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More than just a station forecourt? Exploring experiences, activities and wayfinding around public transport stations using 'digital Tactical Urbanism'

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ABSTRACT

Walking is an integral part of public transport. Therefore, the surrounding of a station must be attractive for pedestrians. Moreover, stations can fulfil more than just transport functions: Their forecourts can serve as a neighborhood anchor and social space. Most research investigates catchment areas or station's interior. There is little research on the immediate station's surroundings regarding walkability and sense of place. To explore this, we conducted a mixed-method study at a mobility hub in Berlin, Germany: (1) We held workshops with planning experts on the role of forecourts and (2) conducted a user survey to identify required features. Based on this, we (3) designed 3D-elements that were placed on the digitally walkable forecourt based on Tactical Urbanism principles. Finally, (4) the forecourt with and without virtual 3D-elements was shown to users and experts with Virtual Reality glasses and 'digital walking interviews' were conducted. This is defined as 'digital Tactical Urbanism' (dTU). The survey (n = 250) shows that participants desire cleanliness, safety and a high-quality walking environment. The interviews (users: n = 17, experts: n = 7) highlight that social safety remains essential despite redesigns; a clean, safe, green, and lively forecourt – offering short access, benches and food-truck spots – can turn stations into neighbourhood anchors and increase ridership, whereas perceived insecurity and lacking maintenance deters use. dTU can make changes in urban environments tangible and allows testing measures before implementation. Approaches for handling social issues and planning concepts to realize neighbourhood anchors should receive attention when planning and researching station surroundings.

1. Introduction

Cycling, walking and public transport are the cornerstones for the transition towards sustainable mobility in metropolitan areas, hereby fostering an environmentally friendly, healthy and socially just way of reaching destinations (German Environment Agency, 2020). Walking has physical and mental health benefits (Kelly et al., 2018; Litman, 2003), is cost-saving (Litman, 2003), pollution-free and noise-abating. Increasing walkability and providing walkable neighborhoods has benefits for all people in the city, as walkable cities increase community contact, identification and security (Gilderbloom et al., 2015; Glover et al., 2022; Litman, 2003). However, German municipal transport authorities have for a long time only rarely addressed walking as a mode of transport and often lack the financial and personal resources to evaluate and implement walking-related measures (German Environmental Agency, 2018). Walking as a mode of transport and as part of intermodal trips, i.e. part of public transport, is therefore still under-represented in transport policy and planning (German Environmental Agency, 2018).

Even when cycling or driving to a public transport station, the last meters have to be made on foot. Hence, walking is part of public transport usage. Considering that nearly half of all trips in German cities are done by public transport (Nobis and Kuhnimhof, 2018), walking is an integral part of everyday mobility in metropolitan areas. However, complex transfer situations and lack of vivid environments around stations can generate negative affective responses by pedestrians (Ceccato et al., 2024; Ferri & Popp, 2022; Yang et al., 2023). A basic prerequisite for making public transport an attractive option is therefore the provision of an adequate access and egress environment around stations from a walking persons perspective (Jehle et al., 2022), as the experience of the station's urban surroundings influences the following trip leg

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(Başaran et al., 2025). Usually, public transport stations are designed as a node for arrival/departure or a commercial space, not a place where people can have an experience or pursue activities other than shopping (Lunardon et al., 2023).

Current research on public transport stations has largely focused on underground and in-station experiences (Yang et al., 2023) or referred to the wider catchment area (see e.g. Ibraeva et al. (2020) or van Soest et al. (2019)). Research usually refers to measurable or perceived accessibility of public transport stations (e.g. Tiznado-Aitken et al. (2020) or Sarker et al. (2019)), walking distances (Hess, 2012) or the perception of insecurity (Börjesson, 2012). Studies that consider the immediate above-ground surroundings - the micro-block and station's forecourts - are scarce (Yang et al., 2023). Moreover, the potential uses of the immediate surrounding of a station and their potential for urban transformation and social interaction is currently lacking attention (Lunardon et al., 2023).

Thus, two inter-related research gaps emerge: Firstly, current research provides a limited understanding of which attributes constitute a high-quality walking environment at the microscale surrounding a station. Secondly, current research lacks evidence on how station forecourts can function as neighbourhood anchors that support urban vitality, social interaction and foster a positive image of public transport. To address these research gaps, this study investigates how high-quality pedestrian environments in above-ground areas around stations can improve the public transport experience, improve its image as a desirable mode of transport and provide spaces for social interaction within the neighbourhood. This perspective shifts the focus from stations as merely being functional to a rather experiential and place-based dimension of public transport stations.

The study takes a mobility hub in Berlin, Germany, as a case study. Methodologically, we investigate (a) pedestrian's current and potential use of the mobility hub and its forecourt when improving the quality of the walking environment, activities and wayfinding and explore (b) if and how pedestrian's emotional responses surrounding the station and identification with the area can be improved by flexible, easy to build and cheap design interventions. To test potential measures with users and planners, the concept of 'digital Tactical Urbanism' (dTU) is introduced, which allows the digital testing of Tactical Urbanism (TU) measures according to the TU principles, without physically interfering in the built environment yet. The paper contributes to the literature on transit-oriented public-space by integrating walkability research with the concepts of quality of stay and neighbourhood anchors and introduces a virtual-reality-based testing procedure. Applying virtual reality (VR) allows to virtually test adaptable, cost-saving and flexible design measures prior to implementation, which is beneficial in challenging planning environments with unclear responsibilities.

2. Background

As shown in a study from Germany, only 53 % of the total travel time of public transport trips takes place inside of a public transport vehicle; the remaining 47 % comprises walking to, at or from the stop as well as changing or waiting at the station (Hillnhütter, 2016). For improving the attractiveness of public transport, the quality of the walking environment around stations should be enhanced. This can also increase the station's role as a social hub and neighbourhod anchor.

2.1. Walkability and the quality of the walking environment

Walkability is an umbrella term that includes research and scholarly knowledge regarding personal mobilities, urban walking policies and political visions and can be understood as "a discourse on the built environment and urban life" (Shields et al., 2021, p. 19). Walkability has been studied for over two decades, and walkability research has traditionally a strong focus on measurable mesoscale indicators: accessibility or proximity, mixed land use, density, sidewalks, street connectivity, safety or neighborhood type (Saelens & Handy, 2008). These are often used in walkability indices or tools. Applying these mesoscale indicators may not always represent the actual walking activity of people, as previous studies show: People living in areas with a high Walk Score do not necessarily walk more (Hajna et al., 2015). Moreover, indices like these may not capture walking as a feeder to public transport, nor the "experiential nature of walking" (Shields et al., 2021, p. 27).

In recent years, research has started to focus on the microlevel, the perceived walkability and the quality of the walking environment, which often lacks attention in earlier walkability research (Bozovic et al., 2020; Guzman et al., 2022). These studies add pedestrians' perceptions and emotions to the understanding of walkability (Dörrzapf et al., 2019). Analysing walkability at the micro level helps to understand how the immediate environment on a particular street or square should be improved to increase the proportion of pedestrians (Shields et al., 2021). Aspects such as perceived safety, human scale and quality of the walking environments, consisting of features such as presence of shops, lighting, greenery or numbers of door, are at the forefront of attention regarding perceived walkability (Ceccato et al., 2024; De Vos et al., 2022; Hillnhütter, 2021; Kim, 2015; Shields et al., 2021). Improving walkability at the microlevel is important for increasing people's willingness to walk (Bozovic et al., 2020) and can even increase the distance people are willing to walk to a public transport station (van Soest et al., 2019).

2.2. Walking environment around public transport stations

Comfort, safety and security are found to be important for pedestrian accessibility of public transport stations in Germany (Jehle et al., 2022). Specifically, perceived safety increases trip satisfaction, but also other features for an attractive travel environment, e. g. urban life, maintenance, trees or wayfinding, contribute to trip satisfaction (Başaran et al., 2025). When arriving at the station, the 'wayfeeling' is important. According to the 'wayfeeling' concept (Ferri & Popp, 2022), feeling and wayfinding are crucial, with feeling referring to physical and mental wellbeing around stations and wayfinding referring to behavioral, environmental and spatial factors that influence how people navigate in transit situations. A lack of wayfinding signs and complex entrance situations can cause confusion and stress, influencing wellbeing and health (Merzoug & Jarass, 2021). For addressing comfort and emotional arousal around stations, monotonous grey areas should be enriched with greenery, paths and nodes, street furniture or small businesses, as they can enhance vitality (Yang et al., 2023), as well as clear wayfinding signage.

There is still a lack of research on "individual navigation, varied perception, and unique emotional experiences in the wayfinding process" (Ferri & Popp, 2022, p. 2). For a pedestrian friendly public transport access this means twofold: On the one hand providing adequate wayfinding with spatial elements and information, on the other hand addressing the socio-emotional needs, e.g. feeling safe, which influence the trip experience (Moeckl et al., 2023). Transfer situations should address the rational as well as the socio-emotional qualities in order to allow a 'flow' of mobility (see Te Brömmelstroet et al. (2022)) and a positive user experience (Moeckl et al., 2023).

2.3. Public transport stations as neighborhood anchors and social hubs

Public transport stations serve not only as access points and interchange hubs within the transportation network, but also as places that combine infrastructure, retail, and open-space functions (Peek & van Hagen, 2002). Unlocking the synergies of 'moving' and 'staying' is crucial for enhancing the value of time spent on public transport (Peek & van Hagen, 2002). This meant usually enhancing commercial and real estate activities (Peek & van Hagen, 2002), allowing people to purchase and increasing economic activity (Lunardon et al., 2023). Yet non-economic aspects, specifically open-space functions, can also enhance the value of

time spent on public transport and improve the qualities of stay as well as the qualities of passing. Urban life at the start and end of public transport journeys can contribute to passengers' overall satisfaction with their trip (Başaran et al., 2025).

There is an immense field of research regarding urban design features related to the quality of place of urban neighborhoods. Architect Jan Gehl emphasized the importance of features related to (Gehl, 2010):

- Protection and safety, e.g. traffic or social safety, sensory experiences
- Comfort, e.g. opportunities to interact, to sit or linger
- Joy, e.g. features adapted to human scale, visually interesting, greenery or weather

As people walk to or from stations, the immediate environment should align with these design principles. In addition, public transport forecourts can as well encourage people to linger by offering opportunities for activities, social interaction and a high quality of place. These go hand in hand with features for a high-quality walking environment. The concept of Transit-oriented Development (TOD) emphasizes that: TOD aims at promoting dense, diverse and compact land use around public transport stations pursuing a combination of walking, cycling and transit environments (Bertolini et al., 2012; Ibraeva et al., 2020). It highlights the role of public transport stations as a place for commerce, a public space, an area for meeting and communication and a place that contributes to the identity (Zemp et al., 2011). TOD principles are often planned and researched in outskirts; however, it is recommended that TOD opportunities are also explored and implemented with city centre residents (Ibraeva et al., 2020). Even though a great body of research deals with the potential of retail and gastronomy in the wider catchment area of stations, the 'micro-block' surrounding stations often lacks attention (Yang et al., 2023).

Potential uses of the immediate environment of stations and their functionality for social interactions should be further explored (Lunardon et al., 2023). Public transport stations could serve as a neighbourhood anchors. The concept of anchor institutions is often referring to education, cultural or medical institutions, being deeply tied to the community, focus on local social, economic and environmental challenges and support the overall well-being of the community (Initiative for a Competitive Inner City, 2016; Koh et al., 2020). For our case, we define neighbourhood anchors in relation to public transport stations as places that attract people, foster identity and generate recurring uses, addressing features of a high-quality walking environment. They could become an anchor if they encourage people to linger, are relevant for local services (e.g. retail, meeting, nature) and support orientation and walkability.

2.4. *Tactical Urbanism for testing walking environments*

To draw attention to the shortcomings of walking policy principles and test potential urban redesigns, Tactical Urbanism (TU) is a highly valuable approach. Its origins lie in the history of urban development, often motivated by the goal of improving cities on a small scale from the bottom up (Talen, 2015). TU measures can be regarded as Phase-0-measures, as they allow to test potential redesigns of urban space before planning phases start (Lydon & Garcia, 2015). Their characteristics are that they are targeted, easy-to-apply and adaptable (Lydon & Garcia, 2015).

However, physically implementing measures in the built environment can be challenging in Germany, even if they refer to TU principles: Even for small-scale interventions, municipal authorities have to be involved, reasons for implementing interventions have to be provided, and processes to get a permit can be long-lasting and resource-intensive. Even low-cost small-scale TU interventions can be difficult to realize, as municipal authorities need courage to change and willingness to try out new ways (Bruck & Hagen, 2024). Moreover, implementing measures in the built-environment does not easily allow for adaptations since the measures are already built, even if they are based on TU principles. As an alternative, Virtual Reality (VR) can be used to let people digitally experience and test measures without physically implementing them into the real world yet. This can address these barriers and provide visually appealing, flexible, adaptable and immersive scenarios, which later can be implemented in the real-world.

In urban design and transport research, VR is a common method, e.g., to investigate street experimentation (Scerri & Attard, 2023), area development planning options (see Szczepańska et al. (2021)), infrastructural or design-related solutions for cyclists (Ullmann et al., 2022) or pedestrians (White et al., 2023) or mental health implications of urban environments (see Buttazzoni et al., 2021). As for public transport, VR has been used to examine people's wayfinding behavior in subway stations (Tang & Auffrey, 2018). VR environments can be shown on a screen or viewed with VR glasses, in which the participant can walk through the virtual world or experience the environment still with a 360° image and 3D elements. Each method has its advantages (for a discussion see Ghanbari et al. (2024)). While VR has received attention in walking and cycling research (see Ghanbari et al. (2024)), to the best of our knowledge it has not been used to investigate how to improve the walking experience and quality of stay on station forecourts. Moreover, existing studies on walkability using VR usually apply surveys to rate environments in terms of safety or attractiveness (e.g. Oselinsky et al. (2023)). Qualitative studies, however, that combine VR and walkability, are still rare (Ghanbari et al., 2024). Regarding public transport stations, qualitative methods support identifying policy and practice implications with spatial relevance (Tiznado-Aitken et al., 2020). Using VR combined with TU is a promising way to visualize and test the redesign of a station forecourt, use it to analyze its effect on walkability, public transport usage and neighborhood vitality with users and discuss with policy and planning practitioners a potential implementation, without the need to implement measures in the real-world yet.

3. Methods

We applied a sequential mixed-method approach (Kuckartz, 2014) (Fig. 1) taking the mobility hub Berlin-Lichtenberg in Germany as our case study. The station Lichtenberg is one of the most important mobility hubs in the eastern part of Berlin with about 20.000 transfers a day and offers access to regional trains, subway, city trains ('S-Bahn'), tramways, busses and sharing options (Berliner Verkehrsbetriebe (BVG), 2021). The station is located in a mixed residential area and allows about 50.000 people in the immediate neighbourhood access to sustainable mobility (Berliner Verkehrsbetriebe (BVG), 2021).

After an initial literature review, we conducted an explorative stakeholder workshop with practitioners to gain an understanding of the station under research and current planning principles (Section 3.1). Our dTU approach refers to the bottom-up understanding of TU by gathering requirements of the users before designing the interventions. Therefore, we conducted a user-centered online survey. Based on the findings from the survey and stakeholder workshops, 3D elements based on TU principles were designed and implemented in 360°-images of the case study station (Section 3.2). This is similar to the approach of Scerri and Attard (2023), who presented participants virtually redesigned areas based on intervention ideas of previous workshops. Following this, user centered VR workshops were held (Section 3.3.1). Finally (Section 3.3.2), stakeholders from the municipality were interviewed using the VR glasses to gather expert perspectives. This research design is considered a 'digital Tactical Urbanism' (dTU) approach (Fig. 1).

3.1. *Stakeholder workshop on TU and planning responsibilities (stakeholder integration I)*

Two stakeholder workshops (stakeholder integration I) were conducted online in March 2022 and April 2023. Participants included representatives from district administration, mobility providers, an

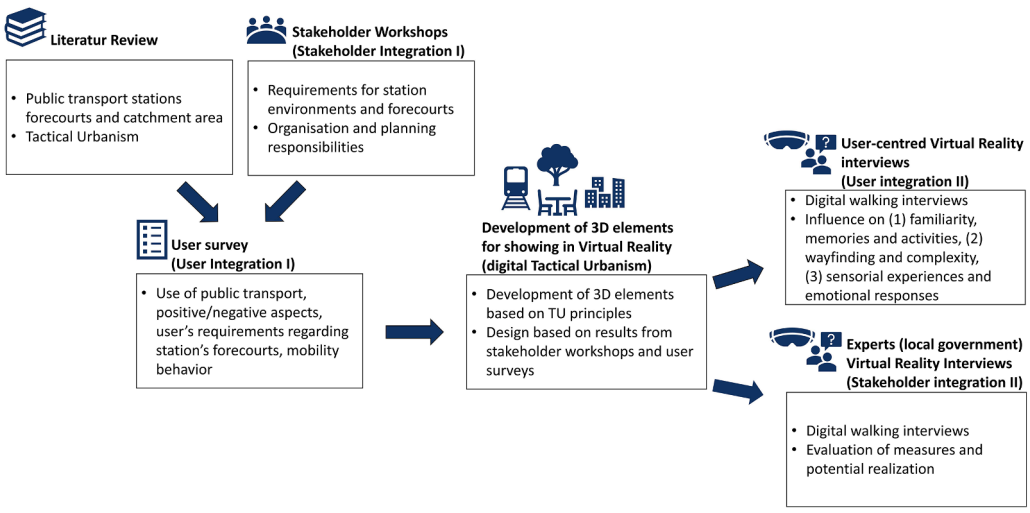

Fig. 1. Study design.

architect, lobby groups, and science. The workshops were held to gather insights from different actors regarding the station under research and explore potentials and current barriers. Based on this, the stakeholders discussed potential TU interventions that could improve the station. They reflected on their planning responsibilities and discussed options to implement TU interventions on site. The workshop demonstrated that obtaining authorization for implementing TU measures would be a difficult and long-lasting process, as authorization must be obtained by different authorities for each measure, even if they are based on TU principles (flexible, cheap and adaptable). To avoid lengthy approval processes, we considered using VR to test and demonstrate potential TU interventions, without the need to undergo the long-lasting approval process yet: The methodology of 'digital Tactical Urbanism' was applied (see section 3.3). Results from the literature review and stakeholder integration (I) will not be presented in this article, but served as a basis for developing the VR world (section 3.3) and are presented in a previous conference paper (see Marquart et al., 2025).

3.2. Online survey (user integration I) and building the VR-world

To include the user's requirements in building the digital TU measures, we firstly conducted an online user survey. The survey was applied to identify the usage, requirements and experiences of people who use the public transport station Berlin-Lichtenberg. For recruitment, non-random sampling methods were used. Large posters and floor graphics were placed for four weeks in the respective station and newsletters, flyers and online platforms announced the survey. The survey took place from July 2023 – September 2023. We analyzed the data by using descriptive statistics.

Based on the results of the survey, we decided together with an architect which kind of 3D design elements will be developed and where they should be placed onto the forecourt. The decision was based on the highest ranked features for an attractive forecourt in general and the highest ranked features for the forecourt in Berlin-Lichtenberg in particular in the online survey (see section 4.1). The selection options in the survey were influenced by the literature review and the stakeholder workshops done at the beginning (see Fig. 1). The survey also included mandatory answers to these two questions in an open answer field. These answers were screened and categorized. Together with an architect who was part of the stakeholder workshops and who received the results from the survey, we discussed in an iterative discussion round how to design the forecourt based on the requirements of the users. We decided to use immersive VR instead of web-based streetscape evaluation as prior work showed that aspects such as naturalness, beauty and safety can be well explained and experienced in an immersive way with VR (Han & Lee, 2023). Unlike previous applications of VR, which often relied on fully interactive virtual environments (Oselinsky et al., 2023), we opted for a hybrid approach. This method combined spherical panoramas of the station's forecourt with photorealistic 3D models, creating an augmented VR design that preserved the familiarity of the real-world context while showcasing proposed enhancements. This familiarity was crucial in order to ensure that the principles of TU, and thus the imaginability of the measures in the real world, could also be realised in the VR world. The spherical panoramas were created using a Kandao Obsidian camera, which captures six fisheye images. These were stitched into a single high-resolution 360° image, and post-processed manually to remove the tripod and operator as well as any stitching artefacts. The images were provided by a colleague from the DFD-WIS department. The 3D-elements were placed strategically in the 360° images in the virtual urban environment and were built according to the principles of flexibility and adaptability of TU. To match the 3D elements with the spherical images, we reconstructed a simplified 3D model of the forecourt in Autodesk 3ds Max, using the real buildings as spatial references. This allowed for precise placement of virtual cameras in the same positions as the real photo locations, ensuring visual alignment. The objects were rendered with transparent backgrounds and composited onto the spherical panoramas. The entire scene was assembled and made interactive using Pano2VR (Garden Gnome Software), which generated a HTML-based virtual tour with hotspots and transitions between viewpoints. This content was loaded onto a Meta Quest Pro headset and displayed using the VR Tourviewer app, allowing the experience to run as a standalone application without requiring a tethered computer.

The developed 3D-elements included seating options, a food truck, a water fountain, a boule game and ping pong tables, greenery and wayfinding pictograms. These were used to increase social interaction and livability, address the lack of perceived social safety in the area and improve wayfinding (see section 4.1). To increase the immersive quality of the VR environment, 3D-scanned figures of people were included. These human models were sourced from our internal 3D asset libraries. Their positions and postures were chosen to simulate realistic everyday activities in the urban context, enhancing the liveliness and relatability of the virtual space. As greenery was desired in the survey (see section 4.1) and shown to be important for pleasantness and emotional arousal (Yang et al., 2023), flower beds and small trees were created. Fig. 2 shows the virtual redesign of the forecourt.

Fig. 2. The public transport station forecourt of our case study without 3D elements (current situation without digital Tactical Urbanism measures, left) and with 3D elements (potential situation with digital Tactical Urbanism measures, right). Participants could look around 360° when wearing the VR glasses. By clicking on 0, 1 or 2 they could switch from the current situation, to wayfinding (pictograms and sharing station information) to a complete redesign (all 3D elements). For experiencing a video of the VR-world see: https://youtu.be/bQ7d8RQTzlc.

3.3. Virtual Reality Interviews

3.3.1. User-centered virtual reality interviews (user integration II)

We recruited users of the public transport station and conducted problem-centered interviews while the participants wore the VR glasses and experienced the VR world (digital walking interview). Problem-centered interviews were chosen, because they involve dialogue processes to meet the communicative capacity of the respondent and ad-hoc questions to explore the phenomenon under research (Witzel, 2012). The semi-structured interview guideline included questions referring to concept of 'wayfeeling' and studies on wayfinding and environmental cognition (see Ferri and Popp (2022) or Bomfim and Santos Cruz (2023) for an overview). The interview guideline referred to the perceived environmental complexity and wayfinding and the participant's environmental familiarity and activities on the forecourt. Emotional responses and feelings regarding the area were explored as well. The interview questions were based on the theoretical background and state-of-the art (section 2). Table 1 gives an overview. To evaluate the emotional responses, the interview guideline had periodical questions on the participant's in-situ feelings, which reoccurred during the interviews. Our aim was that the participants experience how the current forecourt could look like with TU elements, so that they could imagine themselves walking on the redesigned forecourt (Fig. 3).

The interview procedure was as follows: We started with introductory questions followed by the so called digital walking interview, where the participant was guided through the virtual world and interviewed in the meantime wearing VR glasses. Walking interviews are a form of interviewing on-the-move (Evans & Jones, 2011), in our case on-the-move in the VR world. As recommended by Oselinsky et al. (2023), a digital waiting room was created in which the participant could get accustomed with the technology. Afterwards, the participant was guided along four main areas from the subway station to the adjacent neighborhood and the mobility sharing station while wearing the VR glasses (Fig. 4). Meanwhile, the participant was instructed to click on certain points to blend the design features on or off.

For recruitment, flyers were handed out to shops and restaurants as well as passers-by around the station, to also reach participants who do not use digital media. Moreover, announcements were made in online newsletters and neighbourhood communities and by reaching out to local initiatives. The VR workshops took place at a house on the station's forecourt next to the underground exist (see Fig. 4). Participants could schedule an appointment. The interviews lasted between 27 and 45

Table 1
Interview question examples for different topics under investigation in relation to the theoretical concepts.

Interview questions (examples)	Investigated topic	Concept (see section 2)
"Would you spend time here, if you wanted to get to the station?" *"Do you sometimes find yourself in this place? […] What do you like here?"* *"Does the forecourt influence how much you like travelling to/from Lichtenberg by underground or S-Bahn?"*.	(1) Familiarity, memories and activities	Neighbourhood anchor
"Which routes do you usually take from here? Do you change trains here? From where to where or which means of transport do you change here?" *"What do you think of the wayfinding in this scenario? Why?"*.	(2) Complexity, walkability and wayfinding	Walkability and Wayfeeling
"Take a look around. How do you feel here now? If you were to translate [feeling as stated by the participant], what does that do to you?".	(3) Sensorial experiences and emotional responses	Quality of stay, place quality

minutes. Two researchers held the interviews, who also analyzed the data iteratively using MaxQDA. The interviews were recorded, transcribed and analyzed based on qualitative content analysis (Mayring, 2003), using an inductive-deductive approach. Firstly, we used deductively developed categories from the interview guideline (Table 1): (1) familiarity, memories and activities on the forecourt, (2) perceived complexity and wayfinding to the station and (3) sensorial experiences and emotional responses. To analyze the statements made regarding emotional responses, we classified answers on feelings according to the dimensional emotion model by Mehrabian and Russell (1974), specifically distinguishing between unpleasant – pleasant and activation – deactivation. The category (3) served to capture the immediate, emotional and sensory perceptions of the interviewees, focusing on affective responses in relation to the built environment they are exposed to in the VR world. Secondly, based on these categories, new codes were built inductively out of the data during analysis, hence, being open for new and unexpected aspects. The categories (1) and (2) reflect rather functional and symbolic dimensions of how the interviewees use and identify themselves with the forecourt. Some statements of (3) could overlap with (1) and (2), reflecting their dual character, i.e. where a sensory experience informs the identity of a place or vice versa. The transcripts were divided into statements made in the VR (a) before and (b) after showing the newly developed 3D elements.

Fig. 3. Example of what participants see in a digital walking interview (inside the brackets) and the immersive experience they get when being in the VR world shown by a quote of one of the interviewees (source: DLR (n.d.)).

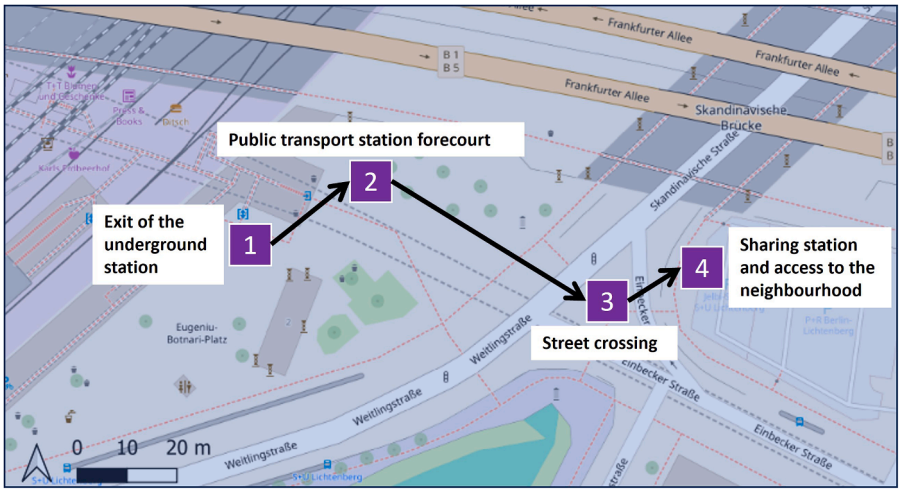

Fig. 4. The four stops of the digital walking interview. Participants could jump from one point of view to the next by using a joystick (Basemap by © OpenStreetMap contributors, modified).

3.3.2. Expert local government virtual reality interviews (stakeholder integration II)

As a final step, we held VR interviews with relevant stakeholders from the city administration, to include their perspective on the interventions and redesigned forecourt. We conducted seven expert interviews with stakeholders from the municipal administration with the following areas of expertise:

E1: Youth development
E2: Landscape planning
E3: Environmental and nature conservation
E4: Transport and infrastructure planning
E5: Citizen participation
E6: Urban and transport planning
E7: Needs of people with disabilities

The interviews comprised questions on feasibility and practicability of implementing the 3D interventions in the real world and potential effects of the redesign on pedestrians from an expert perspective. The experts wore the VR-glasses and experienced the same VR-world as the users. Meanwhile, they were interviewed (digital walking interview). The interviews were held individually at the city administration office in June and July 2024 and lasted between 43 and 53 minutes. The interviews were audio recorded, transcribed and analyzed using thematic analysis (Nowell et al., 2017).

4. Results

In section 4.1, we provide an overview of the survey results (user integration I), which formed the basis for developing the 3D elements for the VR world. The results provide insights into requirements and needs of public transport station forecourts of a larger sample. Next, we present the results from the VR interviews, representing both the user perspective (Section 4.2) and the decision-maker's perspective (Section 4.3). The results demonstrate the influence of the dTU measures on the use and perception of the forecourt.

4.1. Survey results (user integration I)

The online survey was completed by 250 persons. The survey was done before developing and discussing the dTU measures (see section 3.2). Respondents are generally of middle age, well-educated, live in large households and have rather high income. In terms of mobility, survey respondents generally use multiple modes of transport with a focus on public transport. For most respondents, the station Berlin-Lichtenberg is where they start or end their trip (71 %).

The main questions focused on the importance of certain features of a station's forecourt in general, on a scale from extremely important to not important at all (Fig. 5). For most respondents (80 % or more), safe and short routes into the neighborhood, cleanliness and lighting, and good signage of accesses are very important or extremely important. In the upper midfield (60-80% very important or extremely important) are barrier-free access, good bicycle parking facilities, sufficient space to avoid overcrowding and greenery. Of somewhat importance (40-60 %) are camera surveillance, toilets, quality of stay (e.g. seating), security staff and an aesthetic design. Less important (25-40 %) are drinking fountains and nearby shops, sharing services and liveliness of the forecourt. The least important feature for respondents were parking facilities.

As for the respondent's satisfaction of the station's forecourt in particular (Fig. 6), the respondents were mainly satisfied or very satisfied (40 % or more) with the spaciousness of the forecourt, the signage of accesses, the lighting, nearby shops and barrier-free accessibility. More than half of the respondents considered the available sharing services as at least satisfactory, although they were not relevant for about one-third of the respondents. Respondents were dissatisfied or very dissatisfied (40 % or more) with the cleanliness of the neighborhood (68 %), aesthetic design (64 %), the quality of stay (62 %), greenery (60 %), and social interactions (43 %). Of the valid answers on the satisfaction with toilets (63 % with 37 % N/A), 47 % were dissatisfied or very dissatisfied. Drinking fountains considered 56 % (40 % N/A) rather dissatisfactory. A high amount of dissatisfaction also applied to bicycle racks (44 %, 27 % N/A), security personnel (47 %, 18 % N/A) and parking options (43 %, 54 % N/A). Regarding camera surveillance (20 % N/A) and short and

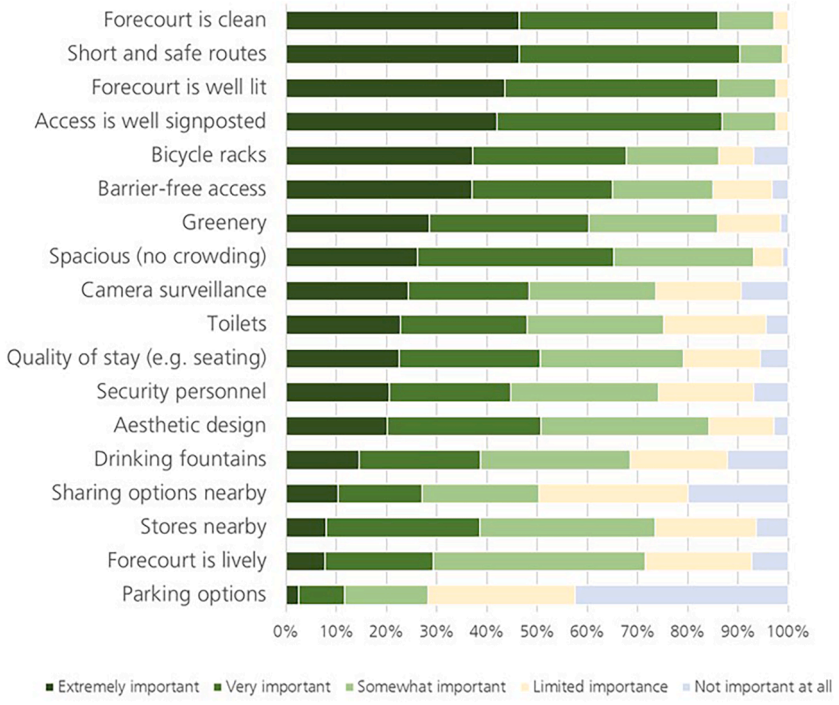

Fig. 5. Importance of certain features surrounding a public transport station in general (N = 250).

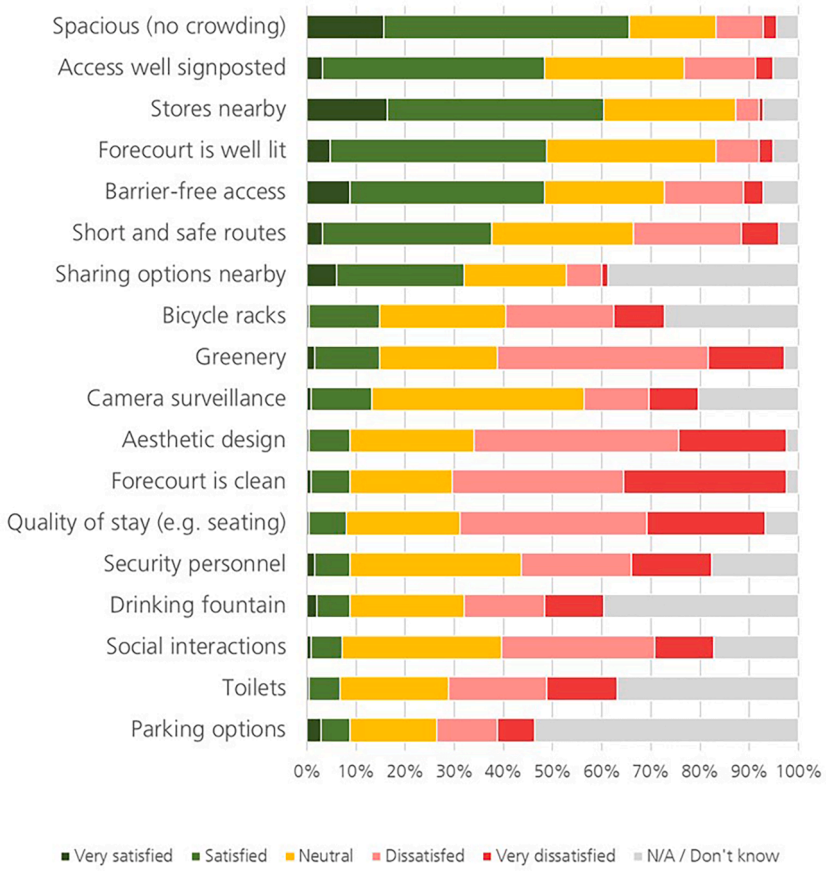

Fig. 6. Respondent's satisfaction of the features surrounding the station Berlin-Lichtenberg in particular (N = 250).

safe routes into the neighborhood, people's opinion was split. While many were satisfied, almost as many are rather dissatisfied and many neutral.

In general, people were more often dissatisfied than satisfied with characteristics of the station's environment. While lighting and signage seem to be sufficiently addressed, other aspects often considered as important require action since the respondent's satisfaction seemed to be low. These are: cleanliness, aesthetic design, quality of stay, greenery, short and safe routes, barrier free access, bicycle parking, toilets, and drinking fountains. Subject to discussion are security and surveillance which need further investigation since the opinions seem to be very divided.

4.2. User-centered virtual reality interview results (user integration II)

The virtual reality interviews (user integration II) were held with 17 participants, i.e. users of the station (demographics see Annex A). Their mean age was 44 years (SD = 13), 53 % defined themselves as female, 41 % as male and 6 % diverse. This represents well the demographic background of the neighbourhood (Statistik Berlin Brandenburg 2024). About half (53 %) had college or university as their highest educational level, 24 % high school, 18 % secondary school and 6 % other. One-fourth were full-time employed, 42 % part-time and the rest either freelance, pensioner, student or pupil. For analyzing the interviews, we referred to the two main topics, which were created out of the theoretical background and state-of-the-art (see Table 1, section 3.4). We developed themes out of the data and categorized them into similar statements in an iterative coding process.

4.2.1. Stations as neighbourhood anchors: Familiarities, memories and activities

We investigated statements on familiarity, memories and potential activities to explore to what extend a station can become a neighbourhood anchor. This includes activities undertaken while accessing, leaving or waiting at the station and the extent to which the participants identify with and feel attached to the neighborhood. When considering the statements before and after showing the dTU 3D elements and how perception changed, three key findings can be identified (Fig. 7): (a) quality of stay, social interactions and sense of place can be improved with the dTU measures, (2) fear of social problems and vandalism prevail despite of the redesign, and (3) functionality is key for station forecourts both before and after showing the potential redesign, and for some people forecourt's main functions should be for short-term usage and meeting areas instead of leisure activities. Fig. 7 shows the key identified themes regarding stations being a neighbourhood anchor found in the interviews before and after the dTU 3D elements and highlights changes in perceptions. This will be discussed in the following.

Activities and usage of station

The current forecourt without dTU interventions was not perceived as a place to rest or spent time, with most of the participants stating this aspect alongside a lack of livability (Fig. 7). Positively mentioned were the already existing snack-bars and takeaway food shops, cafés and shopping facilities in the neighbourhood and inside the station. These were stated to improve the social quality of life and increase the motivation to use the station beyond its function as a mobility hub, however, they do not make the station a place to rest at its current state as there are no facilities on the forecourt itself. Some participants criticized the

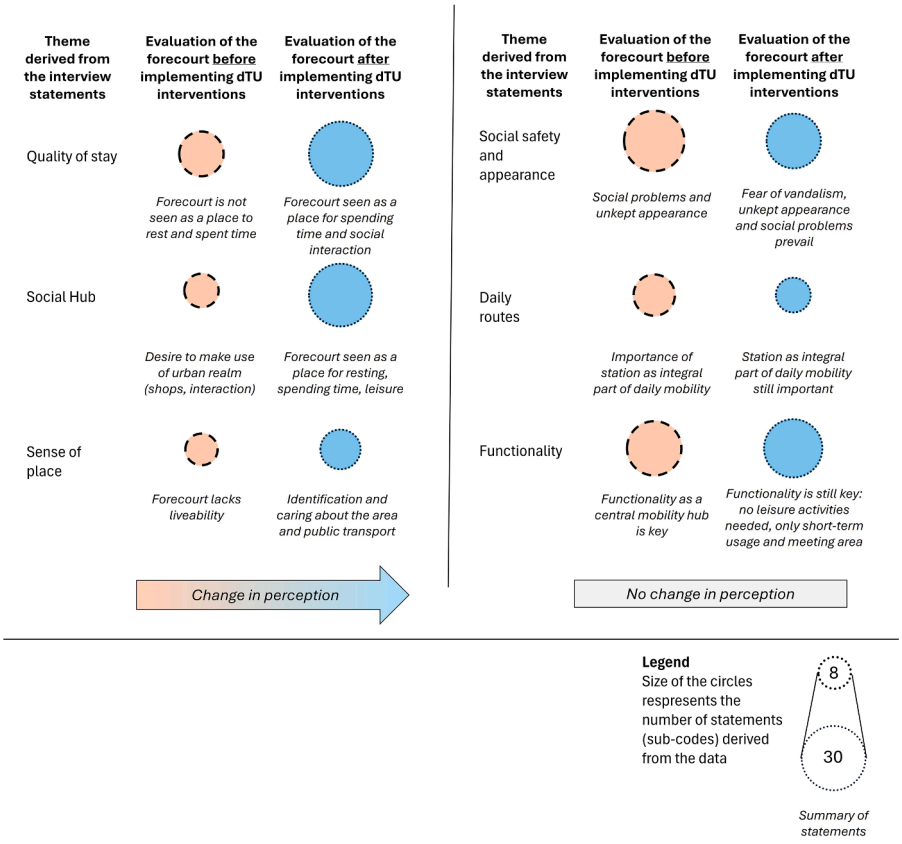

Fig. 7. Main themes relevant for a station being a neighbourhood anchor that came up in the user-centered VR interviews concerning the current situation (without 3D dTU Elements) and potential situation (with 3D dTU Elements). The number of sub-codes (size of circles) shows the number of times a topic was mentioned by the 17 interviewees. Below the circles is a summary of the related statements made in the interviews. A detailed description of the sub-codes can be found in the supplementary material.

lack of livability when passing it:

> *"So, this large, wide, grey area with its rusty, loveless benches really is… You scurry across it. It's nothing [here]." (231201_1405[1])*

After showing the dTU measures, many statements were made on new opportunities to interact with the urban space and potential activities to undertake on the forecourt. The wooden benches inspired the participants to imagine situation where they could interact with other people or spent time at the forecourt, hence, giving the forecourt more functions than just being an entrance to public transport:

> *"I find these two designs with the reclining areas or seating options very pleasant. […] Because it's a lot and it's big. And people can spend time there. And I'm someone who likes to talk to people. I might also want to get into a conversation with someone." (231201_1412)*

After experiencing the dTU interventions, statements regarding activities increased and diversified. First and foremost, many participants discussed a variety of leisure activities they could undertake in the newly designed public space either on their commute home from work or as a leisure activity in itself:

> *"When I arrive at other stations […], I also like it when something happens there, whether I use it or not. But I know that when I come back from my appointment, maybe just after work, I can have a coffee or a white wine spritzer somewhere and then I can go home. That's nice, a welcoming." (231201_1405)*

> *"I could imagine sitting down here by these apple trees. And when it's warm, to read. In the shade." (231208_1624)*

The forecourt was now associated with positive feelings, such as pleasantness, welcoming, happiness and attractiveness. The newly designed space also led to discussion about activities, which go beyond its function as a public transport stop: Participants made statements regarding playgrounds for children, using the table tennis or boule area or visiting the forecourt to meet neighbors or hang out. These positive aspects of the redesigned space could not only lead to a more frequent usage of the station, but also to an increased identification with and caring for the neighborhood:

> *"I like to arrive here with someone and say 'I live here, this is my street!'. It's already home. And [my] neighbourhood, that's […] joy." (231201_1405)*

Moreover, some participants reported that the redesign might not make sense during other seasons such as winter or autumn, showing the need to plan social places not only for one season, but for all seasons.

Fear of social problems and vandalism

Secondly, one of the major topics discussed was social safety (Fig. 7). Participants mentioned that the current situation at the forecourt is shaped by people (homeless people, alcoholics, drug users) lingering at the station. They associated seeing them with a feeling of fear, threat, unsafety, pity, sadness and unpleasantness. Many statements on the current forecourt without the 3D measures were made regarding social problems, memories of people perceived as awkward and scary and knowledge about reported incidents. After showing participants the

[1] The numbers refer to the respective interview (see Annex A). The interview answers are translated from German to English by the authors.

forecourt with the dTU 3D elements, still many statements were made referring to these social problems. Thus, pointing out that a redesign of the station forecourt has to go hand in hand with a concept to address social safety issues:

> *"Because, as I said, there's a permanent clientele here near the kebab stand and there's a slight fear that they'll take up this space [if it is redesigned], which would be a shame, because that would stop other people from meeting up here." (231208_1253)*

> *"But of course, if there are such dangerous people sitting here now, it doesn't make it any better just because there are wooden benches and such. It's still creepy when people hang around here." (231208_1624)*

In line with the social safety related aspects, participants feared that the redesigned area might not be well maintained or even vandalized. It was reported that the dTU 3D elements look too perfect and well maintained. The dTU 3D elements were supposed to reflect the potential design of the forecourt; however, many participants could not image the forecourt as neat as shown in the VR world. In many statements the participants mentioned that the wood will be affected by weather, furniture or table tennis will be broken, destroyed or get dirty ("*these wooden benches quickly become soiled.*" (231208_1417)), unpleasant graffiti sprayed, trash might lay around or the greenery will be covered with weeds:

> *"But I'm pretty sure that if there are no cameras and no security, that […] everything will be destroyed and except maybe that cafe there, because then it's someone who is there. […] Everything else I can well imagine being destroyed." (231201_1501)*

> *"[…] the seating elements [are] so low, that the feet inevitably end up on it. So, it will always be dirty." (231201_1634)*

In addition, some participants raised the issue of possible soiling of the newly designed elements in connection with the pigeons living on the forecourt and requested a solution for the pigeons.

Functionality of forecourt for accessing public transport

Finally, the role of a public transport station forecourt was discussed and different points of views can be identified (Fig. 7). For most participants, the route to the station is rather functional, an everyday route which needs to be taken to access public transport ("*So for me, it's simply functional at the moment.*" (231208_1409)). The station was positively evaluated as a major mobility hub. Yet, some participants criticized the current access to the station due to its lack if liveliness and safety.

While by far the most statements were made that the redesign of the station forecourt offers new forms of activities, social interactions and increased identification and use of this space, almost half as many statements still showed that the station forecourt is primary seen as a place to access public transport and that undertaking activities there is rather secondary. Some participants could not imagine using the area for activities or longer stays despite of the dTU 3D elements:

> *"I don't know if I'm going to read a book here alone at the crossroads, simply because of the traffic. There's a bit too much traffic for you [if you] want to spend time here alone. I'd rather go to the park or the green square." (231208_1253)*

For them, an attractive forecourt is a pleasant prerequisite, but not necessary for their decision to use the station nor a place they would go to spent their time, meet people or do other activities:

> *"I'm just in Lichtenberg [the neighbourhood], not to spend time here or meet up with my friends or anything like that. I'm really only here to change trains and that's all that counts." (23128_1417)*

> *"That [the redesign] has no influence [on using public transport], because I don't use public transport because I like travelling, but because I think it's a commodity for me. I use it to get somewhere because I want to go somewhere and not because I enjoy travelling around the area." (231201_1246)*

This emphasizes that a station forecourt can become a place to stay, interact and a neighbourhood anchor, but firstly, a well-functioning access to public transport needs to be ensured. Hence, a forecourt firstly needs to be an access to stations with a high-quality walking environment, low complexity and good wayfinding.

4.2.2. Walking to the station: Complexity, wayfinding and walkability

We investigated complexity, wayfinding and walkability of the forecourt, before and after implementing the dTU measures. We specifically considered the stated emotions, feelings and sensorial experiences when investigating walkability, as these are integral part when considering walking environments and wayfinding (see section 2.1 and 2.2). The findings are summarized in Fig. 8 and discussed in the following.

Complexity and wayfinding

Generally, the current forecourt with its spacious and wide area was perceived very positively by participants, with statements about the comprehensiveness and openness of the forecourt and reported pleasantness due to the wide area (Fig. 8). After inserting the dTU 3D elements, however, some participants reported that the forecourt is now overcrowded, that the dTU 3D elements do not fit into the forecourt and might increase its complexity:

> *"[It is stressful,] yes, because you had fewer impressions before, I would say. It wasn't nicer, but it was definitely less to look at." (231201_1211)*

In the current situation without interventions two third of the participants stated to know the sharing station, only four reported a lack of knowledge. Especially the dTU measures of the pictograms designed in the colors of the public transport provider improved the wayfinding from the underground station to the bus stops. They also improved the wayfinding to the sharing station, which is currently on the other side of a major road. However, the distance of the sharing station accompanied by the need to cross the main road was an often-mentioned barrier, both before and after showing the dTU interventions. A sharing station closer to the underground entrance and information and signs explaining the sharing concept were desired.

Walkability and related sensorial experiences and emotional responses

In the current situation of the station's forecourt without the dTU 3D elements, greenery and trees and the official painted graffiti and colored walls were associated as pleasant and attractive for walking to the station ("*It adds a bit of colour.*" (P 231208_1624)) (Fig. 8). Some participants reported feeling positive emotions in relation to the painted walls and trees (Fig. 9). The participants also referred positively to existing infrastructure for cleanliness (e.g. garbage bins, public toilet), barrier-free entrance (e.g. the ramp) and weather protection (e.g. the entrance roof). Negative emotions were stated in relation to the concrete area as well as the lack of benches, dirt and pigeons living on the forecourt:

> *"I find this place here, when you come out [of the station], where there are two rubbish bins, and the one bench, a bit sad. It looks sad." (P 231208_1417)*

Generally, the grey concrete area was seen as the most negative visual experience on the forecourt, whereas the legal painted graffiti and greenery were the most positively stated visual experiences (Fig. 9).

Moreover, the current state of the forecourt without dTU 3D elements engendered feelings of sadness and insecurity with regard to the walking experience. Specifically mentioned were homeless people on the forecourt (see section 4.2.1), missing lights and emptiness:

Fig. 8. Main themes regarding complexity, walkability and wayfinding identified in the user-centered VR interviews (n = 17) on the current situation (before implementing 3D dTU Elements) versus the potential situation (after implementing 3D dTU Elements). Each rectangle's size is proportional to the number of times the theme was mentioned by the interview participants and shown in the respective number. Green shading denotes themes that were positively associated; red shading denotes negatively associated themes.

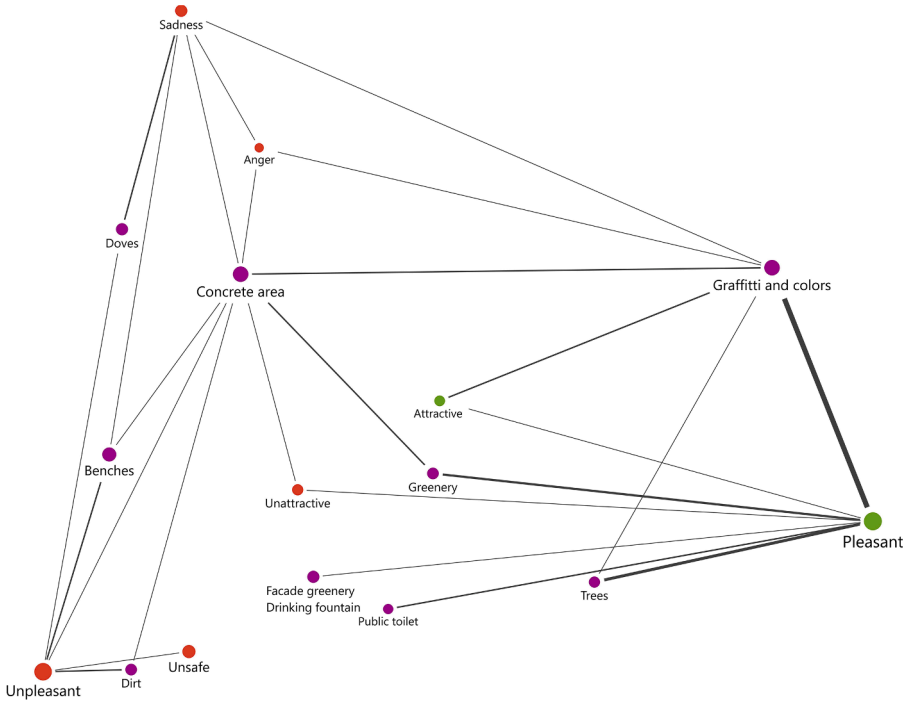

Fig. 9. Emotions stated in relation to visual experiences in the VR world without the dTU 3D elements. The thickness of lines represents how often they were stated in relation, the font size how often the aspect was mentioned. The colors represent positive (green) and negative (red) emotions, purple represents the visual experiences. The closer two codes, the more often they were stated in relation. Only codes found at least four times and in relation with stated emotions are shown. (created with MAXMaps in MAXQDA).

"At the staircase to the underground station […], there are homeless people sleeping there. I think that's an extreme pity, because it is cold, that's something that makes me sad, for example. Or thoughtful or depressed." (231201_1657)

"It's a bit spooky in the evening, of course, because it's very dark, I think. And of course, a lot of violence has already happened in this place." (231201_1412)

Perceived safety, a feeling of malaise and unpleasantness were major issues discussed about the forecourt. A lack of lightning combined with past experiences and negative reporting about incidents on the forecourt (see section 4.2.1) resulted in unsafe feelings. Fig. 9 shows the relation of stated emotions and visual experiences without the inserted dTU 3D elements.

After experiencing the redesign and the dTU 3D elements, participants reported mostly positive emotions and wellbeing-related aspects. It became apparent that greenery and quality of stay were regarded as aesthetic and attractive for their walk to the station, the participants felt

welcoming. Specifically, the newly inserted wooden benches were regarded positive. Other visual aspects stated in combination with positive emotions were the newly built mobile café, the drinking fountain and the table tennis and boule area (Fig. 9). Two participants mentioned that the route appeared shorter with the inserted dTU elements. Fig. 10 shows the relation of stated emotions and visual experiences with the inserted dTU 3D elements.

However, even after showing the participants the dTU 3D elements, some negative aspects for walkability prevailed: noise from the surrounding streets and the still existing concrete area, which has not been unsealed (see Fig. 8). Additionally, many statements regarding social safety prevailed despite of inserting the dTU 3D elements (see section 4.2.1). All in all, the newly designed dTU 3D elements evoked a variety of positive emotional responses among the participants: before inserting the dTU 3D elements, 33 statements on pleasant and 46 statements on unpleasant emotions were made. After inserting the dTU 3D elements, 61 statements referring to pleasant and two to unpleasant emotions. The participants mentioned many positive emotions related to the redesigned environment e.g., the surrounding shops and cafés and food stores increased the feeling of safety due to 'eyes on the street' related to them. Especially the newly designed public spaces for social interactions were perceived as positive, welcoming, attractive and related to feeling happy.

4.3. Expert virtual reality interview results (stakeholder integration (II))

Following the user-centered virtual reality interviews, we held seven virtual reality interviews with decision-makers (stakeholder integration II). These explored the potential effects of the measures from a planning perspective.

4.3.1. Realization and effects of the measures from a planning perspective

The main concerns regarding the redesigned forecourt from an expert perspective were issues related organizational aspects, especially vandalism and maintenance, stated by six experts (Expert (E) 1, 2, 3, 4, 5, 6). The questions were raised who is responsible for maintaining the area and the measures, the municipality itself or people from the neighborhood, e. g., with watering sponsorships. Experts stated the lack of financial resources for maintenance and that the material used for the measures could lead to rapid wear and tear. While the dTU 3D elements suggest an attractive redesign of the forecourt, in reality the measures could soon differ in its appearance.

Following that, social aspects were mentioned. Above all the conflicts of different user groups (E 1, 5, 6, 7). Four experts discussed these issues, pointing out that the redesign needs to go hand in hand with strategies to give certain groups of people a place on the forecourt. The issues of displacement and non-inclusive use of spaces further emphasize the importance of implementing measures that accommodate diverse user needs to promote equitable access to the forecourt's amenities:

> *"It's a place that they [public transport users] can't use at all because it's being used by other groups. And I can imagine that this could also be the case here [with dTU measures], but I don't know. […] But these seating areas, they are not used [for people] to sit there and have a nice chat, I don't know, but that they very quickly become a place where groups of drinkers or something like that sit." (Expert (E5)*

> *"I am against displacement, because the problems are shifting – the kiosk [food truck / mobile café] area feels like displacement." (E1)*

Lastly, built environmental aspects were discussed. The greenery and colorful seating options were regarded as important features to enhance the use of the forecourt and have synergies with climate-adaptive urban planning. Moreover, smaller trees for shading in hot summers, air quality filters and habitats for animals were regarded as improvements to the current situation of the forecourt and positive for nature conservation in the city (E 2,3,4). The wayfinding signs and posters for the sharing station were stated to improve the orientation in the area, according to the experts (E1,2,4,6), however, the measures could also increase the complexity of the area and clearer and more subtle symbols were desired (E1,6): "*It has a certain restlessness with the umbrellas and*

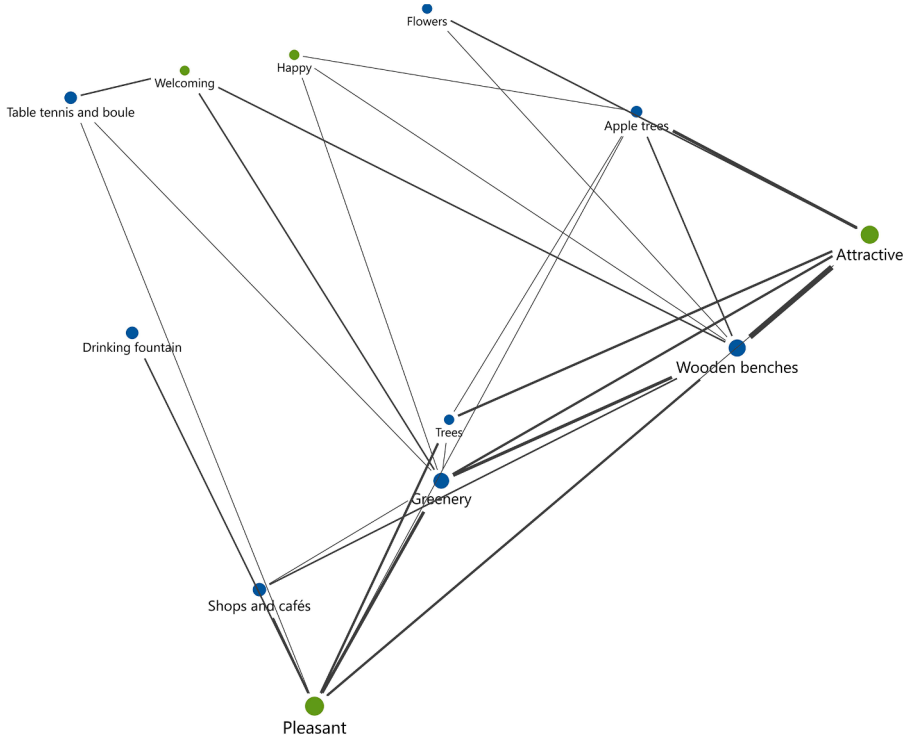

Fig. 10. Emotions stated in relation to visual experiences in the VR world with the dTU 3D elements. The thickness of lines represents how often they were stated in relation, the font size how often the aspect was mentioned. The colors represent positive (green) emotions. There were no negative emotions stated in relation to visual experiences. (created with MAXMaps in MAXQDA).

seating groups." (E1), "*So now I see several points. […] Now I'm wondering whether that's not a bit much and could be confusing.*" (E6).

The experts discussed the potential of the redesigned forecourt for improving people's sense of place and identification with the neighborhood. The experts mentioned that the image of the forecourt had long been negative, the measures could improve that image and make the forecourt a "*place to stay*" (E5), a place "*to feel welcome*" (E1) and a place to "*alleviate stress and provide relaxation*" (E3). Meanwhile, one can still identify with the area:

> *"The space is changing, you can see the changes, but it still remains the station forecourt in Lichtenberg. So, I can still identify with this forecourt."* (E4)

The newly designed measures can change the area to be a place to pass and become a place to stay (E4), where people can communicate (E2) and do not necessarily have to purchase something in order to linger (E4). Nonetheless, it needs to be ensured that the forecourt still functions as an access to the station, even if its quality of stay gets improved: "*It remains a public transport station and is not a park.*" (E1). Most importantly, from a planning perspective the creation and placement of measures itself is not the issue, but an approach to tackle the social situation is needed:

> *"For me it doesn't look challenging to realise, not so complicated and expensive; no civil engineering measures, rather the social aspect is complicated." (E1)*

5. Discussion

This study highlights the often-underrepresented 'micro-block' around public transport stations: its forecourt and immediate surrounding. It examines what a high-quality pedestrian environment should look like and explores the extent to which a public transport station can serve not only as a transport hub, but also as a neighbourhood anchor. The approach of digital Tactical Urbanism (dTU) is introduced and was applied to test interventions.

5.1. More than just a station forecourt: The role and design of forecourts

The results regarding activities and familiarity suggest that station forecourts can be more than just a functional place to pass in order to access public transport, as they can offer opportunities to meet neighbors, read a book or play. Hence, fulfilling two crucial urban design principles: comfort and joy (see Gehl (2010)). Public transport stations can become places of leisure, commerce and communication (Jehle et al., 2022). The interviews showed that designing the forecourt as a social hub improves the image of the neighborhood and increases the identification with the area and public transport itself, being in line with studies from e.g. Ferri and Popp (2022). Forecourts designed for social interaction can improve waiting times or make transfers attractive, as shown in our study. Moreover, shared urban environments have the potential to act as a resource for mental health (Müller et al., 2023). As also stated by the experts, the redesigned forecourt with greenery and recreational spaces can alleviate stress and improve identification with the neighborhood (see section 4.3), being an important health resource for an inner-city area and fulfilling core functions as a neighborhood anchor. In order to realise the potential as a neighbourhood anchor, it is important to enhance its socio-economic role within the neighbourhood, in addition to its function as a transport hub (Lunardon et al., 2023). Since property values inside stations are often too high to allow for local commerce, the station forecourt can offer a space managed by the city provided to local businesses, e.g., mobile cafés, seasonal markets or food trucks. This would enhance its economic role, being an important characteristic of neighbourhood anchors, and improve user experience, as shown with the positive evaluation of the mobile café in our study (see section 4.2.1).

Regarding walking to the station, our findings show that social safety is one of the most important factors. The creation of a vibrant public realm around a station as discussed previously may address the safety requirements without other measures needed. Promoting local vibrancy and incorporating pedestrian activities in early stages of designing stations is recommended, as transit users usually choose to walk alongside vibrant mixed-use main streets (Kim, 2015). As argued already by Jane Jacobs, vibrant street life can be associated with a higher perceived safety (Jacobs, 1961). Public places, bars and restaurant ensure 'eyes on the street' and act as social surveillance (Jacobs, 1961). For women in particular, the physical environment around public transport can promote a sense of security if it is characterized by openness, visibility and the ability to escape (Börjesson, 2012). When redesigning station's surroundings, openness and a wide view should be ensured, being in line with our findings (see section 4.2.2). For decision-makers, the process of deciding on where to place stations and how to design their forecourts should involve elements relating to the perception of secure transport environments. The weight of these elements needs to be determined by each municipality (Tiznado-Aitken et al., 2020). A safe and comfortable walking environment goes therefore hand in hand with forecourts being places for leisure, social interaction and commerce.

Our findings on the importance of safety are only partly in line with similar studies: While a study from Munich showed the most direct and quickest route is influencing route choices to stations (Sarker et al., 2019), another study from Bavaria revealed that safety and security were important, but not the most influential (see Jehle et al. (2022)). However, in our study, many negative comments were made about social safety and people lingering on the forecourt. Even with the dTU 3D elements the participants could not imagine the forecourt without the 'typical clientele' (see section 4.2). Fear of vandalism and missing maintenance represent the lack of confidence among users that a redesign would last long and be beneficial for themselves. We could reveal these experiential aspects of walking by using a qualitative approach and focusing on the forecourt rather than the greater catchment area. The participant's negative associations are deeply rooted in their memories and cannot be easily erased by presenting a redesigned forecourt. When deciding how to redesign the public realm of a station, it is crucial to consider the memories and experiences of people who use the space frequently. Social safety is not only related to security, but also to the negative feelings of sadness or pity that arise when people see homeless people around the station (see section 4.2.1). The experts argued that displacement should be avoided (see section 4.3). Before placing new redesign measures, a fair concept for handling the social situation is crucial. Outreach responses, i. e. providing help and support, are indicated as being more effective than punitive measures, i. e. policing and enforcement of laws (Ding et al., 2021). Forecourts should not only be defined as an access to the transport system, but considered as a social hub used by a variety of people. Hence, responsibilities should not only lie by transport providers, but by social and urban planning authorities as well. Partnerships are needed between transit agencies, but also other organisations from the social sector to tackle these wider societal problems (Ding et al., 2021). The differences in perceived safety in our study compared to other studies show that stations and their neighborhood have unique characteristics and there is no 'one size fits all' solution. It can be valuable to test measures for different neighbourhoods virtually with different actors using dTU.

When designing the forecourt to encourage social interaction it should be considered that crowdedness can also lead to negative feelings. Similar to the findings from Ferri and Popp (2022), some participants emphasized that the forecourt with dTU 3D elements and virtual passengers was too crowded, making them feel anxious. One positive aspect of the current design of the forecourt was its openness (see section 4.2.2). The design of a station's forecourt should therefore keep wide and spacious areas alongside new measures. As for wayfinding, our study results suggest to enrich a forecourt by information how to reach other modes of transport or signs regarding sharing options. This could

increase the popularity of shared mobility options. Colorful pictograms on the floor and signs on the walls are sufficient. Additionally, as pointed out by Hess (2012), signs could show walking duration to address misconceptions of distances. In general, wayfinding and information can increase trip satisfaction (Başaran et al., 2025). A wayfinding concept should therefore be comprehensive and clear while also incorporating intermodal trip options with shared mobility.

All in all, a station's forecourt can be more than just an entrance to a mobility hub. If it is planned to allow social interactions, provide a safe and convenient space and have a high amount of greenery and colorful areas, station forecourts can become social centers of urban neighborhoods. Importantly, the design of the transport system should not end at the station, but consider the micro-block surrounding the station and reach out into the neighborhood, incorporating knowledge of TOD for inner-city areas (Ibraeva et al., 2020). When planning for public transport environments a variety of actors, such as city administration, public transport providers and retailers, are involved with conflicting interests and different responsibilities (Başaran et al., 2025; Bertolini et al., 2012). This was also the case in our study (see section 3.1 and Marquart et al. (2025)). Municipal responsibilities should not end at the entrance of the station as should transport providers responsibilities not end at the exit of the station; a comprehensive planning approach considering user's experience along the whole door-to-door journey is needed.

5.2. Digital Tactical Urbanism: Limitations and opportunities

With this study we introduce the approach of 'digital Tactical Urbanism' (dTU) as a way of making redesigns virtually tangible. Planners or practitioners can virtually try out features, how to position them and test how passengers could be affected by them. In comparison with two-dimensional still images, VR offer a heightened level of realism and the capacity to engender a more pronounced sense of presence (Birenboim et al., 2019). Usually, moving objects or people are used in VR environments (Birenboim et al., 2019). This requires more resources than creating still images and does not align with the TU principles that interventions should be easy to build, flexible and cheap. The hybrid approach of combining 3D elements with spherical photos, as done in our study, offers significant advantages, particularly in terms of cost-efficiency and accessibility. Since the VR glasses serve primarily as a viewer for static images, this method requires only low-budget hardware and is highly portable, capable of running directly on standalone devices without the need for additional equipment. In contrast, a fully interactive 3D virtual reality environment adds an entire layer of complexity, enabling features such as parallax shifts in response to spectator movements and allowing users to freely navigate, demanding significantly more resources. For dTU static 360° images with 3D elements are more sufficient. As our participants related well to the forecourt, our study suggests that static 360° images provide as well a strong sense of immersion. However, it should be noted that 3D elements and VR designs, which are too perfect, may not represent the actual situation and can lead to unrealistic assessments of the use of the space.

The dTU 3D elements should be designed according to user's needs gathered through close collaboration. Co-designing public spaces is crucial to allow users to regain ownership (Lunardon et al., 2023). It should be noted, however, that our participants could not participate in designing the measures while wearing the VR glasses. In that sense, the approach does not align with the collaborative principles of TU. For future research and planning, the collaboration with users should take place within the VR world so that participants can visualize their needs when wearing the VR glasses. Thus, following the bottom-up approach of TU (Talen, 2015) and meeting the need of (neighbourhood) anchor institutions to work closely together with their communities to create shared values (Initiative for a Competitive Inner City, 2016). With considering 'grassroot digital urbanism' when applying dTU, possibilities of technologies can be given back into the hands of the citizens themselves (Vadiati, 2022).

Lastly, we did not address specific user groups. As shown in the research of Hess (2012) or Börjesson (2012), user groups such as women or elderly have specific needs when accessing stations. Focusing on these groups and using mobile VR glasses would allow researchers or planners to bring the redesign to the participant's homes, at schools or retirements homes. This could support inclusive planning and needs to be further applied.

5.3. Uncovering experiental factors and methodological limitations

Previous studies using a quantitative approach have shown similar results to our study, e. g., the importance of perceived safety, greenery or urban activity around stations (e.g. Başaran et al. (2025)). Yet, there is little in-depths research on why and how certain features improve or do not improve walking to the station. With our qualitative approach we provided insights into these rather experiental factors. Thus, uncovering that perceived safety is not only related to crime, but to memories or reports of negative incidents, feelings of sadness and that urban activity can be realized by small interventions like mobile cafés or drinking fountains (see section 4). Moreover, while our survey results revealed that activities and retail were among the least important factors for a forecourt, they might actually have an influence on their route decisions: Retail shops can influence pedestrian's route preferences around stations despite their statements that they are not important and their limited interest in shopping (Chan et al., 2025). This is consistent with our findings. Despite the survey results, the interviews showed that shops and cafés are very important and increase social interaction, livability and feelings of safety. As stated by Hillnhütter (2016, p. 34), "pedestrians are likely to experience their environment unconsciously", thus, stimulating environments may not be prominent in survey results, but are nonetheless important for the walking experience and sense of place. These unconscious experiences can best be uncovered by qualitative, in-depths analysis. When planning public transport forecourts, it is crucial to include these often hidden and rather experiential aspects.

Due to the in-depths analysis, the main component of our study were qualitative interviews with 17 participants and seven experts. Theoretical saturation was reached with this sample size and the variety of planning expertise was met with the seven experts, however, no conclusions for a greater sample can be drawn. Therefore, future studies could apply a quantitative approach and use an experimental design, even applying eye-tracking within the VR world, to virtually test the effects of different design features on respondent's reported station usage or time spent at the forecourt. Findings from our study can be the basis for follow-up quantitative studies with a greater sample.

While the gender and age ratio of our sample represents the neighbourhood well (see section 4.2), we have an over proportional amount of people with higher education (university/college, 53 %) compared to overall Berlin citizens (~40 % (SenASGIVA, 2023)). The sample might not represent the broader user base of the station. Moreover, the call for participation highlighting the VR experience might have motivated tech-savvy participants resulting in a self-selection bias. However, during the interviews it became apparent that for some using VR-glasses was a new experience, with four participants reporting headache and dizziness, two getting dry eyes, one desired to sit instead and one stating that she acted clumsy due to this new experience. These feelings of insecurity and physical reactions show that the VR-workshops did not only attract tech-experienced participants. Their aim was either to contribute to the redesign of the station forecourt or to try out VR for the first time. A follow-up surveys with a greater sample or interviews with specific user groups should be held for a detailed analysis.

Finally, it should be noted that the process of interpretation of the qualitative data is influenced by the interpretation skills of the researcher and his or her impressions of the interviews (Lamnek & Krell, 2016). We aimed at meeting this limitation by having two interviewers who held the interviews, analyzed the data iteratively and discussed different interpretations.

6. Conclusion

There are few studies on the microlevel and immediate environment of public transport stations, specifically their forecourts and potential as a neighbourhood anchor. Our study closes this research gap by showing that station forecourts can be more than just a transit access: they can function as both, a place to stay and a place to pass.

Our findings suggest that a high-quality walking environment of a station's forecourt has to ensure short and socially safe access to the station supported by cleanliness, greenery, aesthetic/colorful and comprehensive design. Surveillance can be ensured by liveliness and social places. Forecourts can easily offer places for mobile gastronomy, e.g. food trucks, or leisure activities, which improve liveliness. Due to its centrality, high frequency of passengers and wide area, station forecourts offer opportunities to be a central plaza for the neighbourhood and can expand their role to not only utility, but for social interaction and become a neighbourhood anchor. However, the findings show that experienced lack of social safety and maintenance around stations negatively influences the use of public transport and its forecourt. This is deeply rooted in past experiences or a negative image of the station and has to be addressed when redesigning a station forecourt, otherwise the forecourt remains a place with its only purpose is to pass it. This also involves a common understanding of responsibilities among decision-makers, making sure that the whole journey to the station is planned in an integrated way.

The following recommendations for future research and planning can be drawn from our study: Firstly, future research should give the social safety aspect around public transport stations more attention. Research could test infrastructural or organizational features improving social safety around stations, for example, engaging street workers or creating vibrant places with 'eyes on the street'. To test lightning, weather or surveillance systems dTU can be applied. Currently, research is lacking on transit situations and homelessness (Ding et al., 2021). Secondly, public transport station's potential as a neighborhood anchor should be further explored with a greater sample and in different regional contexts as research on stations as neighbourhood anchors is scarce. Thirdly, participatory dTU could be applied so that participants can change the design while wearing VR glasses and therefore take ownership of the redesign. Finally, future research could focus on certain socio-demographic backgrounds and use dTU in an experimental design to test effects of different designs with non-users or certain needs groups (e.g. people with disabilities, children). This would ensure more inclusive planning for walking as a feeder to public transport.

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CRediT authorship contribution statement

Heike Marquart: Writing – review & editing, Writing – original draft, Visualization, Validation, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Benjamin Heldt:** Writing – original draft, Visualization, Validation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Alvaro Chignola:** Writing – original draft, Visualization, Software, Resources. **Rita Cyganski:** Writing – review & editing, Supervision, Resources, Methodology, Funding acquisition.

Declaration of competing interest

The authors declare that they have no known conflict of interest.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.urbmob.2026.100193.

Annex A

Socio-demographic background of interview participants

Interview no.	Gender	Age	Profession	Highest educational qualification
231201_1211	f	35	Part-time (flexible)	University / College
231201_1246	f	68	Pensioner	University / College
231201_1405	f	56	Part-time (fixed hours)	Abitur
231201_1412	m	43	Part-time (fixed hours)	Abitur
231201_1501	divers	38	Pupil	Abitur
231201_1543	m	58	n.a.	University / College
231201_1634	m	74	Freelancer	University / College
231201_1657	f	32	Part-time (fixed hours)	University / College
231208_1214	m	37	Part-time (flexible)	University / College
231208_1253	m	33	Full-time	University / College
231208_1409	m	46	n.a.	Secondary school
231208_1417	f	26	Full-time	Other
231208_1500	f	46	Part-time (flexible)	Abitur
231208_1542	m	33	Full-time	Secondary school
231208_1624	f	52	Full-time	University / College
231208_1644	f	36	Student	University / College

(*continued on next page*)

(*continued*)

Interview no.	Gender	Age	Profession	Highest educational qualification
231208_1712	f	41	Part-time (flexible)	Secondary school
Summary of the sample:	Female (f): 53 % Male (m): 41 % Divers: 6 %	Mean = 44,4 SD = 13,3		

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