Eliciting Empathy towards Urban Accessibility Issues

Paananen, Ville; Visuri, Aku; Van Berkel, Niels; Hosio, Simo

Published in:
CHItaly '23: Proceedings of the 15th Biannual Conference of the Italian SIGCHI Chapter

DOI (link to publication from Publisher):
10.1145/3605390.3605416

Publication date:
2023

Document Version
Publisher's PDF, also known as Version of record

Eliciting Empathy towards Urban Accessibility Issues

Ville Paananen
ville.paananen@oulu.fi
University of Oulu
Oulu, Finland

Aku Visuri
aku.visuri@oulu.fi
University of Oulu
Oulu, Finland

Niels van Berkel
nielsvanberkel@cs.aau.dk
Aalborg University
Aalborg, Denmark

Simo Hosio
simo.hosio@oulu.fi
University of Oulu
Oulu, Finland

ABSTRACT

Empathy is an integral part of what it means to be human. Empathy refers to the ability to sense other people's emotions, coupled with the ability to imagine what they might be thinking and feeling. Architectural and urban design have identified empathy as a crucial factor in the design process and especially in user-centered participatory methods. Although empathy has been recognized as important for relating to other people's issues, current research has not explored how urban accessibility issues elicit empathy. We conducted a between-subjects online study where 202 participants observed five scenarios on different accessibility issues. Our results show that empathic traits and previous experience are significant factors in empathizing with accessibility issues. Additionally, storytelling and photos can influence perceptions of accessibility issues. The study highlights the importance of empathic traits and personal experience in understanding and addressing accessibility issues, as well as the potential of storytelling and photos in shaping perceptions of accessibility issues and evoking empathy. Our contribution demonstrates the advantages of incorporating narrative multimedia into design processes for improved urban accessibility.

CCS CONCEPTS

• **Human-centered computing** → **Empirical studies in accessibility**; *Ubiquitous and mobile computing*;

KEYWORDS

multimedia, empathy, urban accessibility

ACM Reference Format:
Ville Paananen, Aku Visuri, Niels van Berkel, and Simo Hosio. 2023. Eliciting Empathy towards Urban Accessibility Issues. In *15th Biannual Conference of the Italian SIGCHI Chapter (CHItaly 2023), September 20–22, 2023, Torino, Italy*. ACM, New York, NY, USA, 13 pages. https://doi.org/10.1145/3605390.3605416

CHItaly 2023, September 20–22, 2023, Torino, Italy

ACM ISBN 979-8-4007-0806-0/23/09.
https://doi.org/10.1145/3605390.3605416

1 INTRODUCTION

The ability to empathize with the experiences of others is critical in society. In public environments, we share spaces with others who have their own unique and personal experience of the space. As experiences of spaces are multidimensional in terms of sensory, geometric, cultural, and various other factors [23], it is not apparent how we understand spatial experiences that differ from ours. This is particularly critical when considering the effects of accessibility in public environments. Urban places present different accessibility issues for people with various impairments, or for caregivers and parents who use devices such as wheelchairs or strollers [2, 6, 17].

Empathy is the ability to understand others' experiences. Thus, it is pivotal in understanding the challenges other people face with different accessibility issues. Largely for the same reason, empathy is now seen as a crucial factor in architectural and urban design [4, 32], and better ways to understand people and their experiences are always called for [8]. In these fields, the user-centered methods that aim to understand users is often called *empathic design* [20] and are conceptually similar to the participatory methods in HCI. For instance, the persona and scenario methods traditional in HCI are now adopted in the fields of architecture and urban design [8]. Understanding people is critical in civic participation, i.e. in developing means for authorities to communicate with citizens in various ways (see e.g. [28, 29]). As such, civic participation has been a longstanding topic in HCI research [16]. To this end, exploring how technologies can be used to accurately convey the real-world effects of e.g. urban accessibility issues will help build more efficient participation methods in the future.

In this work, we report an online experiment to examine how empathy can be mediated through photos and stories in the context of urban accessibility issues. Using five scenarios consisting of different configurations of photos and personal stories, we study how the different elements affect individual's ability to empathize with the challenges faced by other people in the scenarios. Our guiding research question is *how does augmenting descriptive information with photos or storytelling affect the level of empathy towards accessibility issues in urban places?* By answering this question, we contribute to a more nuanced understanding of how to address urban accessibility issues and promote empathy towards others. Specifically, our results highlight an important opportunity for the involvement of urban and HCI designers and researchers in the design of more empathetic digital civic participation methods.

Our results show that scenarios with related personal stories helped people to better imagine the potential effects of urban accessibility issues. Further, people's own empathic personality traits and history with accessibility issues helped them empathize with accessibility issues. We discuss how accessibility issues can be empathized with, how urban accessibility is a systemic issue requiring contextual knowledge, and suggest how future research can explore scenario methods to elicit empathy.

2 RELATED WORK

The study of empathy in the context of accessibility in public environments has been a growing area of research in the fields of HCI and urban design, and it has been studied in offline and online contexts through both qualitative and quantitative methods.

Using awareness campaigns as a starting point, Goncalves et al. developed an online platform to study how contextual information affects the awareness of accessibility issues [13]. Their results suggest that contextual cues, such as pictures of inaccessibility reports and the ability to zoom into the location on a map, helped the participants see how accessibility issues affected them directly. We build on this work and assess how contextual cues, such as photos and stories, can affect empathy towards accessibility issues.

Studying urban accessibility issues at scale has been enabled by the availability of crowdsourcing marketplaces and the massive scale of images of public spaces. For example, such online-based research has focused on topics such as trustworthy sensing [24], machine learning to track the evolution of sidewalk accessibility [34], crowdsourced images of accessibility issues [12], wheelchair accessibility mapping platforms [21], and gamifying the urban accessibility labeling process [25]. Focusing on street-level accessibility issues, Hara et al. used Google Street View in a crowdsourcing study to determine how feasible it is to assess a place's accessibility [14]. Their work suggested that untrained crowd workers can assess sidewalk accessibility with a scalable system. Following a similar approach, in Project Sidewalk [31], Saha et al. used a custom online crowdsourcing tool that showed different accessibility issues and enabled crowd workers to label the content appropriately. Their large-scale study showed how new means of data collection could engage citizens in the urban design processes.

In their follow-up work, Saha et al. used a multi-stakeholder analysis to understand how different needs come up in the civic systems regarding urban accessibility [29]. While underfunding was seen as a significant challenge requiring political solutions, HCI-related findings state that technology can be a double-edged sword. Technology can improve policies and increase policymaker engagement, but it can also reduce the relational aspects of policymaking. Further, technology can lead to more inequality as access to technology varies. In other words, the representations provided by technology have a bias and need to be used consciously, along with other means of participation.

In the context of the present paper, we next focus on how accessibility issues are empathized. Empathy, as it is generally understood, refers to the human capacity to feel and understand the experiences of others. While the concept has been found to be challenging to define exhaustively [10], its modern understanding recognizes subcomponents such as affective and cognitive empathy—capabilities to feel and to understand—backed up by findings in neurology [10]. Empathy has been employed in HCI since the 1990s as a way to understand users in more depth [20], and new uses for empathy have been found in HCI through a growing focus on understanding and emphasizing humans' interrelational aspects. For example, approaches to elicit empathy using empathy tools have been researched to understand users in more depth [26]. In these ways, accessibility issues have also been explored qualitatively. For instance, wheelchair mobility has been explored through its need for temporal, socio-technical, and communal alignment [35], and stroller and parent assemblages have been shown to have unique social dynamics along with distinctive rhythms, affordances, and politics [6, 17]. How urban spaces are locomoted is at the center of urban accessibility, and close examination can highlight the frictions different environments cause.

Finally, we can see how representing the experiences of others is becoming a more frequent topic in different fields of research. As recognized by the interpretive methods used in empathic design [20], there is a challenge of applying knowledge about users to applied knowledge in design. For instance, Doktor Olsen Tvedebrink & Jelić studied how personas could be used in architectural design in the face of a building project that required redesigning due to failure to consider the nuanced behavioral and personal user needs [8]. In the current trend toward more participatory design processes, a better understanding of how interpersonal relations affect the understanding of urban accessibility issues is increasingly relevant.

3 STUDY DESIGN

To understand how the inclusion of different contextual information affects empathy toward urban accessibility, we designed an online study with five scenarios. Each scenario described an accessibility issue derived from the literature on urban accessibility issues. Following on distinct categories of accessibility issues as previously identified by Błaszczyk et al. [2], we constructed five scenarios: A) a blind person walking next to traffic, B) a wheelchair user facing curbs, C) a mobility-impaired person on uneven surfaces, D) a vision impaired person in an intersection, and E) a parent with a stroller on a narrow path. Each participant saw all five scenarios, with the order of scenarios counterbalanced using a Latin square design. All scenarios are included in the Appendix for replication purposes.

We manipulated two variables in our study: stories and photos. Stories have been widely used as narrative elements in empathy studies [1, 15, 22]. Similarly, photos have been shown to be helpful in providing additional context for promoting awareness of accessibility issues [13], which we suggest is also relevant for eliciting empathy. We followed a between-subjects 2×2 design, in which we manipulated the presentation of the scenario to include a story (yes/no) and a photo (yes/no). The stories were constructed to highlight different accessibility issues to present plausible scenarios so that they are understandable, with and without the photos. The photos used were obtained from the Urban Footpath Image Dataset project [12], which empowered citizens to highlight different accessibility issues around Galway, Ireland. As such, we got four unique conditions: 'control', 'story only', 'photo only', and 'both story and

photo'. Each condition included the basic description, control had no augmented information, and other conditions were augmented with the mentioned variables.

The scenarios were constructed by starting with the stories based on findings on common accessibility issues [2, 17]. The stories were written in a neutral tone from the first point of view, focusing on describing the impact of the accessibility issue on the individual. After developing and refining the stories, relevant photos were selected from the dataset. The same process was repeated for each of the five scenarios. For an example of a scenario of an accessibility issue and a related story and photo, see Figure 7.

3.1 Measures

The three main questions investigated are Q1–Q3 (see Table 1). I.e., how much does seeing the situation affect the person (Q1), how understandable the issues are (Q2), and how fixing the issue would help the person (Q3). These items were rated on a 7-point scale of agreement (Strongly agree–Strongly disagree) and asked for each of the scenarios. We included two open-ended questions to elucidate what affects participants' ability to empathize with people with accessibility issues (OE1) and how should the general public be made more aware of urban accessibility issues (OE2). Also, we asked how much the participants had previous history with accessibility issues (PH) and along with an open-ended follow-up question for the participants to elaborate on their previous history with accessibility issues (OE3).

Finally, the literature recognizes multiple means to measure empathy [26]. Besides behavioral observations, physiological measures, and neurological methods, self-report questionnaires have become a popular tool for investigating empathy [27, 33]. In our study, we used the 15-item Interpersonal and Social Empathy Index [33]. ISEI was chosen over older and more frequently used scales, such as IRI or QCAE, as ISEI also measures the contextual factors of empathy. Accessibility issues require a contextual understanding of the situation [13], which aligns well with the social components of the ISEI. The four subscales in ISEI—macro-perspective taking (MPT), self-other awareness (SOA), affective response (AR), and cognitive empathy (COG)—help to understand how the different components are significant when a person empathizes with accessibility issues. Further, the ISEI scale is based on the well-established Empathy Assessment Index and is recommended when time is limited [10]. Participants rated each item on a 6-point scale of frequency (Never–Always).

3.2 Participants and Procedure

We conducted a power analysis with the statistical software G*Power [11] to determine an appropriate number of participants. Using repeated measures (five scenarios) and a between-factors (four groups) study design, we specified a medium effect size $f = 0.25$ with a power level of 0.95 and $\alpha = 0.05$. The required sample size was determined to be 172, which we rounded up to 200, resulting in 50 participants in each of the four conditions.

We recruited our participants from the online crowdsourcing platform Prolific. Using the pre-screening filters, we required that the participants lived in an English-speaking country (Australia, Canada, Ireland, UK, or the USA), spoke fluent English, used a desktop computer to access the study, had over 100 completed submissions on the platform, and had an acceptance rate of at least 98%. The participant sample was balanced based on their registered gender. Participants were compensated at a rate of £9,71/h for completing the study.

Following a short introduction to the study structure, participants were first presented with the five scenarios in counterbalanced order and the related questions Q1–Q3 for each scenario. Then, we asked open-ended questions OE1–OE3 and PH as described in Table 1. Finally, participants completed the 15-item ISEI questionnaire.

The study was run on a custom-built website that enabled showing the different conditions and scenarios programmatically. The online study was deployed on Vercel with a custom domain. The study participants were recruited from Prolific, with the custom website set up to present the condition that had the least responses.

3.3 Data Analysis

We analyzed each item of Q1–Q3 using ANOVA using the study condition as the independent variable. We assume that the presence of the photo can affect how the story is read and the other way around. Therefore, they are in interaction. Additionally, we used the participants' previous history and ISEI scores as covariates. We used the Akaike information criterion (AIC) to select the ANOVA model with optimal fit for each test. For all three questions Q1–Q3, we used a two-way ANOVA to test the effects of the conditions, with scenarios, previous history, and ISEI scores as covariates. Then, we wanted to know how person's responses to the items Q1–Q3 correlated with their previous history with accessibility issues and their ISEI scores. To this end, we computed Spearman's rank correlation between the questions Q1–Q3 and the items PH and ISEI scores.

To assess how the participants experienced accessibility issues, we coded the open-ended OE3 based on the severity of the experience (Low/Severe) and who experienced the accessibility issues (Self/Others). Severity was assessed based on its permanence and how much it disabled the person. The participants who had no experience with accessibility issues were marked as 'No experience'. In the following, we use the subnotation OE3a for the severity and OE3b for the target. Using these categories, we obtained a more nuanced understanding of how a person's experience with accessibility issues affected their responses. We used one-way ANOVA tests to see how significant they were toward the questions Q1–Q3.

We wanted to explore further how significant the ISEI subscales were towards the participants' responses in the questions Q1–Q3. We used ordinal logistic regression with the R package *ordinal*[5] for Cumulative Link Mixed Models to examine the relationship between the questions Q1–Q3 and the four ISEI subscales (COG, SOA, MPT, AR).

Finally, the responses to the open-ended questions OE1 and OE2 were analyzed using coding-based content analysis [19]. The first and the third author familiarized themselves with the full set of responses and subsequently coded 10% of the responses separately. After reviewing and comparing the initial codes, the data was coded in full by the first author. Finally, the codes were grouped to report

ID	Description	Response scale
Q1	I can imagine what the person affected by this issue is feeling.	7-point scale on agreement
Q2	I can imagine what is required to overcome this accessibility issue.	7-point scale on agreement
Q3	Overcoming this accessibility issue would improve my personal experience of the environment.	7-point scale on agreement
OE1	You saw five scenarios on accessibility issues. In general, what affects your ability to empathize with those with accessibility issues?	Open-ended text
OE2	In your opinion, how should the general public be made more aware of urban accessibility issues? Why?	Open-ended text
PH	How much personal experience of accessibility issues do you have? (Whether yourself or through people around you)	7-point scale on amount
OE3	Please elaborate: (in reference to item PH)	Open-ended text
ISEI	15-item Interpersonal and Social Empathy Index questionnaire [33]	6-point scales on frequency

Table 1: Items in the questionnaire in the order shown to the participants. Items Q1-Q3 were asked for each of the five scenarios.

the relevant results. The resulting analysis includes participants' quotes to exemplify different opinions towards urban accessibility.

4 RESULTS

In total, 207 participants completed our study. From these, we removed one duplicate, three missing responses, and one low-quality response, resulting in a sample of $N = 202$. The mean completion time was $8min38sec$ ($SD = 5min8sec$). The participants had a mean age of $M = 38.9$ ($SD = 13.7$). The participants' mean previous history was $M = 3.23$ ($SD = 1.95$), and by conditions, as follows: control ($M = 3.43 \pm SD = 2.13$); photo ($M = 3.18 \pm SD = 1.91$); story ($M = 2.76 \pm SD = 1.63$); and both ($M = 3.53 \pm SD = 2.02$). The participants' mean ISEI score was $M = 68.95 \pm SD = 9.59$, and by conditions, as follows: control ($M = 68.6 \pm SD = 10.3$); photo ($M = 71.3 \pm SD = 8.48$); story ($M = 67.8 \pm SD = 10.2$); and both ($M = 68.1 \pm SD = 8.85$). A one-way ANOVA test found no significant differences among the four conditions in terms of the participants' previous history with accessibility issues ($F(3) = 1.56, p = 0.20$) or ISEI scores ($F(3) = 1.35, p = 0.26$), thus any findings would not be biased based imbalance of these factors.

4.1 What affects participants' ability to empathize?

As a general trend in Q1, participants who saw more information tended to be better at imagining the experience of others, as shown in Figure 1.

To understand how the different manipulations affected participants' responses, we used a two-way ANOVA, controlling for the scenario, participants' previous history, and the participants' ISEI score. The participants' abilities to imagine how accessibility issues are felt were higher in the conditions with the story (Story and Both) ($M = 5.55 \pm SD = 1.53$) compared to without them (Control and Photo) ($M = 5.76 \pm SD = 1.23$) as revealed by a two-way ANOVA ($F(1) = 7.153, p = 0.008$). On the contrary, the conditions with the photo (Photo and Both) ($M = 5.67 \pm SD = 1.33$) had no statistical differences between conditions without the photo (Control and Story) ($M = 5.65 \pm SD = 1.45$). As such, the presence of a story significantly improved the person's ability to empathize with others' experiences, and the photos had no effect. Additionally, the two-way ANOVA found the story and photo had a significant interaction ($F(1) = 9.25, p = 0.002$), revealing that the stories and photos affect how each other's meaning is communicated.

We subsequently sought to understand how a person's background correlated with their responses. Spearman rank correlation showed that Q1 had a moderate positive correlation with the ISEI score ($r = 0.28, p < 0.001$) and a moderate positive correlation with the previous history ($r = 0.22, p < 0.001$). These variables are visualized in Figure 2. For instance, with regard to previous history, the figure shows that if a person has a lot of personal experience with accessibility issues (previous history = 7), they are likely to be able to imagine how others experience accessibility issues. Similarly, the bottom row (Q1 = 1) shows that the participants who could not imagine how the accessibility issues had most probably had a little personal history with them. Additionally, the ISEI scores in the right graph show that the participants with the highest empathic traits had the highest responses in imagining how the accessibility issues are felt, and vice versa.

Analyzing the categories for severity (OE3a), the responses in the category 'No experience' ($M = 5.50 \pm SD = 1.42$) were lower than the responses in 'Low' ($M = 5.62 \pm SD = 1.39$) and 'Severe' ($M = 6.04 \pm SD = 1.23$), as revealed by a one-way ANOVA test ($F(2) = 12.26, p < 0.001$). Additionally, in terms of the target of accessibility issues (OE3b), the responses to imagining how accessibility issues are felt were lower in the category 'No experience' ($M = 5.50 \pm SD = 1.42$) than the responses in 'Other' ($M = 5.73 \pm SD = 1.39$) and 'Self' ($M = 5.95 \pm SD = 1.22$), as revealed by a one-way ANOVA test ($F(2) = 7.62, p < 0.001$). These are shown in Figure 3. A Wilcoxon pairwise comparison with Bonferroni correction showed that there were significant differences between the 'No experience'–'Severe' ($p < 0.001$) and 'Low'–'Severe' ($p < 0.001$) categories (OE3a). Additionally, 'No experience' was statistically significant from the categories 'Others' ($p = 0.005$) and 'Self' ($p < 0.001$) (OE3b).

The ordinal logistic regression showed which of the four ISEI subscales was most significant in the participants' ability to imagine how the accessibility issues are felt (Q1). The summary of the results of the model is shown in Table 2. We found significant differences in the macro perspective-taking (MPT) ($z = 4.522, p < 0.001$) and the affective response (AR) ($z = 2.009, p < 0.045$) subscales in how the participants' ability to imagine the effects of the accessibility issues.

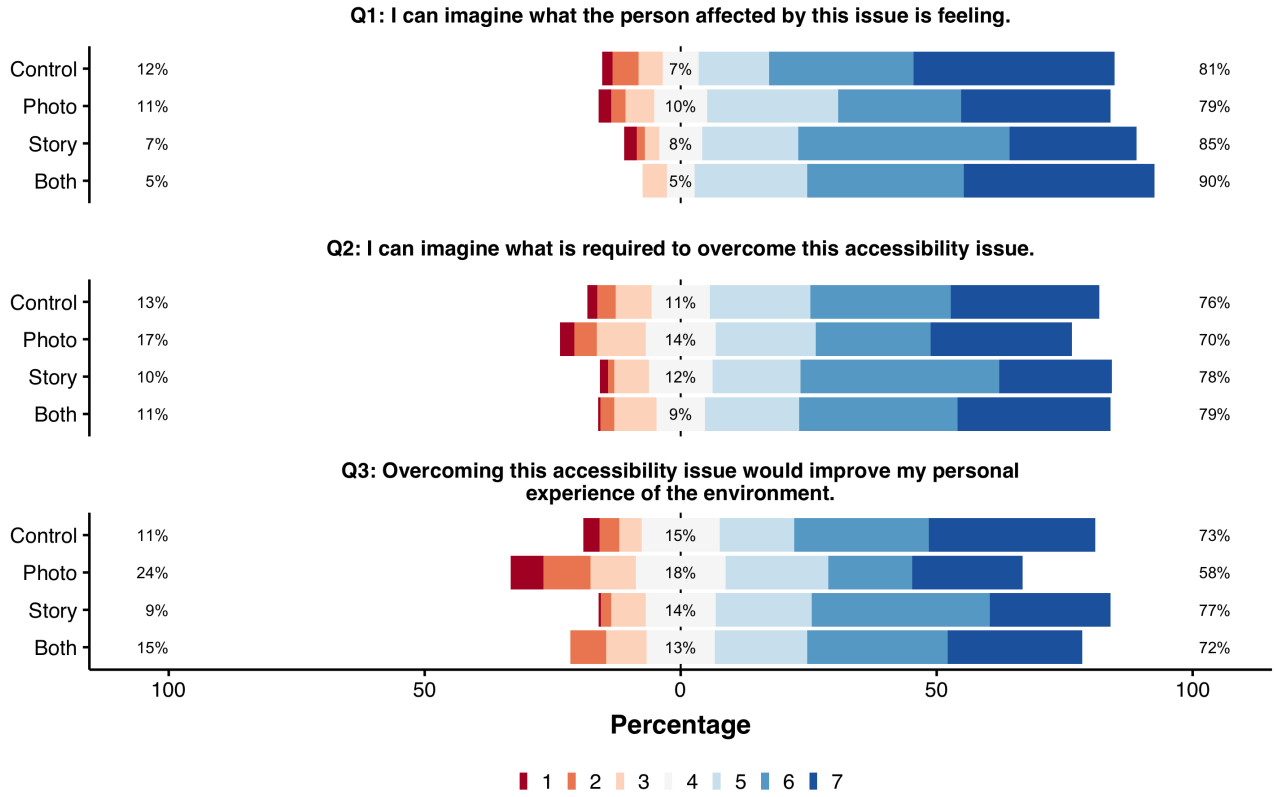


Figure 1: Participants' responses to the three main measures: the ability to imagine how the people in the scenarios feel about accessibility issues (Q1), the ability to imagine what is required to overcome the accessibility issues (Q2), and how overcoming the accessibility issues would improve the participants' experience of urban environments (Q3), based on the four study conditions. The participants responded to these statements on a 7-point scale *Strongly Disagree – Strongly Agree*.

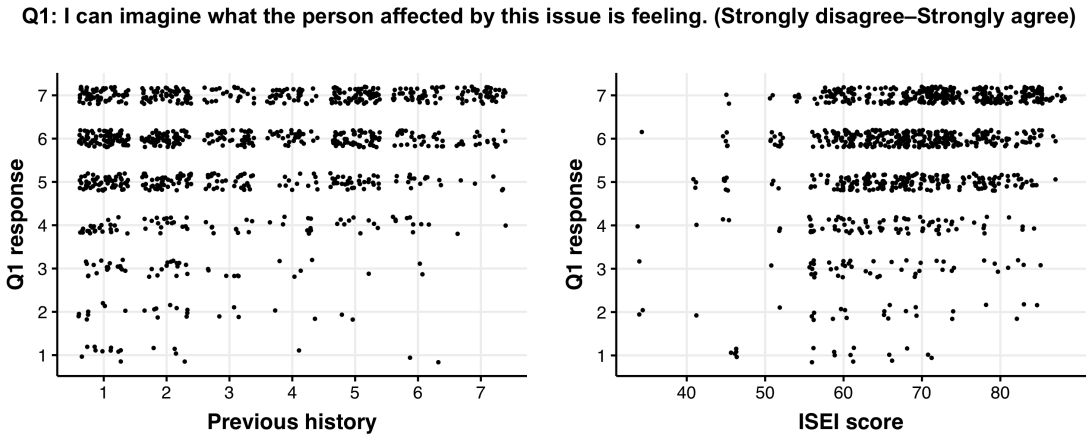


Figure 2: The distribution of participants' previous history with accessibility issues (on the left) and ISEI scores (on the right) per Q1 responses (Y axis, 1 = Strongly disagree, 7 = Strongly agree) across all scenarios, i.e., how well could the participants imagine how the accessibility issues are felt. The distributions show that having more personal history and empathic traits improves picturing the effects of accessibility issues.

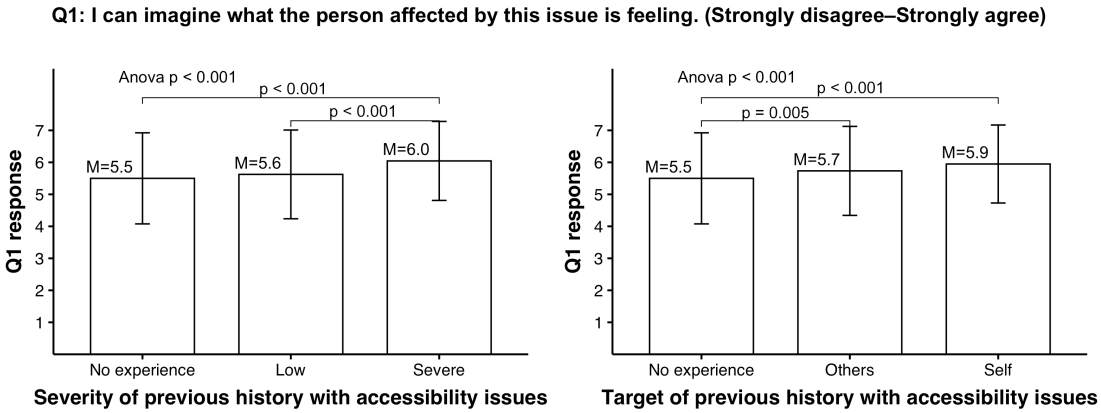


Figure 3: Participants' previous history with accessibility issues as categorized on their severity and target of those issues. One-way ANOVA tests showed that both the severity and target of accessibility issues were statistically significant toward the participants' ability to imagine how accessibility issues are felt (Q1). The Wilcoxon pairwise comparisons with Bonferroni corrections with significant differences are also denoted in the plots.

Table 2: Relationship between the participants' different components of empathy as determined by the ISEI subscales and their responses to the questions Q1–Q3 using as described by an ordinal logistic regression model. The $p < 0.05$ significant values are bolded.

	Q1		Q2		Q3	
ISEI subscale	z	p	z	p	z	p
COG	$z = 0.435$	$p = 0.663$	$\mathbf{z = 2.671}$	$\mathbf{p = 0.008}$	$z = 0.579$	$p = 0.563$
SOA	$z = 0.511$	$p = 0.609$	$z = 1.015$	$p = 0.310$	$z = 0.918$	$p = 0.359$
MPT	$\mathbf{z = 4.522}$	$\mathbf{p < 0.001}$	$z = 1.459$	$p = 0.144$	$z = 1.796$	$p = 0.073$
AR	$\mathbf{z = 2.009}$	$\mathbf{p = 0.045}$	$z = 1.023$	$p = 0.306$	$z = -2.13$	$p = 0.832$

4.2 What affects the ability to imagine what is required to overcome an accessibility issue?

The responses for Q2 resulted in approximately equal values across conditions, as shown in Figure 1. However, the 'Photo only' condition shows lower values. Similarly to Q1, we used a two-way ANOVA to see how their ability to imagine overcoming accessibility issues was correlated with the conditions, controlling for the scenario, participants' previous history, and the participants' ISEI score. The participants' abilities to understand how the issues could be overcome were higher in conditions with the story (Story and Both) ($M = 5.51 \pm SD = 1.37$) than in the conditions without them (Control and Photo) ($M = 5.31 \pm SD = 1.58$), as shown by a two-way ANOVA ($F(1) = 5.10$, $p = 0.024$). Again, the conditions with the photo (Photo and Both) ($M = 5.38 \pm SD = 1.52$) had no statistical differences from conditions without the photo (Control and Story) ($M = 5.44 \pm SD = 1.43$) based on a two-way ANOVA ($F(1) = 0.52$, $p = 0.4717$).

Spearman rank correlation showed that the participant's ability to understand how the situations could be overcome had a low positive correlation with the person's history ($r = 0.16$, $p < 0.001$) and a moderate positive correlation with the ISEI score ($r = 0.24$, $p < 0.001$). Additionally, Figure 4 shows the distribution of the participants' previous history responses and ISEI scores against the Q2 responses. In contrast to the Q1 results, here we can see that even with the previous history of accessibility issues, it is not as obvious to the participants how these issues could be overcome.

Again, contrary to Q1, the participants' severity (OE3a) ($F(2) = 2.64$, $p = 0.072$) or target (OE3b) ($F(2) = 2.66$, $p = 0.070$) of their previous history of accessibility issues was not significant to the participants' abilities to understand how the issues could be overcome, as shown by a one-way ANOVA.

The ordinal regression model showed that only the cognitive empathy subscale (COG) was statistically significant towards the participants' ability to imagine overcoming the accessibility issues ($z = 2.671$, $p = 0.008$), as described in Table 2.

4.3 How solving the accessibility issues would improve the participants' own experience of urban environments?

The Likert responses for Q3 were more divided compared to the previous questions, as shown in Figure 1. Like in Q2, the 'Photo only' condition generally shows lower values.

The participants reported significantly higher values in conditions with the stories (Story and Both) ($M = 5.38 \pm SD = 1.43$) than in the conditions without stories (Control and Photo) ($M = 5.08 \pm SD = 1.75$) based on a two-way ANOVA ($F(1) = 10.40$, $p = 0.001$).

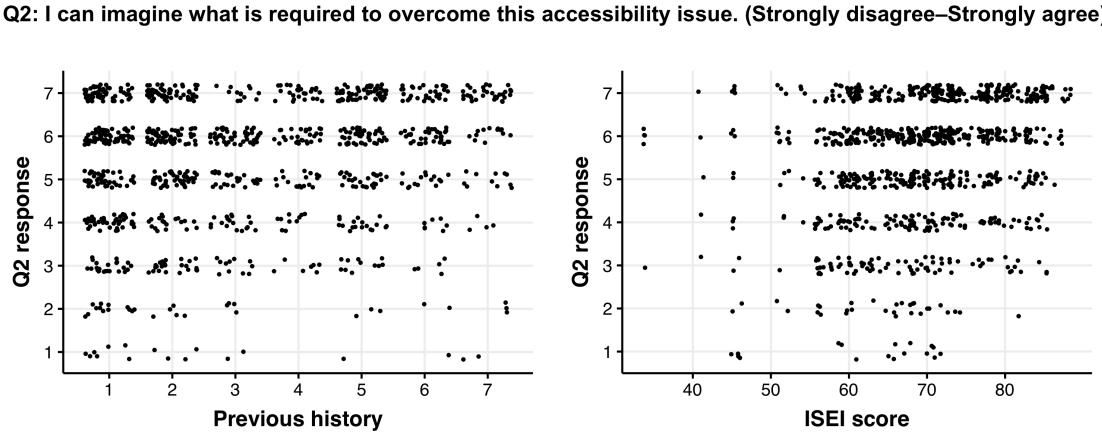


Figure 4: The distribution of participants' previous history with accessibility issues (on the left) and ISEI scores (on the right) per Q2 responses (Y axis), i.e., how well could the participants imagine what is required to overcome the presented accessibility issue.

Additionally, – and surprisingly – the conditions with the photo (Photo and Both) ($M = 5.01 \pm SD = 1.71$) had a lower rating than the conditions without them (Control and Story) ($M = 5.45 \pm SD = 1.47$), as revealed by a two-way ANOVA ($F(1) = 20.85$, $p < 0.001$). Additionally, the two-way ANOVA test showed that the story and the photo are in significant interaction ($F(1) = 5.35$, $p = 0.021$), i.e., the story and the photos together affected how much overcoming the accessibility issues would improve the participants' experiences of urban environments.

The Spearman rank correlation showed that the effect of overcoming the accessibility issues toward a person's own experience of urban environments had a low positive correlation with the ISEI score ($r = 0.12$, $p < 0.001$) and a low positive correlation with a previous history of accessibility issues ($r = 0.18$, $p < 0.001$). The distributions of previous history and ISEI scores against Q3 responses are visualized in Figure 5. The graphs show no obvious tendencies in the participants' responses.

The responses in the severity (OE3a) category 'No experience' ($M = 5.19 \pm SD = 1.54$) were higher than the responses in 'Low' ($M = 5.05 \pm SD = 1.76$) but lower than in 'Severe' ($M = 5.56 \pm SD = 1.49$), as revealed by a one-way ANOVA test ($F(2) = 7.07$, $p < 0.001$), and shown in Figure 6. A Wilcoxon pairwise comparison with Bonferroni correction shows that the 'Severe'-category was significantly different from the 'No experience' ($p < 0.001$) and 'Low' ($p < 0.001$) categories. The target (OE3b) of accessibility issues was not significant by a one-way ANOVA test.

The ordinal regression model did not find any of the ISEI subscales significant for Q3, as indicated in Table 2.

4.4 Qualitative Findings

The open-ended responses were overall diverse, and with the qualitative coding, we focused on the main topics relevant to this paper: what affects how accessibility issues are empathized and where this empathy can be used?

4.4.1 OE1: In general, what affects your ability to empathize with those with accessibility issues? Through the analysis, we categorized the developed codes to describe how accessibility issues are empathized and how they are understood in general.

First, the majority of participants pointed out that having personal experience would help them understand accessibility issues, as also found in the quantitative analysis — whether they had a previous history or not. For instance: "*A lack of personal experience. While I can empathise with them I cannot believe I can truly imagine what it is like to be blind for example. The closer the scenario to my own life the easier it is to fully empathise.*" (Male, 40).

Without first-hand experience, the participants saw imagination as a powerful way to conceptualize how others face public environments, e.g.: "*Being able to play the scenarios in my head*" (Male, 65). Additionally, the relation to a person's own body and capabilities was one medium through which one can begin to understand others: "*I empathized with all the scenarios, but obviously, those that affect my personal mobility would affect my response more acutely.*" (Female, 55). This sentiment was also echoed in terms of sensory capabilities: "*I can empathize with most issues, but I can only relate to the ones that I might experience in a light touch way. For example, I can relate to an uneven surface, because that also impacts me, however, the examples with the blind people isn't something that's possible to fully understand.*" (Male, 32). In this sense, participants believed that their imagination was a useful tool when empathizing—especially when they could build on their prior experiences.

However, imagination has its limitations as well. In imagining the experiences of others, there's a risk of over-assuming what they face: as shown by statements like "*I do not have any of these disabilities, and it is disrespectful for me to say I can imagine because I can't*" (Female, 43), and: "*I have a good imagination and can easily imagine what it is like to be in other people's situations. However, there are deep subtleties involved. Does the fact that they are used to being in their situation make them more or less tolerant than I would be if I was only in their situation for a moment, for example.*" (Male, 39).

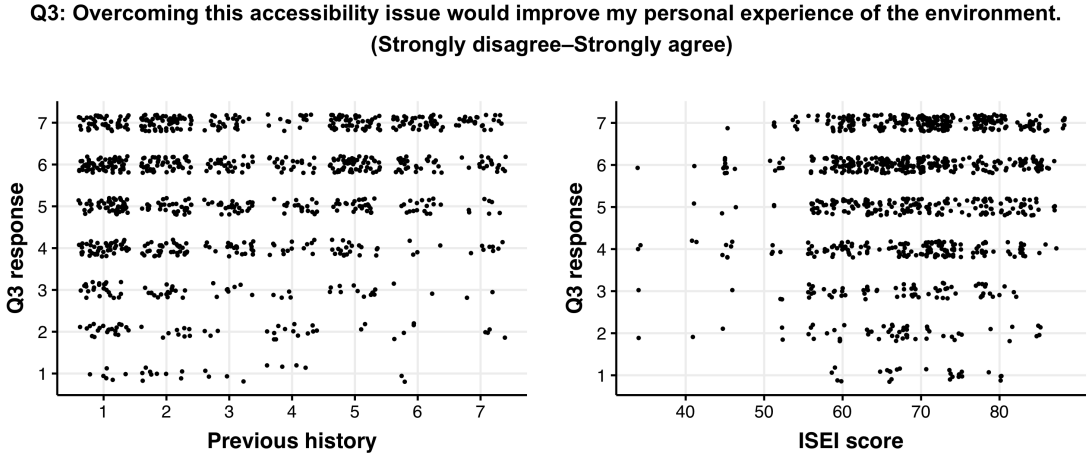


Figure 5: The distribution of the previous history responses (on the left) and ISEI scores (on the right) per Q3 responses (Y axis) across all scenarios, i.e. how much would overcoming the accessibility issue improve the participants' experience of environments.

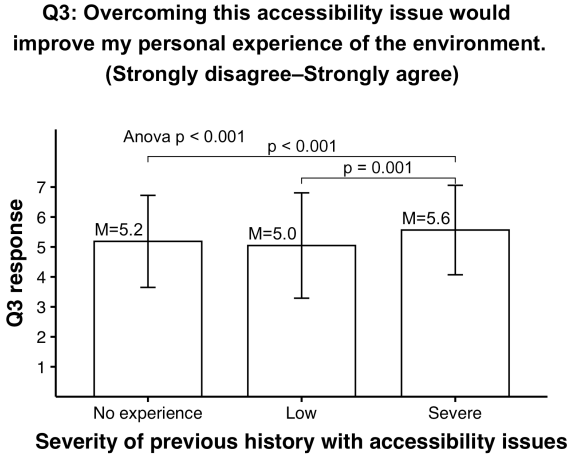


Figure 6: The participants' severity of previous history with accessibility issues affected their opinion on how solving the issues would improve their experiences (Q3). A one-way ANOVA test found that the severity of accessibility issues was statistically significant. The horizontal brackets represent Wilcoxon pairwise comparisons with Bonferroni correction that showed significant differences between 'No experience'–'Severe' and 'Low'–'Severe' categories.

Related to this, some participants raised the role of context in understanding accessibility issues. Descriptions of accessibility issues may only turn out surface-level deep: "*You can empathise well with all of them, but the extent you understand ALL their feelings would vary. I can understand the issues they face, but I'm not sure I could fully understand all their thoughts and the depth of their feelings faced with a lifetime or extended period of having to deal with this.*" (Female, 57). Even further, imagination can be seen akin to pretending: "*I have a strong ability to empathise with people with accessibility issues. I just cannot pretend to know what it feels like.*" (Female, 21).

The scenarios presented in our study revealed the complexity of accessibility issues, eliciting a range of sentiments from our participants towards disabilities and accessibility. Issues such as permanence: "*How permanent their issue, how vital the senses that have been lost are (sight and hearing trump a push chair for example).*" (Male, 41), restrictiveness: "*The opportunity for alternatives or not; if there is no alternative my empathy is higher*" (Male, 40), and source of disability: "*Whether it's a serious disability or personal choice (like having a child - it's a choice)*" (Female, 34), all affected empathy.

Finally, using extreme views as examples, accessibility issues were divisive, as they can be perceived as a source of better-designed environments for all: "*Nothing, I do honestly think that the issues raised are not just to help the people affected, but improve the surroundings for everyone else too*" (Male, 45), and a zero-sum game: "*Should we construct a world for all those with disability issues at the expense of everything else?*" (Male, 68).

4.4.2 OE2: In your opinion, how should the general public be made more aware of urban accessibility issues? Why? The second question yielded more varied responses. Most often, the participants found value in promoting accessibility issues through advertising campaigns, through both online and offline formats.

Besides explicit awareness campaigns, accessibility issues could be mediated in other ways. A few participants also brought up how the improvements themselves can help to bring awareness to inaccessibility issues: "*I think the general public should be made more aware of the issues by witnessing improvements being made to accessibility. This would highlight the issue and make people aware that there were issues originally.*" (Female, 45). On the flip side: awareness can also help to solve issues: "*if the general public were made aware then they may be more accommodating when there is disruption to make the needed changes*" (Female, 43).

Many participants also found other relevant stakeholders in the issue of urban accessibility. Instead of the general public, politicians and designers were the more critical stakeholder group for many participants. Through the local councils and the government levels, the public environments are negotiated with the available funding. For instance: "*To me, this is a government issue - the public shouldn't necessarily be aware; the government needs to make sure that it isn't a problem to begin with.*" (Male, 32). Some also suggested that those affected by accessibility issues should be the ones taking action with statements like: "*It is the responsibility of local government and those people with disabilities themselves to address these issues rather than the general public.*" (Male, 42), and: "*They shouldn't be made more aware. They are already loaded up with tedious messaging: 'see it, say it, sorted.' Is the latest Orwellian waste of time. We are treated as if we were all children. I'm not saying that accessibility issues are not important. But it should be the preserve of urban planners in dialogue with people who require enhanced accessibility. The general public can take an interest if they wish.*" (Male, 39). Advocacy communities were another channel through which accessibility issues could be made prominent: "*Maybe a local group of people with accessibility issues who help to raise the awareness*" (Female, 49). These different stakeholders and their power dynamics have been well-recognized in recent literature as well [29].

Then, different training and workshop activities were seen as viable options to promote empathy and awareness. One participant noted: "*I think people should be put in that position themselves to see how challenging it is. If you are fortunate enough not to face these issues or see a loved one face it, you have no idea. For example, making somebody spend the day with their eyes covered to see what it really is like being blind*" (Female, 21). These kinds of interventions with empathy tools have been gaining popularity in HCI for providing alternative sensory experiences, narratives, and perspectives on various issues [1, 15, 22, 26].

Finally, participants expressed general statements on accessibility issues as a challenge to overcome. For instance, accessibility issues are systemic by nature: "*All avenues help, from local forums to national advertising. Where these are created by other people, such as parking cars on paths, etc, enforcement is also important.*" (Male, 40). Other participants viewed people's interest in accessibility issues with pessimism, while others saw it as a matter of responsibility to be more considerate and empathetic. All in all, the participants saw value in bringing more information towards accessibility issues but were varied in their approaches.

4.5 Summary of Results

The participants' ability to imagine the impact of accessibility issues in Q1 was significantly improved by their previous history with accessibility issues and empathic traits as measured by the ISEI score. Specifically, the affective response (AR) and macro perspective-taking (MPT) subscales were significant, which suggests that emotional and embodied sensitivity and being able to understand the lives of people different from you improves a person's ability to empathize accessibility issues. Having a history of severe accessibility issues leads to more empathy than having no experience or low-severity accessibility issues (OE3a). Also, experiencing accessibility issues yourself or through others improved the person's ability to imagine those issues compared to having no experiences (OE3b). Finally, the stories improved the participants' ability to imagine the accessibility issues, with or without a related photo.

In Q2, the participants responded to how well they could imagine overcoming the accessibility issues. Like in Q1, both the previous history and participants' empathic traits measured by ISEI scores helped the participants imagine overcoming the issues. Additionally, the stories significantly improved the participants' ability to imagine overcoming the accessibility issues. Neither the severity (OE3a) nor the target (OE3b) of accessibility issues was significant. Finally, having a cognitive understanding of the situation (COG) supported solving those accessibility issues.

The final question, Q3, focused on how much solving the accessibility issues would improve the experience of urban environments for the participants themselves. We found that the story, photo, and their interaction were all significant in this regard. However, we found that photos had a negative effect, whereas adding a story had a positive effect. The empathic traits, as measured by the ISEI scores and the previous history, had a low positive correlation. Finally, the severity (OE3a) of the previous history with accessibility issues was significant, where the 'Severe' category was significant against the categories 'No experience' and 'Low'. None of the ISEI subscales was found significant.

Qualitatively, the participants saw substantial value in having personal experience with accessibility issues. In lieu of personal history, being able to imagine accessibility issues was important, although there is a limit to how much one can assume of another's experiences. Accessibility issues were, on the one hand, related to everyone's experience of urban environments. On the other hand, they were perceived as a necessary point of responsibility and consideration for urban planners and policymakers.

5 DISCUSSION

Urban accessibility has implications for both individuals and society as a whole. If some groups, such as the elderly, the visually impaired or families with infants, are not able to fully access and utilize urban spaces, it limits their capability to participate in society as its equal members. Further, accessibility issues cause reduced mobility and isolation, leading to higher healthcare costs in the long term. Valuing accessibility requires providing equal possibilities for participation for everyone [18]. Public research on these issues is important in the context of communicating these issues to the general public, therefore making them more visible and highlighting the importance of urban accessibility. And to do this successfully, a little bit of empathy can go a long way.

5.1 Empathizing Accessibility Issues

Our findings stress the importance of a person's background towards their ability to empathize with accessibility issues. Previous research has recognized the difficulty of empathizing with the experiences of people who we do not share something in common with. This ingroup–outgroup dynamic challenges building bridges in interpersonal relations [10]. In our case, the personal experience of accessibility issues seemed to be one barrier in this dynamic. Segal et al. recognize that providing information on the experiences of marginalized groups might not resonate emotionally, and:

"*Personal experience can be powerful, but difficult to arrange across different groups.*" [10]. We can see this reflected in our findings, as our participants had faced accessibility issues themselves and through others, both of which were significant. In other words, having no experience contributes to the empathy gap. The ISEI scores were significant as well: the participants with macro-perspective taking (MPT) and affective response (AR) traits were significantly better at imagining how people who face accessibility issues feel. This suggests that the scenarios produced emotional responses in the participants and, further, could help understand the social and structural contexts in which the accessibility issues are faced.

Through Q2, we learned that the participants were able to imagine how the accessibility issues could be overcome through stories, but not photos. This is a surprising finding, as we expected that the concrete nature of the photos would support imagining solutions. We hypothesize that this difference comes from understanding the needs of the individual through personal narratives, which are at the center of user-centric design. Through understanding the needs, more general solutions are easier to imagine, whereas, with photos, you need expertise on the specifics of urban design. Here, the ISEI subscale item on cognitive empathy was significant, showing how well the participants are able to understand the concrete impact of accessibility issues.

In the study by Goncalves et al., after seeing accessibility reports, the participants were more perceptive of different accessibility issues and found themselves facing more accessibility issues [13]. Our findings in Q3 show that images made it more difficult to understand how solving the issues would benefit the participants. Conversely, the stories helped to clarify the benefits of solving accessibility issues. We argue that the difference to the study by Goncalves comes from the study methods: Goncalves et al. used an in-situ mobile application, which means that the participants are from the same city and operate under approximately similar cultural climates. This warrants further research, however. In our cross-cultural study, the images show the specific designs of urban environments, which might not be applicable to all of the participants. Conversely, the stories are more general by nature, focusing on the effect on the persons themselves, which is more natural to understand through the shared embodied nature of humans.

5.2 Urban Accessibility as a Collective Responsibility

While accessibility issues are ultimately faced by individuals, in the social model of disability, they are a result of a complex system that has produced them. Finding a root cause is challenging as they are often embedded within the structures of governance, public decision-making, and urban design practices. Our participants acknowledged the role of politicians and policymakers at both the government and local levels in addressing accessibility issues. In the context of US cities, Saha et al. found underfunding and related decision-making as a major challenge [29]. Subsequently, Saha et al. developed a *Civic Interaction Space* diagram, which illustrates the interactions among policymakers, department officials, advocates, and the community [29]. We concur that providing methods and practices that support these interactions helps to bring urban accessibility issues into a more prominent focus. For instance, in understanding how urban spaces are used, the participatory design methods that empower users to voice their needs are especially relevant.

Our current study aligns with the need to support advocacy efforts for accessibility issues. Advocating for accessibility can be improved through the use of digital tools and methods as recognized by the rising trend of digital civics [7]. However, information channels and methods have become an issue of paramount importance in this context. For instance, Saha et al. recognize how the one-sided interaction paradigms, such as service requests for inaccessible sidewalks, do not always provide transparent feedback to citizens [29]. Our participants were divided on this issue, with some viewing accessibility issues as the responsibility of the policymakers and designers, while others emphasized how concrete solutions can highlight how accessibility issues are handled.

While the use of scenarios in our study provided valuable insights, it is important to note that scenarios can have the potential to oversimplify complex issues and imply a sense of 'solutionism' [3]. Our findings indicate that the photos help to focus on the particular, which can, in turn, imply straightforward solutions to accessibility issues. In contrast, the stories did not present clear-cut solutions but might have made the participants feel the issues were more manageable. In this sense, the systemic issue of urban accessibility could be managed through carefully considered narrative methods for persuasion, which "*requires tailored data stories for the target audience that consider their background while appropriately framing and contextualizing the data.*" [30]. Representing and contextualizing appropriately is an ever-present challenge in HCI as scalable computing systems meet the local and layered complexity of the real world [9].

Designing for accessibility is not a zero-sum game. Rather, it should be viewed as an opportunity to enhance the experience of place for all. By employing user-centered design practices, such as personas and scenarios [8], we can represent the needs and perspectives of diverse users in a meaningful way. Furthermore, technology can play a crucial role in communicating the benefits of accessibility, highlighting how it supports and improves the experiences of everyone in the community. Rather than viewing accessibility as a burden, future methods could highlight accessibility as an opportunity for an inclusive design that benefits all.

5.3 Limitations and Future Work

We recognize the following limitations in our work. First, the scenarios portrayed a limited selection of accessibility issues, and the photos were from context which might not apply to participants' own experiences. Second, we used a limited set of accessibility issues, and using a wider selection could clarify how different accessibility issues are understood qualitatively differently. Finally, the coded categories for severity and target of the participants' history of accessibility issues are relative to our sample and may have inaccuracies from the coding process. As such, further research could explore the quality of the previous history with accessibility issues in more detail.

We point out three different ways the present topic could be further explored. First, beyond empathic traits and a history of accessibility issues, what other personal or demographic factors

could affect how empathy is elicited? How do personality traits or interpersonal similarities play into empathy? Second, how do the form and method of the scenarios affect the results? Exploring different formats, such as videos, virtual reality explorations, real-life conversations, or expert statements, could further show how methods are part of understanding users. Additionally, exploring how people generate stories based on images could clarify how images and stories play in understanding accessibility issues. Third, we see potential in testing the findings in a real-world design context, for instance, in the persona-focused scenarios [8] in the interrelations of multiple stakeholders [29]. What tools could be developed to improve communication between the relevant stakeholders? How would designers use those tools? And further, how would you empathize with accessibility issues beyond the people who face them: how would one empathize with urban designers, policymakers, and advocacy groups who struggle with the systemic issue that is urban accessibility.

6 CONCLUSIONS

We examined how empathy can be mediated through different types of information in the context of urban accessibility. Using five scenarios focused on these issues, we investigated how photos and personal stories impact an individual's ability to empathize with the experiences of others facing accessibility challenges. Our findings suggest that personal stories can be effective in promoting empathy and understanding of urban accessibility issues by focusing on the experiences of the individual. Further, we found that a person's background in terms of their empathic traits and history with accessibility are impactful factors in developing empathy. The results of this study have implications for the design of interactive systems related to urban accessibility, particularly in the realm of participatory and empathic design. By understanding how different types of information can impact an individual's ability to empathize with the experiences of others facing accessibility challenges, designers, policymakers, and advocates can employ different means to work towards more inclusive and empathic public spaces.

ACKNOWLEDGMENTS

This research is connected to the GenZ strategic profiling project at the University of Oulu, supported by the Academy of Finland (project number 318930), Biocenter Oulu, the Strategic Research Council (SRC), established within the Academy of Finland (Grants 335625, 335729), and Academy Research Fellow funding by Academy of Finland (Grants 349637 and 353790). This work is also supported by the Carlsberg Foundation project "Algorithmic Explainability for Everyday Citizens".

REFERENCES

[1] Miguel Barreda-Ángeles, Sara Aleix-Guillaume, and Alexandre Pereda-Baños. 2020. An "Empathy Machine" or a "Just-for-the-Fun-of-It" Machine? Effects of Immersion in Nonfiction 360-Video Stories on Empathy and Enjoyment. *Cyberpsychology, Behavior, and Social Networking* 23, 10 (Oct. 2020), 683–688. https://doi.org/10.1089/cyber.2019.0665

[2] Magdalena Błaszczyk, Marzena Suchocka, Magdalena Wojnowska-Heciak, and Magdalena Muszyńska. 2020. Quality of Urban Parks in the Perception of City Residents with Mobility Difficulties. *PeerJ* 8 (Dec. 2020), e10570. https://doi.org/10.7717/peerj.10570

[3] Mark Blythe, Kristina Andersen, Rachel Clarke, and Peter Wright. 2016. Anti-Solutionist Strategies: Seriously Silly Design Fiction. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. ACM, San Jose California USA, 4968–4978. https://doi.org/10.1145/2858036.2858482

[4] Elisabetta Canepa, Valter Scelsi, Anna Fassio, Laura Avanzino, Giovanna Lagravinese, and Carlo Chiorri. 2019. Atmospheres: Feeling Architecture by Emotions – Preliminary Neuroscientific Insights on Atmospheric Perception in Architecture. *Ambiances* 5 (Dec. 2019). https://doi.org/10.4000/ambiances.2907

[5] R. H. B. Christensen. 2022. ordinal—Regression Models for Ordinal Data. R package version 2022.11-16. https://CRAN.R-project.org/package=ordinal.

[6] Susannah Clement and Gordon Waitt. 2018. Pram Mobilities: Affordances and Atmospheres That Assemble Childhood and Motherhood on-the-Move. *Children's Geographies* 16, 3 (May 2018), 252–265. https://doi.org/10.1080/14733285.2018.1432849

[7] Eric Corbett and Christopher A. Le Dantec. 2018. Exploring Trust in Digital Civics. In *Proceedings of the 2018 Designing Interactive Systems Conference*. ACM, Hong Kong China, 9–20. https://doi.org/10.1145/3196709.3196715

[8] Tenna Doktor Olsen Tvedebrink and Andrea Jelić. 2018. Getting under the(Ir) Skin: Applying Personas and Scenarios with Body-Environment Research for Improved Understanding of Users' Perspective in Architectural Design. *Persona Studies* 4, 2 (2018), 5–24. https://doi.org/10.21153/psj2018vol4no2art746

[9] Paul Dourish. 2004. What We Talk about When We Talk about Context. *Personal and Ubiquitous Computing* 8, 1 (Feb. 2004), 19–30. https://doi.org/10.1007/s00779-003-0253-8

[10] Elizabeth A. Segal, Karen E. Gerdes, Cynthia A. Lietz, M. Alex Wagaman, and Jennifer M. Geiger. 2017. *Assessing Empathy*. Columbia University Press, New York.

[11] Franz Faul, Edgar Erdfelder, Axel Buchner, and Albert-Georg Lang. 2009. Statistical Power Analyses Using G*Power 3.1: Tests for Correlation and Regression Analyses. *Behavior Research Methods* 41, 4 (Nov. 2009), 1149–1160. https://doi.org/10.3758/BRM.41.4.1149

[12] Venkatesh G M, Bianca Pereira, and Suzanne Little. 2021. Urban Footpath Image Dataset to Assess Pedestrian Mobility. In *Proceedings of the 1st International Workshop on Multimedia Computing for Urban Data*. ACM, Virtual Event China, 23–30. https://doi.org/10.1145/3475721.3484313

[13] Jorge Goncalves, Vassilis Kostakos, Simo Hosio, Evangelos Karapanos, and Olga Lyra. 2013. IncluCity: Using Contextual Cues to Raise Awareness on Environmental Accessibility. In *Proceedings of the 15th International ACM SIGACCESS Conference on Computers and Accessibility* (Bellevue Washington, 2013-10-21). ACM, New York, NY, USA, 1–8. https://doi.org/10.1145/2513383.2517030

[14] Kotaro Hara, Vicki Le, and Jon Froehlich. 2013. Combining Crowdsourcing and Google Street View to Identify Street-Level Accessibility Problems. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (Paris France, 2013-04-27). ACM, New York, NY, USA, 631–640. https://doi.org/10.1145/2470654.2470744

[15] Andre Helgert, Sabrina C. Eimler, and Alexander Arntz. 2021. Stop Catcalling - A Virtual Environment Educating Against Street Harassment. In *2021 International Conference on Advanced Learning Technologies (ICALT)*. IEEE, Tartu, Estonia, 419–421. https://doi.org/10.1109/ICALT52272.2021.00133

[16] Simo Hosio, Jorge Goncalves, Vassilis Kostakos, and Jukka Riekki. 2015. Crowdsourcing Public Opinion Using Urban Pervasive Technologies: Lessons From Real-Life Experiments in Oulu. *Policy & Internet* 7, 2 (2015), 203–222. https://doi.org/10.1002/poi3.90

[17] Martin Trandberg Jensen. 2018. Urban Pram Strolling: A Mobilities Design Perspective. *Mobilities* 13, 4 (2018), 584–600. https://doi.org/10.1080/17450101.2017.1394683

[18] Bran Knowles, Vicki L. Hanson, Yvonne Rogers, Anne Marie Piper, Jenny Waycott, Nigel Davies, Aloha Hufana Ambe, Robin N. Brewer, Debaleena Chattopadhyay, Marianne Dee, David Frohlich, Marisela Gutierrez-Lopez, Ben Jelen, Amanda Lazar, Radoslaw Nielek, Belén Barros Pena, Abi Roper, Mark Schlager, Britta Schulte, and Irene Ye Yuan. 2021. The Harm in Conflating Aging with Accessibility. *Commun. ACM* 64, 7 (July 2021), 66–71. https://doi.org/10.1145/3431280

[19] Jonathan Lazar, Jinjuan Heidi Feng, and Harry Hochheiser. 2017. *Research Methods in Human-Computer Interaction* (2nd edition ed.). Morgan Kaufmann, Cambridge, MA.

[20] Tuuli Mattelmäki, Kirsikka Vaajakallio, and Ilpo Koskinen. 2014. What Happened to Empathic Design? *Design Issues* 30, 1 (Jan. 2014), 67–77. https://doi.org/10.1162/DESI_a_00249

[21] Amin Mobasheri, Jonas Deister, and Holger Dieterich. 2017. Wheelmap: The Wheelchair Accessibility Crowdsourcing Platform. *Open Geospatial Data, Software and Standards* 2, 1 (2017), 27. https://doi.org/10.1186/s40965-017-0040-5

[22] Marcel Neuenhaus and Maha Aly. 2017. Empathy Up. In *Proceedings of the 2017 CHI Conference Extended Abstracts on Human Factors in Computing Systems (CHI EA '17)*. Association for Computing Machinery, New York, NY, USA, 86–92. https://doi.org/10.1145/3027063.3049276

[23] Ville Paananen, Jonas Oppenlaender, Jorge Goncalves, Danula Hettiachchi, and Simo Hosio. 2021. Investigating Human Scale Spatial Experience. *Proceedings of the ACM on Human-Computer Interaction* 5, ISS (Nov. 2021), 496:1–496:18. https://doi.org/10.1145/3488541

[24] Catia Prandi, Silvia Mirri, Stefano Ferretti, and Paola Salomoni. 2018. On the Need of Trustworthy Sensing and Crowdsourcing for Urban Accessibility in Smart City. *ACM Transactions on Internet Technology* 18, 1 (2018), 1–21. https://doi.org/10.1145/3133327

[25] Catia Prandi, Valentina Nisi, Paola Salomoni, and Nuno Jardim Nunes. 2015. From Gamification to Pervasive Game in Mapping Urban Accessibility. In *Proceedings of the 11th Biannual Conference on Italian SIGCHI Chapter* (Rome Italy, 2015-09-28). ACM, New York, NY, USA, 126–129. https://doi.org/10.1145/2808435.2808449

[26] Sydney Pratte, Anthony Tang, and Lora Oehlberg. 2021. Evoking Empathy: A Framework for Describing Empathy Tools. In *Proceedings of the Fifteenth International Conference on Tangible, Embedded, and Embodied Interaction (TEI '21)*. Association for Computing Machinery, New York, NY, USA, 1–15. https://doi.org/10.1145/3430524.3440644

[27] Renate L. E. P. Reniers, Rhiannon Corcoran, Richard Drake, Nick M. Shryane, and Birgit A. Völlm. 2011. The QCAE: A Questionnaire of Cognitive and Affective Empathy. *Journal of Personality Assessment* 93, 1 (Jan. 2011), 84–95. https://doi.org/10.1080/00223891.2010.528484

[28] Brandon Reynante, Steven P. Dow, and Narges Mahyar. 2021. A Framework for Open Civic Design: Integrating Public Participation, Crowdsourcing, and Design Thinking. *Digital Government: Research and Practice* 2, 4 (Oct. 2021), 1–22. https://doi.org/10.1145/3487607

[29] Manaswi Saha, Devanshi Chauhan, Siddhant Patil, Rachel Kangas, Jeffrey Heer, and Jon E. Froehlich. 2021. Urban Accessibility as a Socio-Political Problem: A Multi-Stakeholder Analysis. *Proceedings of the ACM on Human-Computer Interaction* 4 (2021), 209:1–209:26. Issue CSCW3. https://doi.org/10.1145/3432908

[30] Manaswi Saha, Siddhant Patil, Emily Cho, Evie Yu-Yen Cheng, Chris Horng, Devanshi Chauhan, Rachel Kangas, Richard McGovern, Anthony Li, Jeffrey Heer, and Jon E. Froehlich. 2022. Visualizing Urban Accessibility: Investigating Multi-Stakeholder Perspectives through a Map-based Design Probe Study. In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems* (New York, NY, USA, 2022-04-29) *(CHI '22)*. Association for Computing Machinery, New York, NY, USA, 1–14. https://doi.org/10.1145/3491102.3517460

[31] Manaswi Saha, Michael Saugstad, Hanuma Teja Maddali, Aileen Zeng, Ryan Holland, Steven Bower, Aditya Dash, Sage Chen, Anthony Li, Kotaro Hara, and Jon Froehlich. 2019. Project Sidewalk: A Web-based Crowdsourcing Tool for Collecting Sidewalk Accessibility Data At Scale. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (New York, NY, USA, 2019-05-02) *(CHI '19)*. Association for Computing Machinery, New York, NY, USA, 1–14. https://doi.org/10.1145/3290605.3300292

[32] Helena Sandman. 2021. *Empathy Matters: Architecture for the World's Majority*. Ph. D. Dissertation. School of Art and Design, Aalto.

[33] Elizabeth A. Segal, Andrea N. Cimino, Karen E. Gerdes, Jordan K. Harmon, and M. Alex Wagaman. 2013. A Confirmatory Factor Analysis of the Interpersonal and Social Empathy Index. *Journal of the Society for Social Work and Research* 4, 3 (2013), 131–153. https://doi.org/10.5243/jsswr.2013.9

[34] Ather Sharif, Paari Gopal, Michael Saugstad, Shiven Bhatt, Raymond Fok, Galen Weld, Kavi Asher Mankoff Dey, and Jon E. Froehlich. 2021. Experimental Crowd+AI Approaches to Track Accessibility Features in Sidewalk Intersections Over Time. In *The 23rd International ACM SIGACCESS Conference on Computers and Accessibility* (Virtual Event USA, 2021-10-17). ACM, New York, NY, USA, 1–5. https://doi.org/10.1145/3441852.3476549

[35] Yiying Wu, Xianghua(Sharon) Ding, Xuelan Dai, Peng Zhang, Tun Lu, and Ning Gu. 2022. Alignment Work for Urban Accessibility: A Study of How Wheelchair Users Travel in Urban Spaces. *Proceedings of the ACM on Human-Computer Interaction* 6, CSCW2 (Nov. 2022), 274:1–274:22. https://doi.org/10.1145/3555165

A SCENARIOS

Scenario

Imagine you are a blind person.

Accessibility issue: Footpaths with no clear dividers from the road are dangerous for the blind, especially in areas of high traffic.

Photo:

Story: *I'm fully blind, and my friend lives on the end a footpath and I try to visit him as often as possible. Moving there by myself is not safe as the footpath is right next to a road and I can hear the cars going by really fast. There's no clear difference between the footpath and the road, and once I was startled as I walked too close to the road and a car honked at me.*

Figure 7: Scenario A with a blind person.

Scenario

Imagine you are a wheelchair user.

Accessibility issue: Curbs are difficult to move over with a wheelchair.

Photo:

Story: *The fastest route to the story from my home has this one curb which is difficult to move over. Even though there are small ramps now, it's not easy to go through, and usually, I need to go take a long way around. Going down the curb is easier, and I can take the shorter route on the way back home. Most of the time I can move around by myself, but there are some cases like these that require me to spend more time or effort.*

Figure 8: Scenario B with a wheelchair user.

Scenario

Imagine you are walking on a footpath with crutches.

Accessibility issue: Uneven surfaces are dangerous when you are using crutches, and they can be slippery.

Photo:

Story: *I had a skiing accident and I used crutches for a few months. When I was still learning how to use the crutches, there was a footpath on which I slipped and lost my balance. The path had multiple different textures and it was slightly on an angle. The metal plates on the ground were slippery after the rain and the crutch slid from under me when I leaned on it. Luckily, I only bruised my hand some, but it could have been worse.*

Figure 9: Scenario C with a person using crutches.

Scenario

Imagine you have limited vision.

Accessibility issue: Places with unclear navigation can cause dangerous situations for people with limited vision.

Photo:

Story: *I have a moderately severe cataract and everything I see is a bit blurry to me. Once I was moving through this crossroad in the evening I nearly walked into the middle of the traffic. The intersection doesn't have any helpful visual cues or lights where the crossing is, and I instinctively moved in the wrong direction. I realized when I was crossing the intersection at the wrong point when a cyclist shot by, and I looked closer where I was.*

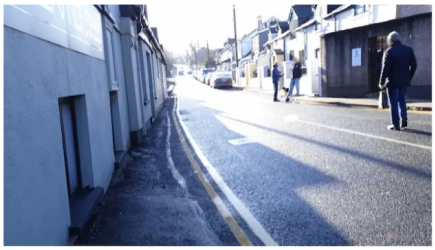
Figure 10: Scenario D with a person with impaired vision.

Scenario

Imagine you are a parent pushing a stroller, going down a footpath.

Accessibility issue: Narrow roads are difficult to maneuver when pushing a stroller, which can lead to dangerous situations.

Photo:



Story: *"I was pushing my child on a stroller and on the route to daycare there's this one street where the footpath is very narrow, and the stroller fits just barely. On a part of the street, there's a section where the footpath is not raised from the road and there's no separation from the traffic. If there's oncoming traffic on the footpath, I need to make sure there are no cars coming to safely move past each other.*

Figure 11: Scenario E with a parent pushing strollers.