 2013; Haake et al., 1984). Being negatively triggered by certain spaces and experiences can impact how that space is used in the future, including the avoiding of said space or experience (Ekman, 1992, 1994; Fendley, 2016; Fu et al., 2018). Wayfeeling encompasses this sentiment and can be identified in this particular behavior: those participants that had negative experiences in the past with transferring relied on their "gut" to help them avoid it during the DTI. This type of outcome can be detrimental to user retention for public transit systems. When individuals recall significant negative moments of their public transit experiences, they can overshadow the entire journey resulting in a negative impression of the whole system (Cox et al., 2006; Diab and El-Geneidy, 2015; Diab et al., 2015).

##### 4.3. Retrospection – the weight of a significant event

To answer our third research question - how does wayfeeling impact participant perception of transit spaces? – we analyzed the participant indicated emotion on their cognitive maps against the observed emotional indications during the DTI activity. We focused on the

importance of significant negative or positive transit navigational events (e.g., getting lost in the station or finding a quicker route to a destination). When participants looked back on their entire journey, there were moments that stood out in their minds as being important or memorable. Reviewing the observation data, it was shown that participants primarily experienced neutral or positive journeys with negative moments scattered throughout the journeys. When comparing that against the cognitive maps, participants were more critical of negative events. In that, these moments had such a significant impact on the participants' experiences that they recollected entire sections of the journey as negative. For example, if a participant was sitting on the tram and they felt like the tram was taking too long to reach their destination, they considered the entire tram journey a negative experience. This finding aligns with existing literature within psychology that focuses on negativity bias, where individuals (particularly young adults), are more likely to socially recall negative imagery and events over positive events (Baumeister et al., 2001; Carstensen and DeLiema, 2018).

Our findings also revealed that for individuals who had preconceived critical viewpoints towards public transit, their neutral experiences often were considered more negative. Moreover, the sections of the journeys that were mostly observed as neutral, were more easily considered as negative by the participants in their cognitive maps. This reflects the participant's critical approach to public transit, and can be seen as an important recognition that continued negative events often outweighed the positive events leading to an overall negative perception of transit experiences. Additionally, continued negative opinions about transit from the broader public also have a tendency to influence personal opinion making individuals more critical of their transit experiences. This finding also aligns with existing literature surrounding the social transmission of information and the preferential bias to negative messaging over positive, which gradually transforms the original message (Bebbington et al., 2017). Participants who were critical about transit to begin with were found to relay their experiences as more negative even in cases of experienced neutral emotional moments.

For some participants that experienced even one significant negative experience, the negative event overshadowed the rest of the journey so much that it affected their entire transit experience. Whereas it took several continuous positive experiences during the DTI to be reflected on as a positive event in their cognitive maps. Positive emotional experiences were not as strong as negative emotional experiences in terms of determining wayfeeling and navigational behavior. This further underscores earlier research where significant emotional moments in one's experience can affect the overall perception of an entire experience (Baumeister et al., 2001; Caduff and Timpf, 2008; Garling et al., 1981; Gray, 2001). This has both positive and negative effects on the perception of public transit, as single moments can define an entire journey and result in assumptions and expectation by the user, having an overall effect on their desire to use public transit in the future.

## 5. Conclusion

Understanding the link between navigational activities and a user's emotional wellbeing in public transit spaces is critical for design and transit policies. The aim of this study was to explore how emotional wellbeing affects navigational behaviors through introducing the concept of "wayfeeling". Wayfeeling considers emotional and sensorial experiences of an individual in navigation and was used in this study to highlight these experiences within public transit. This concept pursues the following research questions (1) Where do participants experience strong emotional reactions in a transit system? And why?; (2) How does participant emotional wellbeing impact navigational decisions?; and, (3) How does wayfeeling impact a participant's perception of transit spaces? The DTI was developed to answer these questions. The strength of the study was through its multi-method approach. It encompassed the observation of *in-situ* experiences, thinking aloud protocols and detailed interviews following the destination task providing a glimpse into

participant minds which led to reflexive in-depth discussions about decision making processes and preferred solutions – something that a survey or questionnaire would overlook. Additionally, the inclusion of the study's modified-CJM allowed for a direct comparison of observed and user-perceived emotionality. This further strengthened the study as it gave the researcher a comprehensive overview of participants' lived experiences.

The analysis of participant navigational transit and subsequent wayfeeling experience allowed to add a qualitative perspective surrounding emotional wellbeing in transit and navigational settings to wayfinding research. The main findings of our explorative study using Munich public transport system as a case study are that the majority of transit related stress occurs during the navigational process. Under-scoring that, the study's findings included: (a) participants had more negative emotional reactions in transfer spaces, especially when changing transport modes; (b) aboveground transfer spaces were perceived as more stressful than the often less complex belowground spaces; (c) once on-board a transit mode participants experienced more positive emotional responses like relaxation; and, (d) a single significant event during their DTI determined whether or not a section of the journey was deemed positive or negative. In addition, significant negative experiences overshadowed some participants' journeys, which affected their overall opinion of the transit system. This raises potential consequences down the road for user retention, as the individual seeks out alternative modes of travel.

The study unveils the potential to improving transit spaces by allowing researchers and practitioners to peer into the emotional and sensorial aspects of public transit users, and help reveal the complexity of user experience within transit environments. With this information, we can hone in on the detailed aspects behind wayfinding design that encourages positive emotional wellbeing in navigational settings. Transit accessibility and desirability can be improved through design that helps to mitigate user stress and discomfort. With emotional wellbeing becoming more of a central aspect in public transit policy, looking at lived realities through wayfeeling can highlight design opportunities within transit networks, helping to maintain user retention, gain new users and encourage inclusivity and thus to foster sustainable mobility.

There are also some limitations to be mentioned. The participants of our explorative study were all early to middle aged individuals familiar with the Munich transport system. Future research using the DTI should include a wider range of generational and social groups, as well as people with mobility limitations and without knowledge of the transport system, which could add further aspects to wayfeeling in public transport. Studies focusing on specific public transit aspects (e.g., one U-Bahn station) could also reveal larger emotional discrepancies in navigational processes helping to broaden an understanding of wayfeeling and in turn emotional wellbeing in public transit spaces. Future investigation of a user's emotional connection to certain navigational tools (e.g., their smartphone) in public transit could further illuminate an emotional reliance on ICT. This, in turn, could help to highlight emotions as a significant factor in both planning and design processes.

## Declaration of Competing Interest

The authors declare no conflict of interest.

## Ethical Procedure

The research meets all applicable standards with regard to the ethics of experimentation and research integrity.

## Acknowledgments

None of the authors of this paper has a financial or personal relationship with other people or organizations that could inappropriately influence or bias the content of the paper.

## Funding

This work was supported by the **Technical University of Munich (TUM)** in the framework of the Open Access Publishing Program. The mobil.LAB doctoral research group is funded as Promotionskollege 032 by the Hans-Boeckler-Foundation. Partial funding for the PhD research is provided by the Hans-Boeckler-Institute. The Hans-Boeckler-Institute had no such involvement in: study design, data collection, data analysis and interpretation, writing of the article, or decision to submit the article for publication.

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