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Psyllidis, A.; Miliadis, V.

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# Population-specific factors of pedestrian accessibility: Bridging practitioner insights and accessibility metrics

Achilleas Psyllidis<sup>\*1</sup> and Vasileios Miliadis<sup>†2</sup>

<sup>1</sup>Urban Analytics Lab, Department of Sustainable Design Engineering, Delft University of Technology

<sup>2</sup>Laboratory of Transportation Engineering, School of Rural, Surveying, and Geoinformatics Engineering, National Technical University of Athens

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## Summary

*Modern geographic information systems (GIS) and planning support systems (PSS) incorporate numerous pedestrian accessibility and walkability indicators. However, these tools often prioritize spatial metrics over perceptual factors and overlook population-specific differences. This creates a gap between measurable indicators and those valued by planning practitioners. Through co-design workshops, Q methodology, and factor analysis, we identify key factors influencing pedestrian accessibility for diverse populations and highlight areas of alignment and mismatch with existing GIS/PSS indicators.*

**KEYWORDS:** Accessibility, Walkability, Demographics, Co-design, Q Methodology

## 1 Introduction

Accessibility measures reflect the complex interplay between the spatial distribution of activities, the quality of mobility systems, and individual travel cost perceptions, abilities, and preferences (Geurs and Van Wee 2004; Levinson and Wu 2020; Miliadis, Psyllidis, and Bozzon 2024). As cities pursue sustainable mobility policies that encourage active transportation, numerous pedestrian accessibility and walkability indicators are incorporated into geographic information systems (GIS) and planning support systems (PSS) (Papa et al. 2016; Boulange et al. 2018).

Although research consistently demonstrates that walking engagement is shaped by a combination of built environment attributes, pedestrian network characteristics, and perceptual and behavioral factors (Forsyth et al. 2008), most GIS and PSS tools prioritize spatial attributes while overlooking perceptual elements or differences across population groups. Commonly used indicators, such as travel time, proximity to essential destinations, activity concentration, population distribution, and pedestrian network features, may not fully capture the multifaceted nature of pedestrian accessibility.

We conduct co-design workshops with urban and transport planning practitioners to identify factors

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<sup>\*</sup>a.psyllidis@tudelft.nl

<sup>†</sup>vmiliadis@mail.ntua.gr

influencing pedestrian accessibility for specific population groups. Using Stephenson’s Q methodology (Stephenson 1953; Watts 2012), we rank and analyze these factors across diverse demographic groups. Our findings shed light on areas of convergence and divergence between practitioners’ perceptions and existing GIS/PSS accessibility indicators.

## 2 Co-design workshop setup

We conducted two co-design workshops with urban and transport planning practitioners to explore pedestrian accessibility indicators. The first workshop took place online in May 2023, in collaboration with the American Planning Association, and involved nine experts from the State of Massachusetts. The second workshop was held in person in September 2023 in Helsinki, Finland, bringing together eighteen practitioners from nine European countries: Finland, Germany, Italy, Ireland, the Netherlands, North Macedonia, Slovakia, Slovenia, and Scotland, UK.

Both workshops follow a two-phase structure consisting of a plenary session and group discussions. For the group sessions, participants are divided into smaller teams — three groups in the first workshop and four in the second — each comprising three to five members. Each group is tasked with focusing on a specific population group: children, women, seniors, and persons with disabilities.

The goal of the co-design workshops is to identify the factors influencing pedestrian accessibility to essential amenities for specific population groups by examining participants’ perspectives. Using Stephenson’s Q methodology (Stephenson 1953), participants are first asked to share their views on the topic and then rank and sort the identified factors. To facilitate this process, participants use a specially designed board with a prearranged set of grid cells, known as the Q grid, shaped like an inverse pyramid (Fig. 1). The grid allows participants to rank factors from least important (left) to most important (right). The Q grid features nine cells used to order an equal number of factors. At either end of the inverse pyramid-shaped grid are the least and most important factors, containing one cell each. In the middle, three cells are used to order neutral factors. Q methodology has similarly been used before to reveal expert viewpoints on key factors impacting walkability (Cardoso, Miliias, and Hartevelde 2024).

In the plenary session, participants individually and collaboratively identify and rank general factors influencing pedestrian accessibility, without focusing on any specific population group. In the subsequent group session, each team is assigned a particular demographic group and is asked to revisit the plenary board, introduce new factors if necessary, and re-rank them onto a new Q grid of the same size. Finally, in the concluding plenary session, participants compare the population-specific boards with the general ones, identifying areas of convergence and divergence. They also reflect on how the identified factors align or conflict with indicators typically used in GIS/PSS tools.

Data collected through the Q-sorting process undergo factor analysis in two steps. First, we compile and cluster the general factors influencing pedestrian accessibility and employ reflexive thematic analysis (Clarke and Braun 2013). This process enables the identification of overarching themes and relationships between them, using iterative inductive coding. These themes are then ranked from least to most important considering the ranking of factors from the participants. The second step concerns the population-specific factors, analyzing which factors were added, removed, or re-ranked. This helps detect areas of convergence and divergence across groups and highlight differences from the initial general ranking.

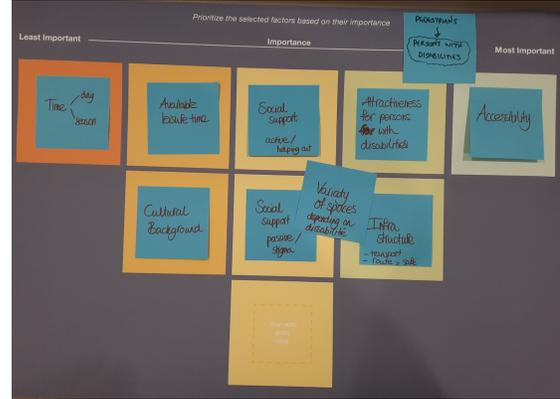
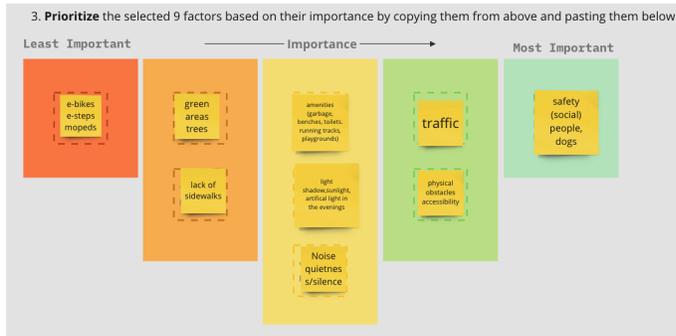


Figure 1: Boards used during the workshops. *Left*: Online workshop with participants from Massachusetts, USA. *Right*: In-person workshop held in Helsinki, Finland.

### 3 General factors influencing pedestrian accessibility

Table 1 lists factors identified during the plenary session, grouped into eight themes: *safety*, *attractiveness*, *connectivity*, *social environment*, *noise*, *light*, *air pollution*, and *climate*. Among these, *safety* was the most frequently mentioned and highly ranked, encompassing both general safety and specific aspects like social and traffic safety. *Attractiveness* focuses on aesthetic qualities, activities (e.g., seating, socializing), and amenities. *Connectivity* addresses the ease of reaching destinations, highlighting barriers like distance or lack of sidewalks. *Social environment* reflects community engagement and support with factors like “social engagement,” “neighborhood support,” and “family/school connections.” *Light* covers natural and artificial lighting, including “shadow,” “sunlight,” and adequate evening lighting. *Noise* emphasizes sound-related factors, including “quietness” and “silence.” Finally, *climate* incorporates weather and air quality considerations, such as “microclimate,” “seasonal comfort,” and “climate adaptation.”

We identified connections between themes through factors that span multiple categories (Fig. 2). *Safety*, the most mentioned theme, frequently overlaps with others. For example, factors like “social safety” and “gender ratio” connect safety to the *social environment*, while adequate lighting after sunset links it to *light*. *Attractiveness* is closely intertwined with *safety* and all other themes. For instance, “construction sites” and “pavement quality” affect both the attractiveness and perceived safety of streets. Similarly, factors like “sunlight,” “shadows,” “seasonal comfort,” and “quietness” link attractiveness to *light*, *noise*, and *climate*, while social interactions tie it to the *social environment*. Lastly, *connectivity* often intersects with *safety* and *attractiveness* through shared factors like “pavement quality” and “construction sites,” which influence walkability and street perception.

Themes of factors that affect pedestrian accessibility	
Identified Themes	Factors
Air pollution	“air pollution”, “noise and air quality”
Attractiveness	“attractiveness”, “aesthetics/attractiveness”, “cleanliness”, “wayfinding”, “attractiveness/public space”, “pedestrian path/pavement quality”, “green areas/trees”, “amenities (garbage, benches, toilets, running tracks, playgrounds)”, “adequate/appropriate facilities there for seating, recreation, games, socializing, walking, etc”, “activities” “is the quality of experience compelling?”
Climate	“climate consideration (shadow, water, greens)”, “weather and climate adaptation”, “seasonal comfort”, “microclimate - too hot? too cool? comfort across different seasons”
Connectivity	“accessibility”, “distance”, “convenience distance”, “accessible sidewalk and crossing network”, “proximity from home to space”, “lack of sidewalks”, “physical obstacles/accessibility”, “construction sites/blocked ways”, “space/large pathways”
Light	“adequate lighting for evening/nights”, “light and lamps, dark months”, “light shadow, sunlight, artificial light in the evenings”, “time of day/year/seasons”
Noise	“noise”, “noise/quietness/silence”, “noise and air quality”
Safety	“safety”, “social safety”, “feeling safe to, during, from”, “perception of safety”, “Traffic/volume/speed”, “traffic safety”, “busy roads to cross road network including safe crossings and bus route”, “safety (social people, dogs)”, “time/effort/safety issues crossing roadways”, “construction activities”
Social environment	“social engagement in the community”, “social support in the neighborhood”, “social/anti-social activities”, “family, school”, “gender ratio”, “cultural relevance”, “feeling personally welcome in the public space (e.g., age, race, gender, mobility, etc.)”

Table 1: Factors influencing pedestrian accessibility, categorized into eight themes based on the first (plenary) workshop round.

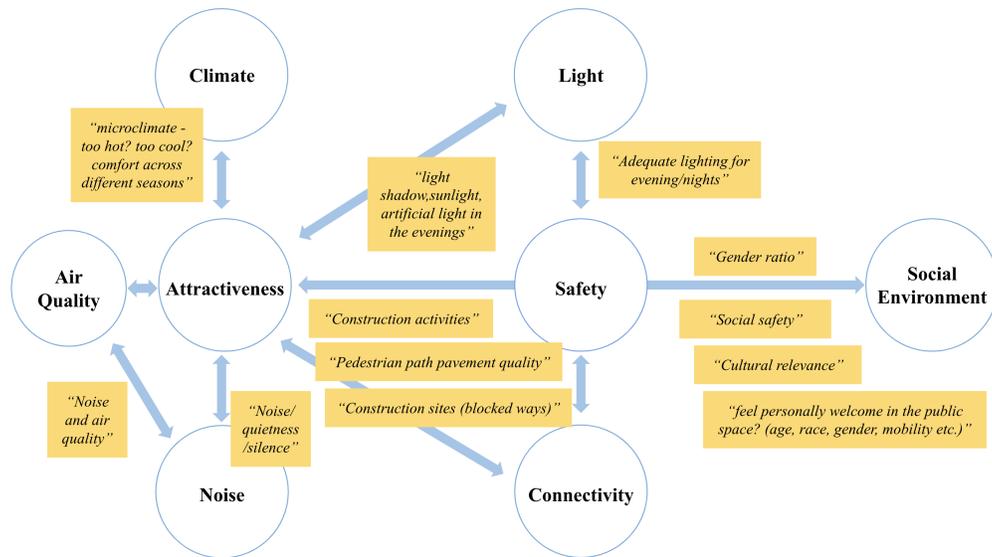


Figure 2: Relationships among the eight themes identified as key factors affecting pedestrian accessibility.

#### 4 Population-specific factors of pedestrian accessibility

In the group session, participants were asked to consider pedestrian accessibility factors through the lens of children, women, seniors, and persons with disabilities. Table 2 summarizes the factors added, removed, or re-prioritized during the group sessions. The columns “Added” and “Removed” indicate factors introduced or omitted, while “(+)Priority” and “(-)Priority” reflect changes in importance. Participants predominantly added new factors or elevated the priority of existing ones from the plenary session, as shown by the greater number of factors in the “Added” and “(+)Priority” columns compared to “Removed” and “(-)Priority.” Many newly added factors were ranked as highly important, underscoring their significance when focusing on specific pedestrian groups rather than pedestrians in general.

Safety emerged as the top theme in the case of *children*, with factors like “traffic” and “safety” ranked highest. Connectivity and safety-related issues, such as “safety issues crossing roadways” and “lack of sidewalks,” were newly introduced or re-prioritized. Safety for children primarily concerns accidents rather than social threats. Additional factors included “cleanliness,” “distance from home,” and “peers” (other nearby children). Factors related to “light,” “noise,” and “amenities” were removed.

In the case of *women*, safety was emphasized even more, with factors like “social safety,” “surrounding lights and services,” and “eyes on the street” highlighted. Newly added factors included attractiveness elements such as “planting, decor, cleanliness,” and “facility features.” Connectivity, light, and climate factors, such as “accessible sidewalks” and “climate considerations (shadow/water/greens),” were de-prioritized or removed.

Safety remained the top concern for *seniors* as well, particularly regarding “pavement quality” and “risk of slipping.” Additional priorities included rest opportunities, such as “places to sit down,” “distance,” and “perceived distance,” along with proximity to peers and other age groups. The importance of “shade, sunlight, and heat” increased, while factors like “fences/gating” and broader accessibility considerations were removed.

For *persons with disabilities*, key factors focused on accessibility and safe infrastructure, including “accessibility” and “infrastructure, transport, route=safe.” Social support was further categorized as “passive” (e.g., addressing stigma) or “active” (e.g., direct assistance). Newly added factors included “attractiveness for persons with disabilities” and “variety of spaces depending on disabilities.” Some factors were rephrased to better reflect their needs (e.g., “attractiveness” became “attractiveness for persons with disabilities”), while others, like “noise and air quality” and “family, school,” were removed as less relevant.

<b>Differences in the factors that affect specific pedestrian groups</b>				
<b>Pedestrians</b>	<b>Added</b>	<b>(+)Priority</b>	<b>Removed</b>	<b>(-)Priority</b>
Children	“public bathrooms”, “safety issues crossing roadways”, “peers”, “active recreation for children and services for parents”, “distance from home”, “cleanliness” (6)	“Traffic”, “lack of sidewalks” (2)	“light shadow, sunlight, artificial light in the evenings”, “amenities (garbage, benches, toilets, running tracks, playgrounds)”, “Noise quietness/silence” (3)	“safety social” (1)
Women	“eyes on the street”, “security”, “features of facility: what draws people to this place?”, “details: planting, decor, cleanliness”, “surrounding lights and services” (5)	“convenience distance”, “attractiveness of a destination”, “social safety”, “wayfinding” (4)	“space/large pathways” (1)	“accessible sidewalk and crossing network”, “personal individual mobility”, “traffic safety”, “signing information”, “climate consideration (shadow/water greens)” (5)
Seniors	“safety, ice free risk of slipping”, “free green public transport”, “places to sit down/rest”, “facilities”, “Ammenities e.g., benches and shade”, “social space with peers”, “access for different age groups” (8)	“distance”, “cleanliness”, “Shade sunlight and heat” (3)	“Space (broad sidewalks)”, “Fences/gating”, “Construction sites (blocked ways)”, “equity of accessibility - for all people (safety, design free of barriers)”, “busy roads to cross road network including safe crossings and bus route” (5)	“activities, “cultural relevance” (2)
Persons with Disabilities (only Helsinki workshop)	“variety of spaces depending on disabilities”, “attractiveness for persons with disabilities”, “Infrastructure, transport, route=safe”, “social support passive/stigma”, “social support neighborhood active/helping out”, “cultural background” (7)	“accessibility” (1)	“social/anti-social activities”, “Attractiveness public space”, “noise and air quality”, “family, school” (4)	(0)

Table 2: Pedestrian accessibility factors added, removed, or re-prioritized by participants when considering specific demographic groups.

## 5 Discussion

Co-design sessions with planning professionals revealed significant discrepancies between the key perceived factors of pedestrian accessibility and those typically measured by GIS and PSS tools. Priorities also changed when considering specific groups instead of the average pedestrian. Safety emerged as a universal theme, but was interpreted differently: traffic safety for children, social safety for women, risk of slipping for seniors, and physical barriers for people with disabilities. Distinct needs shape other priorities, such as connectivity and peer proximity for children, cleanliness and amenities for women, rest areas and climate considerations for older populations, and inclusive infrastructure and active support for persons with disabilities. Although these findings align with existing walkability research, GIS/PSS tools often prioritize objective factors due to challenges in measuring subjective ones and data limitations. These insights call for advancing GIS/PSS tools to better integrate subjective factors into the analysis of pedestrian accessibility.

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