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EDITORIAL

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Walkability: From Spatial Analytics to Urban Coding and Actual Walking

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Abstract

Walkability has become a key focus of urban research, linked to the aims of reversing car-dependence and re-enabling walking as a healthy, environmentally sustainable and sociable mode of mobility. This thematic issue presents a collection of articles using cutting-edge research methods ranging from walk-along interviews to statistical analysis of historic photography, topological and morphological analysis of street networks, and analysis of the spatio-temporality of various aspects of streetlife. The articles included here provide new insights in understanding morphologies of walkability in cities across the globe. This concise selection of non-reductionist walkability research reveals the exceptional breadth of research tools, inspiring further methodological innovation, and supporting future urban design and planning practice.

Keywords

assemblages; public space; spatial analysis; spatial planning; streetlife; urban codes; urban mapping; urban mobility; walkability; walking

Walkability has emerged as a key focus of multi-disciplinary research, linked to the aims of reversing car-dependence and re-enabling walking as a healthy, environmentally sustainable and sociable mode of mobility. While often conflated with actual walking, etymologically walkability refers to the capacity for walking enabled by the built environment (Dovey & Pafka, 2020). It has been linked to the key neighbourhood-scale morphological properties of access, density, and mix, as well as micro-scalar elements of the street section, such as public/private interfaces, footpaths, and landscaping. Yet none of these attributes can be reduced to a simple measure, nor are these separable from the natural conditions of topography or climate. The multiplicity of interrelations between these various factors is what defines the overall urban design quality.

Research advancing understandings of walkability remains highly multi-disciplinary, spanning across the fields of urban design, planning, transport and public health. Accordingly, there have been many attempts to summarize the growing body of research, including by Forsyth (2015), Talen and Koschinsky (2013), and Shields et al. (2023). Empirical research captured in these is often focused on metrics of street network models (Marshall et al., 2018), to the detriment of non-measurable aspects (Ewing & Handy, 2009). In the process limitations of theoretical models and metrics are in some cases simply disavowed, while in others a multiplicity of methods is used to capture the non-quantifiable aspects of urban morphology (Biraghi & Pafka, 2025).

This thematic issue presents a collection of articles using cutting-edge research methods to explore morphologies of walkability, as a foundation for the design and planning of urban environments. Of 19 abstract proposals received, a compact selection of six outstanding articles has been included, providing a "taste" of the breadth of current directions of enquiry in the field. These include articles contributing to urban theory, research methods, and planning practice.

Emanuel and Hilliard's (2025) archival analysis of historic photography of Stockholm taken between 1880 and 1939, recording over 3,000 pedestrians, captures with precision the effects of increasing automobility on streetlife intensity. This is manifest in the increasing relegation of walking to the sidewalk pavements and the radical reduction of children's independent mobility. The authors provide well-grounded insights on aspects of streetlife that have been neglected in research to date, such as that about a quarter of pedestrians were engaged in static activities. Notable too are the quantified findings about the prevalence of social life on local streets as opposed to main streets that are more focused on channelling flows. This invites a more nuanced reading of the "social logic of space."

Vrebos et al. (2025) propose a participatory research process using walk-along interviews to capture sensory experiences of place and changing senses of belonging within "neighbourhoods-in-flux." Their approach is guided by new materialism, and an interest in processes of emergent capacities and processes of becoming (DeLanda, 2006; Deleuze & Guattari, 1987).

Salahieh and Zibar's (2025) exploration of walkability in post-conflict Aleppo provokes us to direct our attention to a distinct type of case study, in which "walking becomes a precarious tiptoeing" and tactic of survival, adapted against urbicidal practices. Hopefully this should encourage researchers to not shy away from engaging with such difficult topics in the future, in an era of academic output easily falling in the trappings of facile big-data supported numbers-crunching.

Gorzka et al. (2025) present a comparative study of coastal flood adaptation projects of urban waterfronts around the Baltic Sea. The nine projects from five countries show increases in connectivity and water access, demonstrating synergies between planning for climate adaptation and increased walkability outcomes. These cases point to the potentials of flexible and adaptable designs for blue-green infrastructures, that should raise expectations from similar projects around the globe.

Biraghi et al. (2025) develop a data-based framework combining statistical and spatial analysis for assessing and prioritizing pedestrianization projects. The approach is exemplified using a neighbourhood of Rio de Janeiro as case study. The systematic multi-method analysis of five parallel streets combines topological and

morphological analysis of street networks along with socio-spatial analysis of functional mix and aspects of streetlife. The authors argue that urban planning shall be always informed by such complex and extensive analysis of current conditions, increasingly enabled by various datasets.

Patil et al. (2025) analyse the contrasting sensory experiences of informal street vending in Nagpur with the highly regulated street markets of Brisbane. Identifying in each case positive and negative sensory experiences, the authors attract attention to the role of urban codes in mediating conflicts, and the role of planning in enabling streetlife without supressing its vitality. They argue for nuanced regulations that carefully consider the rhythms of street-trading in all its socio-spatio-temporal complexity.

As evident in all these articles, it is now well-established that walkability is linked to a complex set of attributes of built form. Nevertheless, numerous 'WalkScore'-like aggregated indexes have been proposed, sometimes branded particularly for commercial use in the property sector. Such tools often lack methodological transparency, yet risk influencing planning practice. Not less concerning is to see such indexes making in-ways into formal academic publishing. Such reductionist approaches may well have their appeal but are more likely to be obscuring the diversity of walkable environments. All the articles in this thematic issue go in the opposite direction by developing practical and effective methods or measures to assess qualitative urban aspects relevant for walking. As such, these may contribute to a repository of "Actionable Urban Measurements" (AUM), of easily computable, understandable, and adjustable urban form metrics relevant for assessing various properties related to walkability. The increasing availability of sophisticated open access tools and large datasets enables the creation of multi-faceted non-reductionist frameworks for the characterisation of urban structures and the assessment of their performances.

To foster the impact of research, it is critical to produce tools able to replace misguided planning routines in our cities. We hope that this concise selection of walkability research reveals the exceptional breadth of such tools, inspiring further methodological innovation, as well as support related research and practice. Ultimately the value of conceptual frameworks and research methods is best reflected in the impact these have on actual living conditions.

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Conflict of Interests

The authors declare no conflict of interests.

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ARTICLE

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Capturing the Socio-Spatiality of Walking: A Historical Coding of Stockholm's Street Life

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Abstract

Walking develops in a dynamic relationship to its socio-material environment. A historical perspective helps nuance the multiplicity of interrelating factors that influence the practice. This article focuses on walking in Stockholm between 1880 and 1939, a period of great change to the city's streets and movement within them. Through a detailed coding of 466 photographs, depicting more than 3,000 pedestrians, we examine micro-scalar elements, such as the use, material, and demographic of the pavement, to allow us to plot developments in the socio-spatial character of walking over time. The results reveal stable patterns as well as both gradual and rapid change. The intensity of pedestrians remained over time as did the sociality of streets. With increasing automobility, however, pedestrians were increasingly found on pavements rather than roadways. A slightly skewed gender balance also remained across the studied period, though men's and women's more specific street use varied substantially. Meanwhile, the presence of children in streets and their independent mobility declined radically. Some of these patterns also varied across different types of streets. These findings are discussed in relation to urban automobility, wider societal trends, and their relevance to walkability studies and present-day efforts to increase walking.

Keywords

street life; urban history; walkability; walking practices

1. Introduction

Mobility practices are always changing. This article offers a historical analysis of walking in Stockholm from the late 19th century until World War II through a detailed study of street photographs. By employing a quantitative, statistical method to analyse photos, we trace qualitative change and variation in pedestrian

street use and relate it to overall mobility patterns, transformations in the built environment, and broader societal change. We posit that a historical perspective on walking helps nuance the multiplicity of interrelating factors that influence the practice.

Walkability—the theme of this thematic issue—typically refers to the built environment's capacity to enable walking. Whether through street connectivity and land-use mix, or the micro-scale level of street design, walkability studies suggest a one-way causality where spatial and material conditions shape walking (de Vos et al., 2023). There is much more to pedestrian space than walking, however, as people linger, socialise, demonstrate, play, care, and consume within it. Recent scholarship has extended perspectives to also consider "walkability as a capacity that may or may not be actualised" (Masoumzadeh et al., 2023, p. 355). Scholars have highlighted the importance of incorporating qualitative attributes of the pedestrian environment, including whether it is safe, interesting, or conducive to social, non-walking activities (Girling et al., 2019; Mehta, 2013). Walkability studies have also come into question for "operating on an aggregate level" (Shields et al., 2023), neglecting the heterogeneity of pedestrians. When perceptions are also factored in, walkability varies by socio-demographic characteristics such as age, gender, and ethnicity (de Vos et al., 2023). Reflecting sentiments in the "mobilities turn" within the social sciences (Sheller & Urry, 2006), Shields et al. (2023, p. 36) emphasise walking as a "richly social" and relational activity, suggesting that walkability studies should therefore seek to capture "not only transportation and mobility capacities, but also the social qualities of these environments as social spaces."

Taking stock of such extended views on walkability, our contribution seeks to further understandings of walking as a variegated social practice that develops under the influence of the urban environment as well as socially constructed ideas about who belongs in the street and its appropriate use. We posit that a historical understanding affords greater sensitivity to the role of wider social processes in shaping mobility practices and broader street use. Although historians are restricted in their reliance on available records, access to long-term change in both the urban environment (e.g., streets) and its use (e.g., walking practices) affords a greater understanding of the continuous interactions between the two. In this article, we seek to evidence the changes in walking practices that purportedly resulted from their dynamic relationship with their socio-material environments.

Previous research into the history of walking indicates that in the 20th century, pedestrians in increasingly car-centric cities were marginalised through traffic regulations, police enforcement, urban planning, and evolving social norms regarding street use. These shifts were primarily driven by efforts from various stakeholders to regulate the coexistence of pedestrians and cars in city streets. Scholarship also testifies to pedestrian subversion and opposition to expected "appropriate" behaviours around, for example, pavement use, respect to yielding patterns, and deference to designated crosswalks (for a review, see Emanuel & Normark, 2023). Meanwhile, the detrimental effect of urban automobility on the sociality of streets is often taken for granted. Many have argued that streets were deprived of their multifunctional character and social role as spaces for play, commerce, protest, and meaningful interaction as they increasingly transformed into traffic arteries (Habermas, 1989). As Richard Sennett puts it, under the influence of modernist planning, public space became a "derivative of movement" (Sennett, 2017, pp. 15–17). However, while cities undoubtedly transformed in response to urban automobility, research has also stressed that changes to street sociality were already well underway and that the motor car only accelerated the departure of many non-traffic activities from city streets (Brown-May, 1996, pp. 49–50; Ladd, 2020; Lofland, 1998, pp. 17–18).

Focusing more specifically on women and children, other historians have sought to understand their access to, and agency within, urban public space and the often morally charged debates concerning their presence there. The industrialisation of Western cities in the 19th century led to a great influx of working-class people. As cramped living conditions pushed them out of their homes, streets turned into places where people of all sorts gathered and intermingled, which, in the eyes of the new urban middle-class elites, posed a threat to social order (Dennis, 2008). Despite reformers' ambitions to remove them through regulation and moral consternation, working-class women and children in the 19th century often used streets to socialise, perform daily chores, work, and play (de Coninck-Smith, 1990; Stansell, 1982). Middle-class women's participation in public life was also circumscribed by bourgeois discomfort at their alleged vulnerability, yet scholars have highlighted how they were able to, within limits, renegotiate and extend their boundaries (Domosh, 1998; Ryan, 1990). In the new century, as women enjoyed increasing employment opportunities and engaged in new shopping and leisure practices, they also appropriated public spaces in new (though still gendered and culturally constrained) ways (Hickey, 2023; Sewell, 2011). Meanwhile, concerns around traffic and perceived threats to children from street crime and violence led reformers, and later city authorities, to spatially segregate them, building playgrounds to lure them off the streets, though seemingly with limited success (Hart, 2002; Karsten, 2002). Children preferred less "programmed" spaces for play and, as they grew older (as diaries and oral history testimonies have shown), increased their radius for playing, courting, and working (Laakkonen, 2011; Sleight, 2016).

This knowledge is primarily derived from text-based sources: archive documents, published reports, newspaper articles, and diaries, which, while effective in capturing actor sentiments and articulated tensions, struggle to capture the mundanity and extent of walking. While we know that pedestrian resistance to dominant ideas about appropriate and legitimate street use existed (Emanuel, 2021a, 2021b; Norton, 2021), we do not know to what degree. Similarly, while we know that women's and children's presence in the streets was a contentious issue, we lack a thorough understanding of how this presence changed in reality, as well as whether streets became more or less sociable. Here, we argue, photographs can help qualify, support, or challenge findings from text- and memory-based historical research.

Although historians tend to prioritise written documents over photographs as sources, they have nonetheless made use of the medium. Photographs help grasp the lives and circumstances of "ordinary people," track groups that have otherwise left little trace in traditional sources such as women and children, and access details of practices that are often so taken for granted as to not warrant mention in contemporary text-based sources (Burke, 2019; Jordanova, 2012). Correspondingly, we are not primarily interested in the deeper cultural meanings or messages of the images we study, but rather in how they can help understand walking in its social context and material environment.

Inspired by recent academic readings of large series of street photographs, we seek to uncover walking practices in Stockholm within the context of a changing urban environment. Through the coding of photographs of two European downtown streets, Cochoy et al. (2015) provide a comparative analysis of long-term (1875–2011) change in what they call "pedestrian logistics," that is, what pedestrians carried and how. They also consider pedestrians' increasing tendency to use crosswalks and pavements. Gruber et al. (2018) focus on the streets around the Vienna State Opera in the period 1860–1949 and employ a broad coding scheme, tracing changes in street space and street life beyond mobility. Their extensive quantitative dataset allows them to track specific patterns across time, though their socio-spatial analysis primarily draws

from qualitative interpretations of photos, rather than a cross-referencing of quantitative trends. Both studies share a focus on centrally located and rather atypical city streets. While it allows them to address place-specific interactions between street use and design, it forgoes city-wide analysis. Männistö-Funk (2021), on the other hand, explores a much broader territory, studying gendered walking practices in Turku, Finland. In her reading of 3,500 photographs between 1890 and 1989, she focuses on the spatial gender distribution across the city's grid plan area, finding that men were centrally concentrated, while women were more evenly distributed across the city. She also touches on gendered differences and the associated trends in carrying items, accompanying children, and walking alone or in groups. Collectively, these studies point to the free use of the street by pedestrians in the early 20th century, as well as their subsequent displacement under the influence of urban automobility.

Our contribution to these studies is two-fold. Firstly, we employ a wider coding scheme for recording pedestrian practices and characteristics that incorporates and builds upon those of the previous studies. This allows us, through cross-analysis, to chronologically outline changes in walking as a socio-spatially variegated practice (that is to say, who walks where and with whom) at a more detailed level than in previous studies. Secondly, in making our codebook and dataset available (see Supplementary Material), we open for future comparisons with other cities.

2. Methodology

This article employs a close "reading" (coding) of street photographs to study changes to walking as a socio-spatial practice in Stockholm between 1880 and 1939. With a scope incorporating what is today referred to as the inner city (corresponding roughly to the grid-patterned neighbourhoods) our search yielded 466 photos containing a total of 3,008 pedestrians. As the photographs were distributed across three periods with different levels of car traffic (P1: 1880–1905, practically none; P2: 1906–1920, very low levels; and P3: 1921–1939, early expansion; see Figures 1–3 for two examples from each), the cross-period analysis allows for an assessment of the impact of early urban automobility on walking. Including the post-war period may also have contributed, but for this article, we prioritised a wider scope of coding rather than a longer period. With additional layers of coding (further explained below), we are able to reveal patterns related to age, gender, sociability, and spatial characteristics.

Photographs have both strengths and challenges as historical sources. As well as their intended subject, they also capture incidental information, making them a rich source for studying both objects and activities (Gruber et al., 2018, p. 296). When analysed systematically, as here, they allow the historian to move beyond the possible—that is to say, historically noteworthy phenomena more likely to be documented—to grasp the typical (van den Heuvel et al., 2020). At the same time, chronologically tracking the smaller details of mundane practices (such as walking) allows us to question the stability and universality of their character (Cochoy et al., 2015, pp. 2268–2269).

Regarding the challenges associated with photographic source material, Cochoy et al. (2015, p. 2272) offer four core criticisms to be aware of: the subjectivity of the photographer; the capture of content but not meaning; the flexibility of interpretation; and the time-specific conventions of photographic practice. With respect to photographic conventions, Gruber et al. (2018, p. 296) stress how "the zeitgeist…might determine what is worthy of depiction," offering two further criticisms of which to be aware: the intentions of the

photograph's commissioner and the awareness of the subject(s) being depicted. We mitigate the last point by excluding photos that were obviously staged (e.g., subjects are lined up) or include subjects overtly gazing into the camera. With regards to the more salient problematisations, and in line with Cochoy et al. (2015, p. 2272), we stand by the assumption that the "aggregation and comparison of a larger collection of photographs" helps to "escape the framing of a single image," freeing us somewhat from photographer and commissioner influence. With regards to the challenges related to meaning and interpretation, these are largely irrelevant in our case, as we code only for the presence (and location, movement, gender, and age) of people and objects, without attempting to read deeper cultural meaning from the photographs.

Our use of street photography as source material is, however, not free from limitations. Notably, as technological developments allowed for camera operation in darker conditions, photos from the later periods could be taken with less preparation and during daytime/seasons of lower light. The challenge of shifting conventions within photographic practice is also not overcome by the large dataset. Furthermore, much of the collection, particularly during P1 and P2, is drawn from only a few photographers, each with their own style and preference. Kasper Salin, for example, is responsible for 153 of our 466 images. As well as being an amateur photographer, Salin was Stockholm's city architect whose desire to capture soon-to-be demolished buildings, particularly in the less-developed district of Södermalm, stemmed from his critical take on the city's development (Forsmark, 2012, pp. 38–39). This reliance on Salin in the early periods represents a thematic, political, and social bias which, due to the limited number of alternative photographs, we can but acknowledge.

The source material stems largely from three main collections. The Stockholm City Museum's digital archive (https://digitalastadsmuseet.stockholm.se), which since 1932 has gathered photos from both public and private collections (Forsmark, 2012), formed the foundation of our search. Keywords ("streets," "street life," "street environment") were used to identify relevant photos. As this search yielded less data for P1, we bolstered our dataset using a photo book (Josephson et al., 1930) and postcards of street life from a published collection (Rosell & Dyhlén, 2009). Most of the online source material detailed location and time, though often with a fairly broad estimate regarding the latter. Estimates often straddled two of our periods, thereby demanding subjective categorisation. As well as using information external to the image (knowing Salin's preference for shooting older, soon-to-be-demolished buildings, for example), the period in which the date range most lay was typically chosen.

Beyond basic data about the period, photographer, source, and location, each photograph was coded for street characteristics (roadway and pavement material, type of street, and district location), traffic, and the social and spatial characteristics of each pedestrian. Regarding social data, we coded for age and gender as well as company incidence and composition. Age (adult or child) was determined subjectively, which in rare instances demanded a somewhat arbitrary classification (see Figure 1b for an example of a pedestrian recorded as "man" when "boy" may also have fitted). Gender was recorded based on our perception of historically rigid appearance and attire binaries, which rarely resulted in ambiguity. Similarly clear was company incidence, which was noted if pedestrians were in an obvious group or walked side-by-side (see the children in Figure 2a or the two men in the distance in Figure 2b). Company composition (whether uniform or diverse in terms of age/gender) was judged by the aforementioned subjective gender and age interpretations. We feel that the subjectivity and researcher bias in social coding is, as mentioned above, mitigated by the large sample size.

With respect to spatial characteristics, pedestrian movement and position on the roadway or pavement was recorded, which we could then plot against social data for each pedestrian. This allowed us, for example, to identify the degree to which pedestrians used pavements for walking, how this developed over time, and to what extent the pattern differed across gender and age, as well as street type (main or minor). Our coding selection allowed for the spatial-temporal comparisons we set out to explore, which, with acknowledgement to the inherent limitations of both our method and the photographic medium as source material, we discuss in the following sections.

Figure 1. Period 1: (a) Junction of Norrtullsgatan and Odengatan (one "main street" and one "minor street"); the corner house was torn down in 1902; two men ("homo-social") have stopped in the macadam roadway for a conversation, despite oncoming horse-drawn traffic, while two women ("homo-social") cross the street; a male pedestrian walks down the right-hand cobble-stoned pavement; (b) Drottninggatan ("main street"); all pedestrians stick to the pavement, despite traffic absence. Sources: (a) Salin [ca. 1900–1902]; (b) Salin [ca. 1885–1907].

Figure 2. Period 2: (a) Junction of Sankt Paulsgatan and Timmermansgatan ("minor streets"), 1912; children play together in the roadway as a female cyclist passes; other pedestrian types inhabit the streetscape beyond, among them a still-standing man and a ("hetero-social") moving couple on the sett-stoned left-hand pavement; (b) Birger Jarlsgatan ("main street"), Norrmalm, 1907; the majority of pedestrians stick to the pavement in spite of no traffic. Sources: (a) Heimer (1912); (b) Heimer (1907).

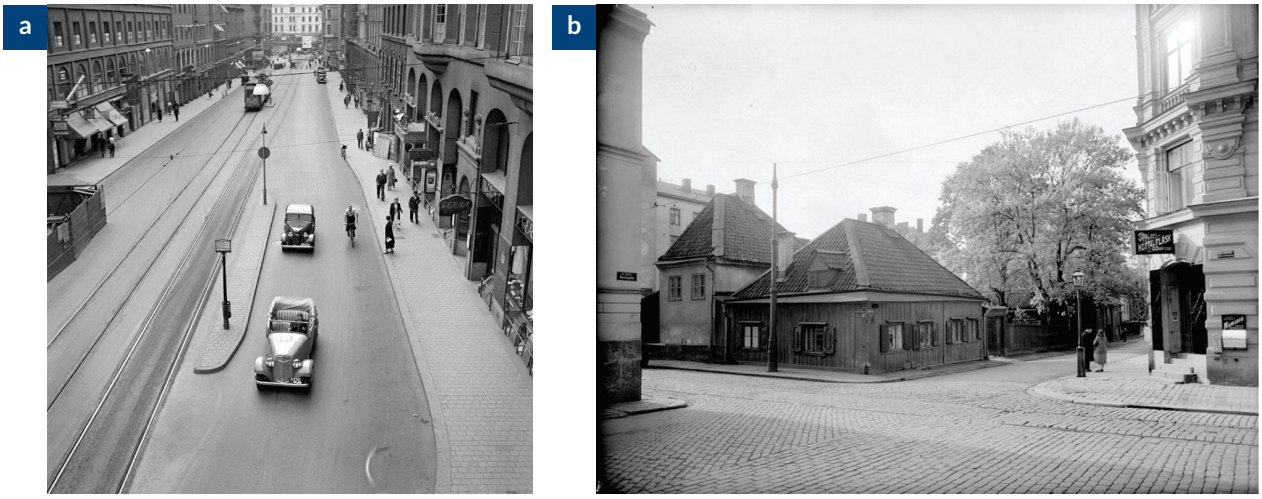

Figure 3. Period 3: (a) Kungsgatan ("main street"), 1938/39; all pedestrians are adults, moving, largely unaccompanied and using the left-hand pavement; some women carry handbags; no pedestrians use the edge of the concrete pavement, besides the woman awaiting cycle and vehicle traffic to pass before crossing the asphalted roadway; (b) corner of Bondegatan and Renstiernas Gata ("minor streets"), 1929; the wooden house was demolished the same year; two women stand opposite, occupying an otherwise empty street. Sources: (a) Lange [ca. 1938–1939]; (b) "Hörnet av Bondegatan" (1929).

3. Walking as a Traffic Mode

The turn of the 20th century marked Stockholm's transformation into the industrial centre of Sweden, its population tripling to 300,000 as it evolved from a trading and shipping town just 50 years earlier. The urban elite sought to capitalise on this growth by modernising the city with new infrastructure systems, a Haussmann-inspired street layout, and a streetscape featuring gutters, levelled surfaces, and smoother pavements and roadways (for more details and full references, see Emanuel, 2023). In the first half of the 20th century, Stockholm outgrew today's grid-patterned inner city, with tramways servicing suburbs that allowed families to leave the centre for a life in the outskirts (Hall, 2009). As a result, although the entire city's population in 1940 (590,000) was almost twice that at the turn of the century, more than 20% (ca. 130,000) now lived outside the inner city. Although the first automobiles appeared in Stockholm's streets as an elite means of pleasure mobility early in the century, the 1920s was the first period of real expansion, with motorised traffic outgrowing horse-drawn, a worrisome growth in traffic accidents, and the introduction of various forms of traffic control, including pedestrian crossings (Dufwa, 1985, pp. 76–108).

Previous research into the history of walking points to the paradoxical combination of the marginalisation, yet omnipresence of pedestrians in 20th-century cities (Pooley et al., 2021). While they may have remained dominant in number, pedestrians had to adjust to higher traffic intensity and increasingly car-oriented street design (Hornsey, 2010; Rooney, 2018). The question remains, however: When and to what degree did pedestrians adapt to these changes?

Table 1 shows the mean number of the different kinds of human-operated "mobile units" per photograph, as well as the percentage share of all types (i.e., the "modal split") for the respective periods. While pedestrians easily outnumbered all other mobile units, their share of traffic gradually declined, falling from 84% in P1 to 74% in P3. Motorised traffic, negligible in P2, grew significantly, making up 16% of all traffic in P3, with the

first half of the 20th century seeing a partial transition from human and animal propulsion to fossil fuel. The presence of trams and cyclists also grew slightly in P3, likely a result of suburbanisation, which also prompted the use of bicycles as a cheap means to commute (Emanuel, 2012). Relatively speaking, motorised vehicles increased, and pedestrians decreased, particularly after the First World War. However, when considering the number of pedestrians *per photo* in each period, which can be said to correspond to the intensity of pedestrian traffic, we find a slight increase from around 6 per photo (or "per street") in P1 and P2 to 7.6 in P3. These findings reflect those of previous research. Pedestrians remained "the biggest modal group" on Turku's streets (Männistö-Funk, 2021, p. 234), while in central Gothenburg (Cochoy et al., 2015), despite the increasing number of cars in the interwar period, they amounted to less than 15% of the number of pedestrians (compared to 22% for Stockholm in P3).

Table 1. Modal distribution across the three periods.

	Pedestrians	Horse-drawn vehicles	Cyclists	Motor vehicles	Trams	Carts	Total
P1	5.84 82.7%	0.52 7.4%	0.07 1.0%	0.01 0.2%	0.09 1.3%	0.52 7.4%	7.16
P2	6.04 80.9%	0.52 6.9%	0.13 1.7%	0.05 0.7%	0.09 1.3%	0.64 8.6%	7.47
P3	7.57 73.7%	0.10 1.0%	0.47 4.6%	1.64 16.0%	0.22 2.1%	0.27 2.6%	10.27

Notes: Mean per photo appearances of different mobile units in respective period, and their percentage distribution (the modal split); only moving vehicles were counted (not parked cars/bicycles).

While pedestrians did not decline in number (on the contrary, their presence increased in line with Stockholm's growing population), their whereabouts in the street changed considerably. As Stockholm began establishing pavements in the mid-19th century, they focused initially on centrally located districts (Emanuel, 2023). However, aside from a few peripheral locations in the earliest period studied here, all consulted photographs feature pavements. Overall, pavements had smoother paving than the roadways and, at least in pre-car times, were a matter of pedestrian comfort as much as traffic safety. Cobblestone pavement had been all but abandoned by the turn of the century, the city administration instead preferring sett stones, before turning to asphalt and concrete in the 1920s. Paved roadways followed a similar (though later) trajectory, with the development of gradually smoother surfaces (Dufwa, 1985, pp. 50–51). Our findings are in line here, with one-third of roadways remaining unpaved in the earlier periods, falling to just 3% in P3.

Noticeable in Table 2 is the relatively constant degree of roadway presence among pedestrians in P1 and P2 (36% and 39%, respectively), but a sudden decline to 15% in P3. That is, pedestrian use of pavements increased dramatically to 85% in the interwar period. This mirrors anecdotal evidence regarding pedestrian freedom around the turn of the century in using the entirety of the street (Faire & McHugh, 2014, p. 23; Joyce, 2003, pp. 215–216), although a majority nonetheless chose the pavement for reasons of comfort rather than to stay safe from traffic (see Figure 1b). Pedestrians' shift to pavements in P3 was, we argue, due to the increase in motorised traffic and related danger in the roadway rather than the improving smoothness of pavement surfaces. Between 1914 and 1927, the number of reported accidents in Stockholm rose from 600 to 2,100, with pedestrians accounting for two-thirds of traffic fatalities and nearly 60% of those injured (Dufwa, 1985, pp. 98–100). A decline in accidents during the 1930s was likely due more to the stabilisation in the growth rate of motor vehicle use during the Depression than to effective traffic education, although such had been

initiated on a smaller scale in the 1920s and made mandatory in 1936 (Emanuel, 2021b; Swedish Government, 1948, pp. 249–250, 357). This interpretation is supported by previous scholarship, which has argued that, as motorised traffic grew, streets became increasingly ordered, flows more separated, and pedestrian use less ambiguous. They progressively knew their place, stuck to the pavement, and learned to cross the roadway in an organised fashion (Cochoy et al., 2015; Gruber et al., 2018; see also Moran, 2006).

Table 2. Pedestrian position and movement in the street.

	Overall street use					Pavement use				
	Position		Movement			Position			Direction	
	Roadway	Pavement	Moving: Along the street	Moving: Crossing the street	Still	Middle	Towards the roadway	Towards the buildings	Left pavement	Right pavement
P1	2.10 36.0%	3.74 64.0%	3.76 64.4%	0.57 9.8%	1.50 25.8%	1.75 46.8%	1.15 30.8%	0.84 22.4%	56.9%	43.1%
P2	2.34 38.8%	3.70 61.3%	3.40 60.2%	0.76 12.6%	1.64 27.2%	1.90 51.4%	1.11 30.1%	0.69 18.5%	61.0%	39.0%
P3	1.16 15.3%	6.41 84.7%	5.01 66.3%	0.69 8.8%	1.89 24.9%	3.75 58.5%	1.35 21.1%	1.31 20.4%	55.7%	44.3%

Notes: Appearances per photo and percentage distribution of pedestrians' street use; left and right pavement (columns to the far right) in relation to the direction a pedestrian was walking.

Table 2 also reveals other less dramatic as well as less easily interpretable patterns of continuity and change in pedestrian practice. Firstly, a stable pattern of greater use of the left-hand pavement compared to the right. This might be explained by the fact that, since the late 19th century, local regulations recommended pedestrians do so to facilitate their efficient circulation (Emanuel, 2023). Meanwhile, pedestrians increasingly used the middle section of the pavement, while walking close to the roadway declined (see Figure 3a, for example). This can be interpreted in different ways. An early preference for smoother kerbstones (Emanuel, 2023) might have been offset by the entire pavement surface becoming smoother (as discussed above and also seen in our data, which suggests a steady decline in cobblestone pavements: 19% of photos in P1, 12% in P2, and none in P3). Alternatively, over time, pedestrians may have avoided the pavement section closest to increasingly fast-moving traffic. One feature that shows little variation over time, but is nonetheless interesting, is that a quarter of pedestrians were still. Whether they played on the spot, stopped to talk to friends, browsed shop windows, waited to cross the street, or observed their surroundings, while on foot, they did not walk (see Figures 1–3 for examples of stillness). Why this did not change, despite the street increasingly becoming a space of movement and circulation, is hard to say. A greater understanding of how dominant "ways of being still" varied over time may provide an answer, though our current method does not capture this. Nonetheless, the relatively high share of non-moving pedestrians emphasises that walking is not just about transportation, but a practice with social qualities. As we will see below, it also shows variations across social groups.

4. Walking as a Socially Differentiated Practice

Besides traffic, streets are social spaces, shared by people of all classes, ages, and genders, though not all groups are necessarily equally present. Table 3 reveals the age and gender distribution of pedestrians in the

Stockholm photographs. We notice a striking increase in the number of adults per photo (men and women) in P3 compared to earlier periods and an equally striking decline in the number of children. That is, the slight increase in pedestrian presence noticed above masks a more remarkable trend: Making up approximately one-fifth of all pedestrians in P1 and P2, children's share decreases to just 6% in P3. Boys' presence declined more rapidly than girls', to the degree that they were almost equally absent in P3. How can we understand this dramatic change? School was compulsory for Swedish children aged 7–14 in 1882 and Stockholm's official statistics suggest that almost all children were registered at one. Although some families likely failed to comply with government regulations, children did not swap the street for the schoolyard to any large degree during the studied period. Local demographic change takes us further. The influx of young adults seeking work in the capital, paired with an exodus of families to Stockholm's new suburbs in the 1930s, reduced the population share of children in the inner city from 25% in the late 19th century to just above 10% in 1940 (calculations based on data in *Statistical Yearbook of Stockholm*; City of Stockholm, 1905–1940). Yet, as we will see, other factors were also at play.

The gendered pattern among adult pedestrians shows more stability. Across time, women made up a share of 35–40% of adult pedestrians. Though they were fewer than men throughout the studied period, their overall number in the street also increased. These findings align with those of Männistö-Funk (2021, p. 235), where women in Turku's inner city were "almost as numerous as male pedestrians."

Table 3. Pedestrians' age and gender.

	Men	Women	Boys	Girls	Adults	Children
P1	2.97 63.0%	1.75 37.0%	0.72 65.0%	0.39 35.0%	4.72 80.9%	1.11 19.1%
P2	3.06 64.5%	1.69 35.6%	0.79 61.2%	0.50 38.8%	4.75 78.5%	1.29 21.5%
P3	4.41 61.9%	2.72 38.1%	0.24 55.4%	0.20 44.6%	7.13 94.2%	0.44 5.8%

Notes: Appearances per photo and percentage distribution of pedestrians across age and gender; the percentages represent men's and women's share out of adults (left), boys' and girls' share out of children (middle), and adults' and children's share out of all pedestrians (right).

Table 4 reveals the degree to which pedestrians populated streets either on their own or in groups. We understand this as a measure of the sociality of the streets. Throughout the studied period, an intriguingly high share (40%) of pedestrians frequented streets in the company of others: walking in pairs or groups, standing together, or sharing in play (see Figures 1–3 for examples of sociality). This alone testifies to streets as social spaces, a feature that survived at least the early stages of automobility.

There is more to say in terms of who walked with others and the characteristics of their company. Women, while less prevalent in the streetscape overall, were in company more often than men. That said, the majority of women in all periods walked alone, which aligns with Männistö-Funk's (2021, p. 231) find that in Turku, women of all social classes commonly walked unaccompanied, despite the many claims of its inappropriateness. Across time, a similar number of men and women were in hetero-social (male/female) company. Meanwhile, while men featured less in company overall, homo-social male company was twice as common when compared to women. (See Figures 1—3 for examples of "hetero-social" and "homo-social"

Table 4. The sociality of walking.

	Social state		In company				Kind of adult company and gender				Kind of company and age			
	In company	Alone	Men	Women	Boys	Girls	Men hetero-social	Men homo-social	Women hetero-social	Women homo-social	Men with child	Women with child	Boys with adult	Girls with adult
P1	2.19 37.5%	3.65 62.5%	0.84 28.1%	0.61 34.9%	0.44 60.9%	0.30 77.4%	0.16 5.3%	0.64 21.4%	0.16 9.4%	0.33 19.1%	0.04 1.5%	0.11 6.5%	0.05 7.0%	0.12 30.6%
P2	2.59 42.9%	3.45 57.1%	1.04 34.2%	0.73 43.3%	0.45 57.1%	0.36 72.5%	0.15 4.9%	0.82 27.0%	0.13 7.5%	0.45 26.9%	0.06 2.1%	0.15 9.0%	0.12 15.1%	0.15 30.0%
P3	2.86 37.9%	4.70 62.1%	1.42 32.2%	1.08 39.8%	0.20 83.3%	0.16 82.8%	0.36 8.3%	0.97 21.9%	0.32 11.9%	0.57 21.1%	0.09 2.0%	0.18 6.7%	0.09 38.9%	0.11 55.2%

Note: Appearances per photo and percentage distribution of pedestrians in company or alone; how often each age/gender category was in company; how often (adult) pedestrians were in company with someone of their own or the opposite gender; and how often adults accompanied children and children were accompanied by adults (% of respective age and gender group).

companies.) Women also accompanied children to a much higher degree than men: While 6–9% of all women accompanied a child, only around 2% of all men did.

Turning to children's sociality, they were much more often in company than adults and particularly so in P3. Girls were most often in company (73–83% across the periods) and more frequently than boys in P1 and P2, but not in P3. The two far-right columns of Table 4 also reveal two striking patterns: Children were increasingly accompanied by parents (or other adults), and girls much more so than boys. This reflects previous research that suggests girls, especially from the middle classes, were more constrained in their mobility than boys. That is to say, they were more often accompanied and their excursions from the home shorter, though their freedom in these respects increased after the turn of the century (Sleight, 2016, pp. 107–111). That said, the percentage difference declined in P3, when 40% of boys and 60% of girls were accompanied by an adult. It is important to remember that the shares need to be understood in the context of children being less frequently present on streets altogether. For example, the share of girls of all pedestrians is consistently the least of all groups, falling to 2.6% in P3.

From this data, we can conclude that while women often visited streets in their husband's or other men's company, men were much more often with male acquaintances. The data also suggests that children's (particularly girls') independent use of streets declined as they became increasingly escorted by their parents or other adults and that boys tended to frequent streets more often in groups.

As seen in Table 5, roadway use declined significantly in P3 for all age and gender categories, particularly among children. Significantly, around half of all boys used the roadway in P1 and P2 (far more than girls as well as adults), but in P3 were mostly found on pavements. Women used pavements slightly more than men in P1 and P2, which might reflect greater concern about appearing respectable in public. However, this

gendered difference levelled out in P3. Interestingly, pedestrians in P1 who attended streets in groups were more often in the roadway when compared with the average pedestrian, while in P3, the situation reversed: Groups were more often found on pavements compared to the overall pattern among pedestrians. These findings suggest that the increase in traffic forced sociality from roadways onto pavements by shaping new norms about appropriate pedestrian behaviour (as exemplified in Figure 3a, pedestrians often socialised on pavements despite no traffic in sight).

Table 5. Position in relation to age, gender, and sociality.

	Men		Women		Boys		Girls		In company		Alone	
	Roadway	Pavement	Roadway	Pavement	Roadway	Pavement	Roadway	Pavement	Roadway	Pavement	Roadway	Pavement
P1	1.08	1.89	0.54	1.21	0.36	0.36	0.11	0.28	0.88	1.31	1.22	2.43
	36.4%	63.6%	30.9%	69.1%	50.4%	49.6%	29.0%	71.0%	40.2%	59.8%	33.4%	66.6%
P2	1.18	1.88	0.50	1.18	0.44	0.35	0.22	0.28	1.03	1.57	1.31	2.13
	38.5%	61.5%	29.9%	70.1%	55.6%	44.4%	43.8%	56.3%	39.6%	60.4%	38.1%	61.9%
P3	0.68	3.73	0.43	2.29	0.04	0.20	0.01	0.19	0.33	2.53	0.82	3.88
	15.5%	84.5%	15.7%	84.3%	16.7%	83.3%	3.4%	96.6%	11.6%	88.4%	17.5%	82.5%

Note: Appearances per photo and percentage distribution of pedestrians' position in the streetscape across age and gender, and whether they are in groups or alone.

As we saw in Table 2, roughly 75% of all pedestrians across all periods were walking, while 25% were sedentary. Yet, as seen in Table 6, there were large variations within this across gender, age, and sociality. Unsurprisingly, social pedestrians show a much greater tendency to be still than those using the streets alone. Intriguingly, roughly half of all children were still (more so for boys than girls); roughly twice as high a percentage when compared with adults. While we did not code for specific activities of still pedestrians, we nonetheless assert that children who were still either just "hung out" or engaged in street play on pavements or roadways (see Figure 2a).

Table 6. Movement in relation to age, gender, and sociality.

	Men		Women		Boys		Girls		In company		Alone	
	Moving	Still	Moving	Still	Moving	Still	Moving	Still	Moving	Still	Moving	Still
P1	2.18	0.79	1.63	0.12	0.31	0.42	0.21	0.18	1.43	0.75	2.90	0.75
	73.4%	26.6%	93.2%	6.8%	42.6%	57.4%	54.8%	45.2%	65.5%	34.5%	79.5%	20.5%
P2	2.24	0.82	1.43	0.26	0.41	0.38	0.32	0.18	1.70	0.89	2.70	0.75
	73.3%	26.8%	84.7%	15.3%	51.6%	48.4%	63.8%	36.3%	65.5%	34.5%	78.3%	21.7%
P3	3.30	1.11	2.17	0.55	0.14	0.11	0.08	0.11	1.99	0.87	3.69	1.01
	74.7%	25.3%	79.9%	20.2%	55.6%	44.4%	41.4%	58.6%	69.6%	30.4%	78.5%	21.6%

Note: Appearances per photo and percentage distributions of pedestrians' movement in the streetscape across age and gender, and whether they are in groups or alone.

Strikingly, across periods, men moved considerably less than women, although women also became increasingly sedentary. It seems as if women's use of city streets in the early 20th century was busier and more utility-oriented than men's. This interpretation is strengthened by the data on pedestrians' carried

items (see Supplementary Material), which shows that women, although fewer in number than men, carried a comparable number of items. Thus, the proportion of women carrying items was significantly higher: around 25% of women compared with 16% of men in P1; and 20% compared with 10% in P3. Considering dominant gender roles and women's overall responsibility for social reproduction (managing the home and children as well as putting food on the table), it is unsurprising that they moved through the streets with greater urgency and were more frequently burdened with belongings. Their increasing stillness over time is not as easily interpreted, though might be explained by an increasing purchasing power that allowed them to engage in the emerging consumer culture (Husz, 2004). Stockholm saw a dramatic levelling out of income inequalities after 1920. By 1920, more than 50% of women over 15 years old in Stockholm were employed out of the home; not least young women who had moved to the capital for work (Bergman & Kock, 1938, pp. 471–475). As more women joined the labour market, and as working women increasingly shifted from domestic to clerical work after 1920, their income levels began to catch up with that of men (Bengtsson & Molinder, 2024). While this did not increase their comparative presence in city streets, it might have brought changes to how women (and men) used streets as well as when and where.

5. Walking as a Spatially Differentiated Practice

Streets were social spaces, and many features of street use (presence, whereabouts, movement patterns) were differentiated across age, gender, and sociality. Walking and street use also varied across different types of streets and districts (though the latter is not included in our analysis here). Of the 159 photographs in P1, 159 in P2, and 148 in P3, 40, 41, and 59 respectively were taken in streets that we categorise as "main streets": 14 larger streets, cutting across city districts, which still today structure the cityscape of inner-city Stockholm. All other streets were classified as "minor streets" (see Figures 1–3 for examples of main and minor streets). Table 7 reveals that the pedestrian share of all traffic was slightly higher on minor than main streets, while motor vehicles show the reverse pattern. The number of pedestrians per photo was 50% higher on main compared to minor streets in P1 and P2 and 80% higher in P3—which broadly mirrors the overall traffic distribution over main and minor streets. Whether it was due to appeal or necessity, pedestrian use of main streets remained.

Table 7. Modal split in main and minor streets.

	Pedestrians		Horses		Cyclists		Motor vehicles		Trams		Carts		Total	
	Main	Minor	Main	Minor	Main	Minor	Main	Minor	Main	Minor	Main	Minor	Main	Minor
P1	7.98	5.12	0.88	0.40	0.10	0.06	0.03	0.01	0.18	0.07	0.93	0.39	10.1	6.1
	79.2%	84.7%	8.7%	6.7%	1.0%	1.0%	0.2%	0.1%	1.7%	1.1%	9.2%	6.4%		
P2	7.93	5.38	0.68	0.46	0.27	0.08	0.12	0.03	0.10	0.09	0.90	0.55	10.0	6.6
	79.3%	81.7%	6.8%	6.9%	2.7%	1.2%	1.2%	0.4%	1.0%	1.4%	9.0%	8.4%		
P3	10.29	5.76	0.14	0.08	0.63	0.37	2.34	1.18	0.36	0.12	0.41	0.18	14.1	7.7
	72.7%	74.9%	1.0%	1.0%	4.4%	4.8%	16.5%	15.3%	2.5%	1.6%	2.9%	2.3%		

Note: Appearance per photo and modal split on main and minor streets in Stockholm.

Table 8 shows pedestrian position, movement, and sociality in the streetscape, but now offers comparison between different "kinds of" streets. While the data on position reveal little of interest, pedestrians were more mobile but less commonly in company with others in main compared to minor streets throughout the studied period. Even if pedestrians did not apparently shy away from main streets, stationary sociability was

more likely in minor streets with less traffic (see Figures 1a and 3b). Meanwhile, main streets arguably served more as pedestrian corridors for the circulation of unaccompanied, predominantly male, individuals.

Table 8. Street behaviour in main and minor streets.

	Position				Movement				Sociality			
	Main		Minor		Main		Minor		Main		Minor	
	Roadway	Pavement	Roadway	Pavement	Moving	Still	Moving	Still	Company	Alone	Company	Alone
P1	2.85 35.8%	5.13 64.2%	1.85 36.0%	3.27 64.0%	6.15 77.1%	1.83 22.9%	3.72 72.9%	1.39 27.2%	2.78 34.8%	5.20 65.2%	1.99 38.9%	3.13 61.1%
P2	3.00 38.9%	4.68 61.1%	2.11 38.7%	3.36 61.3%	5.90 76.8%	1.78 23.2%	3.87 70.9%	1.59 29.1%	2.80 36.4%	4.88 63.6%	2.52 46.1%	2.95 53.9%
P3	1.34 13.6%	8.44 86.4%	1.03 16.9%	5.07 83.1%	7.49 76.7%	2.29 23.3%	4.48 73.6%	1.62 26.4%	3.34 34.1%	6.44 65.9%	2.55 41.7%	3.55 58.3%

Note: Appearances per photo and percentage distributions of pedestrians' position, movement, and sociality in the streetscape in main and minor streets.

The gender distribution among adult pedestrians shows little difference between main and minor streets (Table 9). However, children were considerably more present in minor than main streets. Meanwhile, while there is a stable gendered pattern of children's presence in minor streets (60% boys, 40% girls), there is a rather spectacular levelling out of their differing presence in main streets: from 85% boys and 15% girls in P1, to an equal gender distribution in P3. This levelling out is due to the significant increase in girls' presence (particularly when compared to the presence of boys) in main streets between P1 and P2, followed by an even more significant decrease in the presence of boys (again, particularly when compared to girls'). Firstly, this aligns with the aforementioned suggestion in previous research of an increase in girls' freedom of movement (P1 to P2). Secondly—and cross-reading with findings from the previous section—boys, who in general had a high presence in main streets and roadways in earlier periods, show a particularly strong trend in moving to pavements and side streets. Their whereabouts appears to have been particularly impacted by traffic, which we understand as resulting from their greater engagement in street play.

Table 9. Age and gender in main and minor streets.

	Main		Minor		Main		Minor		Main		Minor	
	Men	Women	Men	Women	Boys	Girls	Boys	Girls	Adults	Children	Adults	Children
P1	4.58 64.9%	2.58 36.1%	2.44 62.3%	1.47 37.2%	0.73 85.7%	0.10 14.3%	0.72 60.0%	0.49 40.0%	7.15 89.6%	0.83 10.5%	3.91 76.4%	1.21 23.6%
P2	4.27 67.9%	2.02 32.1%	2.64 62.8%	1.57 37.2%	0.93 66.7%	0.46 33.3%	0.75 59.1%	0.52 40.9%	6.29 81.8%	1.39 18.2%	4.20 77.0%	1.26 23.0%
P3	5.90 62.5%	3.54 37.5%	3.43 61.3%	2.17 38.7%	0.17 50.0%	0.17 50.0%	0.29 58.1%	0.21 41.9%	9.44 96.4%	0.34 3.6%	5.60 91.6%	0.51 8.5%

Note: Appearances per photo and percentage distributions of pedestrians' age and gender in main and minor streets.

6. Discussion

The analysis above focussed on walking as a mode of traffic and as a socio-spatial practice. Using a large sample of street photographs, we have uncovered trends and aspects of walking and street use that are often hidden in other historical sources. It is important to note that while photographs are useful in capturing pedestrian whereabouts and street use over time, the data gathered from our coding alone offer limited explanatory power. However, details about actual walking, rather than how it was discussed and fought over, can help us to interrogate findings, claims, and narratives based on textual historical sources. As previously noted, shifting photographic conventions throughout the periods, an overreliance on certain photographers, and a gradual shift in focus to more central districts containing a greater number of livelier main streets are likely to have skewed our data somewhat. However, the observed trends and changes are often so great as to offer insight despite these factors.

Treating walking as a mode of traffic, we found that throughout the studied period, pedestrians far outnumbered all other kinds of road users. Even the early onset of urban automobility did not curb walking in city streets, though our results suggest that in many ways, it did contribute to changing dominant pedestrian behaviours. Of particular note is the drastic decline of pedestrians found in the roadway after 1920. Instead, their use of pavements increased from 60–65% in the earlier periods to 85% in the interwar period. Such radical change in behaviour is partly explained by the greater intensity and danger brought to streets by increasing car traffic and corroborates findings in previous historical research (Errázuriz, 2011). Targeted campaigns to change pedestrian behaviour also played a role, as did material change in the streetscape (Emanuel, 2021b; Norton, 2007; Rooney, 2018).

Our detailed reading of Stockholmers in the streetscape uncovered other significant details and trends that are, we argue, relevant for a wider understanding of pedestrian street use. One illuminating result is that, over time, around 25% of all pedestrians were still; they resided in city streets but did not walk. Hence, they ignored sidewalk regulations that, since the late 19th century, framed the streetscape as primarily a place for pedestrian circulation (Ehrenfeucht & Loukaitou-Sideris, 2007; Emanuel, 2023; Mackintosh, 2017, Chapter 5). Also of note is the fact that, over time, 40% of all pedestrians populated city streets in company (rather than alone). Notwithstanding dominant ideas about the value of speed, circulation, and uninterrupted flows in contemporary society (think of Le Corbusier's axiom "death of the street," as well as later interpretations about streets becoming monofunctional traffic arteries devoid of social life), our data suggest that a significant minority of pedestrians rejected this transformation and continued to inhabit streets as social creatures, lingering in the flow despite having less space at their disposal for doing so as they were increasingly relegated to the pavements. Hence, our study suggests that some facets of walking and street use are surprisingly resilient.

The treatment of walking as a mode of traffic here roughly corresponds to mainstream walkability research's consideration of walking as a homogeneous practice. Considering pedestrians not as a whole, but instead part of a socially differentiated practice, reflects the more recent interest in walkability studies to account for sociodemographic variation. Walking is shaped not only by the material-spatial environment but also by its social character and non-walking activities. In some instances, considering age and gender uncovered variations that were otherwise masked when assessing pedestrians as one. Regarding gender, our data suggest a rather stable distribution between adult men (60%) and women (40%) present in city streets.

This is a somewhat unexpected finding given previous research's suggestions about women's increasing appropriation of public space.

Our finer-grained analysis helps nuance things further. Women, compared with men, were more often in company (including with children), moving, carrying items, and using pavements rather than roadways, though this disparity diminished somewhat after 1920. These findings amount to a seemingly paradoxical image of women in the street: on the one hand, having less time to linger than men, busy carrying out their daily chores; on the other, socialising more and attending to their children. However, drawing on the work of feminist scholars, these two features can be interpreted as facets of women's walking as a relational activity (Heddon & Turner, 2012, as cited in Männistö-Funk, 2021; Middleton, 2010, as cited in Männistö-Funk, 2021). Through walking, women maintained meaningful relationships and attended to the needs of those around them. Indeed, throughout the studied period, walking remained a gendered practice. However, whereas the inequality in women's and men's street presence remained stable over time, the gender gap in their use of streets was closing.

Regarding age, we found a remarkable decline in the street presence of children, from roughly 20% of all pedestrians in the earlier periods to only 5% after 1920. While the exodus of families to Stockholm's suburbs takes us some way in explaining this dramatic decline, further explanation is found in our data on changes in children's independent mobility, which is most likely related to the onset of urban automobility. While children often frequented streets on their own or in other children's company during the earlier periods, after 1920, 40% of boys and 50% of girls were accompanied by an (often female) adult. Meanwhile, children's tendency to use pavements rose significantly: for boys, from 50% to more than 80%; for girls, from 70% to almost completely. In many respects, the gendered pattern among adult pedestrians also applies to children, with imbalances often levelling out somewhat over time. Evidence from England and Germany shows that children's independent mobility has been on the decline since the 1970s (Shaw et al., 2013), but our findings suggest that, in fact, this decline set in considerably earlier.

Our more fine-grained analysis points to a need to consider spatial differences, with different streets offering different opportunities to pedestrians, not least children. While busier main streets did not deter pedestrians, they stand out as particularly catering to their flow, with an overrepresentation of single males and those on the move. Smaller streets, on the other hand, seem to have offered alternative life worlds: more stillness and sociality as well as an overrepresentation of children across the studied period. Regrettably, we did not code for children's activities, though still feel confident in stating that there were many instances of street play in the earlier periods, which reduced dramatically after 1920. As street play was more prevalent among boys, its decline also helps explain why gender differences levelled out over time. For example, while 93% of boys roamed the city street on their own in the earliest period, only around 60% of them did so after 1920 (the corresponding figures for girls are 70% and 45%). Whether they were no longer allowed, or practically unable, to play in city streets, the rapid change in boys' use of street spaces after 1920 is surely connected to the marginalisation of play from inner-city roadways and pavements. This can be compared to the new suburbs, where opportunities for children's play were often put centre stage after the Second World War (Moll & Kuusi, 2021).

The strength of the structured photograph coding employed here is in its capturing of pedestrian number, whereabouts, and movement patterns, as well as associated sociodemographic and spatial variations. With

the interpretative support of qualitative historical research, it also allowed us to make claims about how they reflect social norms around street use, notably concerning children's play in streets, and how the role of women as caregivers intertwined with their walking practices. Attending to such facets of walking and related street use would, we argue, be a valuable expansion of walkability studies. Hence, our findings fuel the recent trend in embracing the full social complexity of walking, understanding it not just as transport, but as a relational activity shaped by street design and socially produced spatial connections (cf. Masoumzadeh et al., 2023; Shields et al., 2023). This includes, among other things, addressing both how well a pedestrian space accommodates non-walking activities and the variegated experiences of different social groups.

What are the implications of our findings for current efforts to improve the conditions for walking in cities? The period under study in this article is far removed from the present day and we are reluctant to make any linear projections based on the trends we have found. Nor will we, based on the more stable patterns, make any essentialist claims about the nature of streets, walking, or street life. Yet our study shows that the early onset of automobility—although not the only factor at play in changing historical street use—had multifarious and demographically varied effects. This means that, while much needed, current agendas and efforts to create "streets for people" rather than cars (Bertolini, 2020) or create car-free inner cities (Nieuwenhuijsen & Khreis, 2016), might produce similarly uneven effects on different social groups and types of activities. Therefore, efforts to make streets more walkable, whether by road closure or traffic reduction, must ensure that they are open to the types of activities that make them attractive spaces for all.

7. Conclusion

This article set out to understand continuity and change in pedestrian street use through a detailed coding of photographs in Stockholm between 1880 and 1939. Recording mundane details concerning pedestrian type and location within the streetscape afforded a cross-referencing across time and space that revealed both expected and surprising relationships. Two of the most notable findings—the rapid drop in the number of children on city streets after 1920 and the stable 40% incidence of pedestrian groups—serve as examples of each. While our sample size of photographs and their contents arguably prevents any watertight conclusions, the ability to document developments across space and time offers evidence otherwise absent from historical research on walking in cities. We have, for example, been able to quantify the gendered nature of streets, document the relationship between the rise of the automobile and the marginalisation of pedestrians to the pavement, and describe not only the incidence of urban sociality but also its type.

Inspired by previous scholarship (Cochoy et al., 2015; Männistö-Funk, 2021), the article moreover explored the potential of coding historical photographs as a method for unearthing and contesting socio-spatial trends of walking in cities. Despite the initial ambition to record material change in the built environment, this proved complicated beyond our scope. A concerted effort to do so again, alongside a finer coding of variegated pedestrian type (dress, objects carried) and activity (types of stillness, children's instance of play), leaves room for future development. As does an expansion of the timespan and/or location, which would open up further diachronic analysis and useful city comparisons.

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Conflict of Interests

The authors declare no conflict of interests.

Supplementary Material

Supplementary material for this article is available online in the format provided by the authors (unedited).

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ARTICLE

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Walking Praxis as Community-Based Research: A Deep Map of Affective Flows in a Neighborhood Development Process

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Abstract

The rapid transformation of suburban neighborhoods, driven by development and changing demographics, is causing feelings of loss, disconnect, and a perceived diminution of political representation. This study examines socio-spatial relationalities that affect the sense of belonging in such neighborhoods-in-flux. We propose a re-imagined participatory research process with residents from the perspective of "walkability." Go-along walking methodology enabled us to gather place-based narratives that revealed how emotions and memories influence different aspects of the sense of belonging. Jointly moving through the environment gave us sensory exposure to sights, sounds, smells, and tactical sensations of the neighborhood. It also deepened our understanding of how residents mentally and physically navigate the proposed social and spatial transformations outlined in a municipal development plan. Our analysis, informed by a new materialist framework and visualized in a deep map, demonstrates how the walking methodology can generate new knowledge about socio-spatial dynamics to plan and design place. The methodology facilitated spontaneous and affective encounters with both human and other-than-human agents. The diverse range of place-based emotions, memories, and stories shared, provided insights into how the changing built environment and place identity produce multiple belongings. The findings suggest that go-along walking praxis offers a unique socio-spatial window into the affective flows of belonging in neighborhoods-in-flux.

Keywords

deep mapping; go-along interviews; new materialism; spatial planning; suburban village; walking

1. Introduction

While many of us engage in walking on a daily basis, it is commonly considered a mundane activity of almost unconscious movement. Yet, scholarly interest grows in walking as an emplaced method to tap into lived experience, memories, and community (O'Neill & Roberts, 2020; O'Rourke, 2013; Springgay & Truman, 2018). In this study, walking becomes a powerful tool for understanding how residents negotiate their sense of belonging in the context of rapid development and transformation in the Flemish region. The region, characterized by its dispersed suburban spatial fabric that is neither urban nor rural with expanding villages, allotments, and ribbon development, has suffered from decades of poor spatial decision-making and planning (Renard et al., 2022). In recent years, the transformation pressure has increased due to several spatial, social, economic, and environmental challenges, such as a housing crisis, mobility issues, and changes in the infrastructure of energy supply. Suburban villages have experienced both housing dispersion as well as (core) densification, while political mergers and economic shifts made such smaller villages more dependent on larger centers to meet basic needs such as employment, education, public services, or even social contacts.

At the same time, there is a gap between ambitious policy and implementation due to the complex web of planning policies, policy exceptions, and competing interests. The strong focus on denser neighborhoods, apartments, and collective living also aims to attract new residents, with a financial incentive to increase the municipal tax base to fund sports and cultural facilities (Canfyn & Janssens, 2014). This spatial change disrupts the sometimes nostalgic visual image of these villages and communities. Such change is not an easy process, precisely because it affects daily lives. The speed of change is perceived as a threat to the community's sense of belonging, through the disruption of spatial and social connections and changing demographics (Segers et al., 2021).

However, institutionalized (participatory) planning processes have insufficiently paid attention to aspects of a sense of belonging, unwillingly feeding a growing wave of resistance connected to a call for more participatory democracy (e.g., Abbeloos, 2023; Blommaert, 2023; Van Maele, 2023). The essential role of participation in urban planning as well as its challenging nature, has been well documented (Kuhk et al., 2019). While it can be applauded that participation is now institutionalized in planning processes, in its implementation it remains challenging to establish open dialogue and trust with citizens (De Bie et al., 2012). Resulting plans are still often static and disconnected from the local community and place reality. This contrasts with a growing understanding of place as fluid and entangled, as stated by new materialism (Fox & Alldred, 2017). Similarly, Massey (2005) defined place as relational and continuously changing, the site of coexisting differences, and thus a dimension of politics and power. From this dynamic understanding of place, such participatory processes insufficiently address the complex reality of neighborhoods-in-flux. We argue that a new materialist or socio-spatial lens could help participatory planning to acknowledge and incorporate this dynamic and relational place understanding.

Therefore, this study takes a socio-spatial approach to investigate how ongoing and accelerating spatial change affects residents, with a particular focus on the social dimension of a sense of belonging. Our study work is situated in a context of accelerating socio-spatial change. We therefore opted to investigate the sense of belonging through the theoretical concept of "assemblage," and, more specifically, the concept of "affect" as described as a becoming by Deleuze and Guattari (1988). Going beyond the emotional dimension,

this conceptualization understands affect as a force that shifts the state or capabilities in relations. Affective flows drive the unfolding of our lives, communities, and history as these connections expand capacities (Thrift, 2004). The combination of this focus on affects and moving through the changing environment to map socio-spatial practices and experiences allowed us to take stock of the ongoing changes during our fieldwork which resulted in a deep mapping process. Such deep mapping integrates rich multilayered streams of evidence (visual and textual) that enact multi-vocal understandings to democratize the spatial narrative and knowledge of a particular place (Springett, 2015).

Go-along walks were used to gather emplaced narratives, allowing us to engage residents in a sensory exposure to memories and emotions in relation to social and material aspects of place, in which we acknowledged the entanglement between body, mind, and environment (Springgay & Truman, 2018). Drawing on the new materialist or socio-material analytical framework of Fox and Alldred (2022), we mapped out different socio-spatial accounts, both real and imagined, in relation to the affects and capacities these relationships generated. Simultaneously, and by means of reflecting on our research strategy, we investigated what sort of knowledge could be generated from these go-along interviews by adopting this new materialist analytical framework.

We focus our study on the suburban, Flemish neighborhood Veltem-Beisem, hamlet of the municipality Herent. Located in the suburban agglomeration between Brussels and Leuven, it is subjected to increasing socio-demographic pressure through a number of factors. For decades, the expanding employment hubs of both cities increasingly attracted employees. Municipal boundaries permeate, as people settle in the urban agglomeration to fulfill housing needs. The village's tranquil, safe, and spacious housing arrangements, (more) affordable property rates, access to nature (Figure 2), and easy commute options appeal to both old and new residents. Rapid development aims to address housing demands. Expansion of the city has spilled to the core of the municipality, where in the last decade at least 1,000 new apartments were built. This fundamentally changed its character, previously available central green space, and demographics. Veltem-Beisem itself has recently seen an increase in similar, denser housing developments (Figure 1).

The spark that accelerated the neighborhood dynamics in Veltem-Beisem and our interest in the case was a general concern with the public investigation of a proposed spatial plan for the village center. The process started with a series of consultation events, including two walks and multiple info moments with a steering group in 2017. The plan was produced and presented for public investigation in 2022 to allow citizen feedback on the proposed plan. However, the process and its outcome were not perceived as participatory, representative, or place-sensitive by many residents, which has affected the relations between the

Figure 1. Development of 32 residences in the core of the village.

Figure 2. Chapel and field track.

municipality, the citizens, and the neighborhood. Citizens came together in protest, seeking judicial support to jointly submit almost 500 objections. Afterward, the plan was adapted and approved before being annulled after an appeal.

We were already personally connected to the village through previous research in the socio-spatial transformation of the community church St. Laurentius (Vrebos et al., 2023). Sensing the friction the plan triggered on the community, we decided to plug our socio-spatial toolkit into this placemaking process to investigate the underlying dynamics of an unfolding sense of belonging. This research investigated the broader dynamics of socio-spatial change and started during the public investigation.

2. Literature Review

2.1. Sense of Belonging

A sense of belonging is "the subjective feeling of deep connection with social groups, physical places, and individual and collective experience" (Allen et al., 2021, p. 1). This means that belonging consists of a "place belongingness" or the feeling of being "at home" through everyday practices and a politics of belonging through a more official membership (Antonsich, 2010). It can be spatially defined by a geographical area such as a neighborhood, or non-spatially, defined by proximity in social networks and shared values and ideals, e.g., through a cultural group, sports team, or social networking site (Raman, 2014). According to Segers et al. (2021), sense of place is an essential aspect of a sense of belonging. It is considered a fundamental human need essential for human wellbeing and even survival, similar to food, shelter, and physical safety (Baumeister & Leary, 1995). The concept is linked to numerous positive outcomes, while the lack of belonging has several negative outcomes on psychological and physical health (Allen et al., 2021), to the point that it has been used as a predictor for depression (Hagerty & Williams, 1999).

Despite the broad academic consensus on the significance of belonging, there has been a critique of the lack of conceptual clarity and consistency. Moreover, it is argued that the concept is studied too often through a unidimensional, subjective, and static approach which prioritizes social belonging, omitting the connection to place and culture and overlooking the dynamic interaction with social space (Allen et al., 2021). Other scholars have proposed more nuance. Yuval-Davis (2011) stresses the multidimensional axes of power that shape belonging and therefore proposes intersectional approaches. Youkhana (2015) proposes an alternative, space-sensitive conceptualization of belonging that takes the aspects of space and place further and integrates a material-semiotic perspective, distancing herself from what she calls an essentialized conceptualization of belonging in terms of social, political, and territorial boundaries and demarcations. She replaces this conventional, static spatial thinking based on inherent spatialities, territoriality, and boundary-making, with concepts based on movement and flow, developing a rhizomatic and entangled understanding of belonging through multiple and heterogenous actors. This builds on the idea that belonging is relational and "comes into being between people and things, and between people and people, through material conditions" (Youkhana, 2015, p. 16). She operationalizes this intersectional entwined conceptualization of belonging by proposing space as an analytical category. The socio-spatial changes in a neighborhood-in-flux affect the sense of belonging as both the physical place changes and the group identity shifts with a changing demographic. What was once perceived as a gradually evolving landscape in contrast to the urban environment has now entered a phase of rapid transformation.

2.2. New Materialism

New materialism denotes a range of philosophical perspectives with a focus on a turn to matter. The many new materialisms are characterized by three propositions: first, the world and its content are understood as relational, uneven, and in constant flux (Barad, 2007). Second, dichotomies like nature and culture are rejected and replaced with a continuum, as both the physical and social have material affects in this dynamic world (Haraway, 1997). Third, non-human and inanimate actors hold agency to produce the social world (De Landa, 2017). Instead of focusing on individual bodies and their supposedly inherent characteristics, new materialist theory focuses on assemblages, affects, and emergent capacities and "attends to complex flows of affects in everyday events that progressively and endlessly produce and reproduce the social world and human lives" (Fox & Alldred, 2022, p. 630). Some of the critiques on new materialism are the neglect of human responsibility and power dynamics as well as the difficulty to operationalize the theory. We aimed to address this latter critique by expanding previous approaches to operationalize the theory (Feely, 2020; Fox & Alldred, 2022).

The place emphasis of the model proposed by Fox and Alldred (2022) stems from the conviction that materiality possesses agency and can consequently affect relationships and social practices. This lens offers an analytical opportunity to apply the new materialistic philosophy to investigate the complex interplay between people, places, and things. By focusing on assemblages, the framework investigates events through the human and non-human relationships formed, the affects that shape these relations, the capacities these affects produce in matter, and, finally, the micropolitical consequences (Fox & Alldred, 2022). Affects represent a change of state of an entity and its capacities, which can be physical, psychological, emotional, or social. Capacities are what components are able to do through relations in the assemblage.

2.3. Walking and Mapping Methodologies

The increasing academic interest in walking methodologies within social sciences is situated in various turns, such as the spatial, sensory, and participatory turn. It builds on the understanding of place and spatial practices as actors in constructing lived experiences, perception, and meaning-making (Springgay & Truman, 2018). Despite the mundane act of walking often operating on a low level of awareness, it can invite an embodied attunement to place: the sensory experience of walking exposes the interconnectedness between our bodily movement, our consciousness, and our environment (O'Neill & Roberts, 2020). Walking as a method activates this awareness and as such can uncover tacit perceptions of places that hold personal significance in the present or past by passing through social and material circumstances. Walking as both method and methodology is practiced in a broad range of disciplines and widely theoretically studied (Springgay & Truman, 2018). Go-along interviews are a walking methodology where researchers tap into the potential of walking in participants' natural habitat while asking questions, listening, and observing. Actively moving through and interacting with the physical and social environment of participants as a companion allows researchers to engage deeply with the participant's emplaced experiences and spatial practices (O'Neill & Roberts, 2020). The slow navigation through the socio-spatial environment evokes a stream of place associations, including memories, anticipations (Kusenbach, 2003), and place attachments. The immersion in participants' environments cultivates a particular spatial sensitivity, offering privileged access to the socio-material milieu that shapes participants' everyday experiences (Martini, 2020).

In this study, we combine walking methodology with mapping practices to better understand the spatial entanglement between the material and discursive and the unfolding affects on sense of belonging. Walking

allowed for the rich and materially grounded investigation this lens requires. Extensive research has been done on the explicit and implicit power dynamics in maps (Corner, 2011) with artists and scholars experimenting with the combination of walking and mapping to counter unfair power dynamics through critical cartography (O'Rourke, 2013). Similarly, deep mapping aims to shift the spatial narrative towards a more democratic one by breaking through temporal, spatial, and disciplinary boundaries. It is an in-depth cartographic place investigation, which is an embodied and reflexive immersive exercise in contrast to a shallow or one-sided one, applied by literature, art, theatre, geographic information systems, or other forms (Roberts, 2016). Not necessarily a traditional cartographic approach, deep mapping involves an embodiment of mapping information on a representational plane, expressing metaphorical and sometimes material relations between various map components (Springett, 2015).

3. Methodology

A semi-participatory design approach was adopted to ensure that the research was inclusive, collaborative, and emplaced. This involved an initial engagement with the neighborhood committee to explain the objectives and consult on the format of the methods of walking and mapping. The objective of the study was presented to the larger community during an event organized by the committee, in the presence of about 100 participants. The presentation used maps and photos to visualize the changing neighborhood through the past, present, and future. The overlay of the plan with aerial imagery was perceived as eye-opening for understanding the concrete physical impact of the abstract spatial plan. While we extensively consulted with the neighborhood committee, the research was not done in a true partnership due to the ongoing tensions between different parties. This tension necessitated an inclusive yet critical position and an active engagement of all stakeholders, including the municipal council, developer, local entrepreneurs, and citizens not involved in the neighborhood committee. After the study and the changed plan were approved, results were communicated back to the community during a presentation in the neighborhood church, towards about 70 people. Participants included the mayor, aldermen, and representatives of various organizations, triggering member reflections (Tracy, 2010).

3.1. Positionality

While the first author has historic family ties to the village, the last author lives and has a business there. Two years prior to starting data collection for this study, the team has been involved in the neighborhood assemblage in a number of ways. In a previous research project, we initially connected to the municipality by joining a participatory process for a church reconversion. This research resulted in the development of a hybrid tool to engage citizens in a visual and emplaced way (Vrebos et al., 2023). We used the momentum of renewed interest in the (changing) spatial environment instigated by the proposed Spatial Development Plan (Ruimtelijk UitvoeringsPlan or RUP in Dutch) to initiate this research, sensing a need to gain a deeper understanding of the dynamics of the neighborhood. After the launch of the RUP and the mobilization of the population, we decided to expand our socio-spatial research on the ongoing neighborhood dynamics.

3.2. Go-Along Walks to Co-Produce Data

Initially, we engaged with the neighborhood committee leading the mobilization and attended community events where we could informally connect with residents. Here we established further connections and

shared research intentions. The first author conducted go-along interviews with citizens and other stakeholders to investigate the unfolding sense of belonging using an assemblage lens. This lens helped us to better understand perceptions and fears of past, ongoing, and future socio-spatial change and its affects on the sense of belonging. Approaching the semi-structured interviews as go-along interviews had three advantages. First, it allowed us to take a more reciprocal approach, going beyond the traditional binary of a dialogue between interviewer and interviewee. This gave agency to place in the walking conversation, setting up a polylogue (Anderson et al., 2010). Second, it facilitated the mapping of implicit social community relationships beyond the strongest social ties. Third, it offered insights into the multilayered environmental awareness or engagement of spatial practices (Kusenbach, 2003).

The 12 interviews were semi-structured through a number of topics such as their relationship towards the neighborhood, memories, sensory experiences, and stories, such as perceptions of change or views on the future, further directed by the socio-spatial reality itself. Each interview ended with a reflection on the go-along walking methodology. Two stakeholders preferred a more traditional interview in their offices. Participants all had a direct link with the village, being citizens, having a business, and/or having a political position. While most interviews were one-on-one, one go-along was done in a group of four citizens. Participants decided on the route to walk (or in one case, to bike), the pace of movement, and locations to stop and dwell. Routes are shown in Figure 3, while some of the stops are shown in Figures 4 to 7.

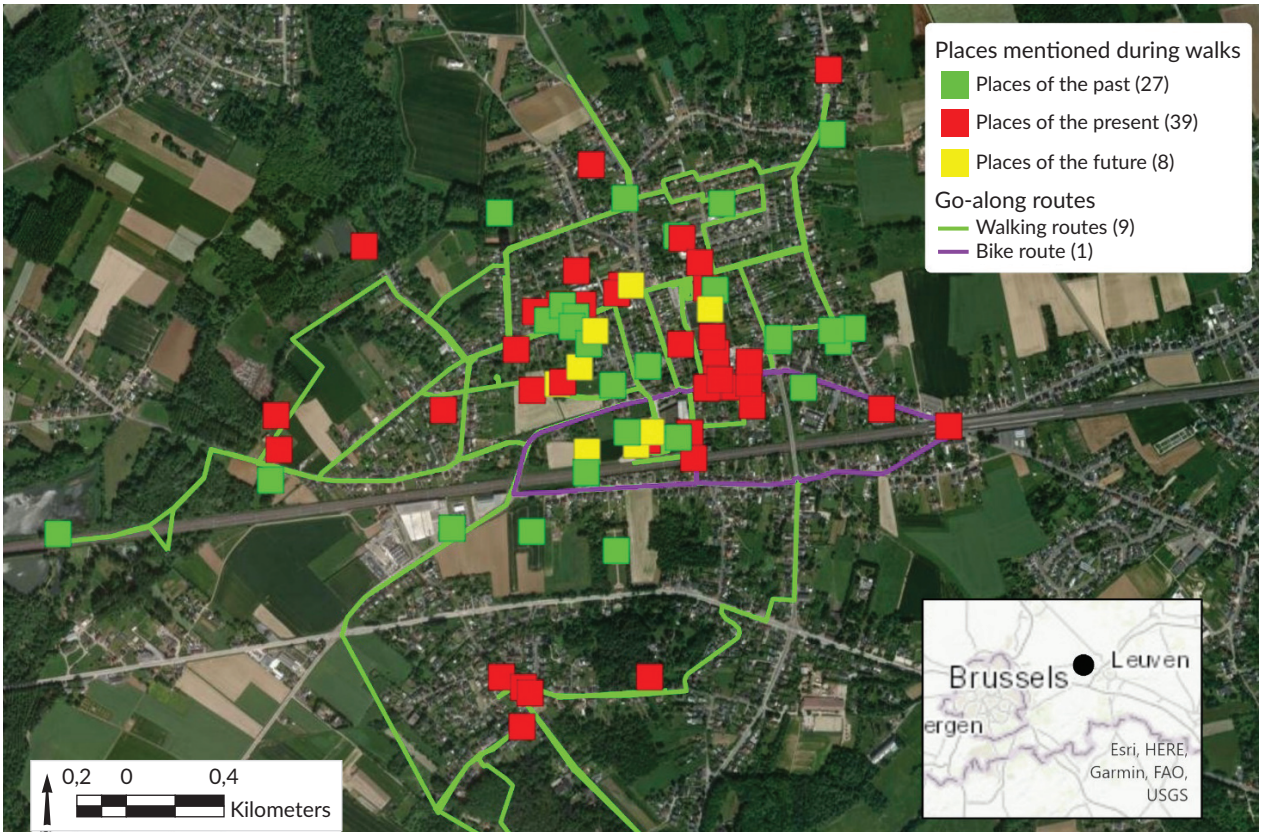

Figure 3. Map of the neighborhood-in-flux showing the trajectory of the walking (in green) and bike (purple) conversations and the main locations mentioned related to the past (green), present (red), and future (yellow). Notes: Map by authors, made September 2023; inlay map showing the relative position between Brussels and Leuven.

Figure 4. The park on the village square lacks a clear identity.

Figure 5. New development of serviced residences enacting the scale of the village architecture.

Figure 6. The facade of the previous milk factory, now temporarily used for a range of socio-cultural events and commercial activities.

Figure 7. The railroad dividing the village in two and a mural on the previous milk factory.

The interviewer could interfere with specific questions based on serendipitous encounters. Duration varied between one hour and three hours. The interviews ran multidirectional, as the first author was often asked to share her own socio-spatial experience with the neighborhood or her thoughts on socio-spatial change as a planner. Conversations were audio recorded, and photos were taken on the way.

3.3. A New Materialist Lens to Data Analysis

After transcription, we analyzed the interview data through a new materialist lens to tackle the intricacy of the neighborhood assemblage. We used a framework developed by Fox and Alldred (2022).

Taking a relational view on the sense of belonging (Youkhana, 2015) aligned with the new materialism perspective of material-discursive entanglement. Consequently, our analysis focused on (a) how human and non-human relations contribute to a sense of belonging in the neighborhood under study, (b) how affective flows draw these relations into the neighborhood assemblage, and (c) how spatial capacities are produced in the neighborhood. These themes structured the preliminary codebook uploaded in the software NVIVO and supported a semi-deductive coding strategy to work through our data. The preliminary framework consisted of the three themes of relations, affects, and capacities and started from the categories for relations (human and non-human) and affects (physical, psychological, social, and economic) as defined by Fox and Alldred (2022). Through an iterative thematic analysis process of the transcripts, we clustered the codes into code clusters and adapted the categories as seen in the coding tree in Table 1. Insights were presented to the community in a member reflection. The researchers then linked these coded affects to the spatial relations to understand the affective flows in relation to the socio-spatial accounts. Photoshop was used to visualize the different spatial narratives in a deep map (Figure 8) imposed on an aerial picture which was later hidden.

By using compacted quotes and visualizations to enact different perspectives from the go-along walks, the deep map emplaced the multi-vocal affective flows. The accompanying description narrates the four major capacities identified and the micropolitical consequences on the sense of belonging.

4. Findings

Our socio-spatial analysis of the interview data is presented in this section, with the coding tree in Table 1 and an overview of the interviews in Table 2. These tables are followed by the deep map in Figure 8 that geovisualizes how the specific affective flows draw the relations into the neighborhood assemblage. The affective flows are evoked through a selection of emplaced statements and illustrations based on interview quotes. This is followed by a short description of the capacities that produce these affects and the micropolitical consequences on the sense of belonging.

Table 1. The coding tree was generated based on themes by Fox and Alldred (2017).

Theme	Category	Code clusters
1. Relations	Human	Community
		Conflict and tension
		Local economy
		Participation, dialogue, and communication
	Sense of place	Characteristics and qualities assigned to the village
		Human place connection
		Mobility and infrastructure
		Move or settle
		Nature
		Neighborhood locations
		Place and time
		Relations between places
2. Affects	Economic affects	Citizen economics
		Infrastructure and economics
		Lack of facilities or deficient facilities
		Market economics
	Psychological and emotional affects	Ambiguity
		Appreciation for place or spatial change
		Concerns about spatial change
	Physical and spatial affects	Change as a loss or tabula rasa
		Change of public infrastructure as an improvement
		Change that builds on what is there
		Expansion and new constructions (open space disappears)
		Lack of change
		Social and spatial affect each other
		Speed or extent of change (unrecognizable)

Table 1. (Cont.) The coding tree was generated based on themes by Fox and Alldred (2017).

Theme	Category	Code clusters
2. Affects	Socio-cultural affects	Changing community relations
		Changing relations to the past
		Different interests, functions, and thoughts lead to tension
		Resisting change for the future
		Social engagement, care, and civic life
		Territorial affects, uncertainty, and resistance
3. Capacities	Governance	Governance can trigger positive change
		Governance issues polarize
		Lack of emplacement in the development or participatory process
	Money	Money or power steers change
	People	Hope about the future of place
		Speculations about place and placemaking
		The protest triggered a sense of belonging
		Protest and participation affected plans
		Capacity to make place
		Capacity to organize events
	Place	(Unused) potential and challenges of the existing patrimony
		Changing geographical areas affect social relations
		The agency of location and locale

Table 2. Description of interviews.

ID	Date	Participant position	Type of interview	Spatial narrative focus
1–4	13-11-2022	Neighborhood committee (four citizens)	Go-along walk-in group	RUP is not in the interest of the community
5	22-11-2022	Citizen	Go-along walk one-on-one	The rich history of Veltem-Beisem is worth remembering
6	7-12-2022	Representative bicycle committee (non-citizen, though living within walking distance)	Go-along bike one-on-one	The situation of the current bike infrastructure is unsafe Advocates practical solutions to increase the safety and comfort of cyclists
7	8-12-2022	Citizen	Go-along walk one-on-one	The unknown Bovenberg neighborhood also deserves attention Decision-making in the RUP is disconnected from the situated reality Previously active in the neighborhood association
8	5-1-2023	Citizen	Go-along walk one-on-one	Change has been a constant over the last 80 years A previously active member of football

Table 2. (Cont.) Description of interviews.

ID	Date	Participant position	Type of interview	Spatial narrative focus
9	17-2-2023	Citizen	Go-along walk one-on-one	Affordable housing is a big concern Did everything to return to live in the village after having lived elsewhere due to the housing prices An active member of football
10	24-2-2023	Alderman and (previous) entrepreneur (soon to be citizen)	Go-along walk one-on-one	Change is needed to address current socio-spatial challenges and improve living standards Previously active in scouts and youth work
11	26-2-2023	Citizen and Opposition	Go-along walk one-on-one	The spatial changes and plan are harmful to the village Active in scouts and several other organizations
12	27-2-2023	Citizen and Alderwoman	Go-along walk one-on-one	The municipality must protect the natural richness of the village
13	9-3-2023	Entrepreneur (non-citizen)	Conversation in office	Set up a business in an old milk factory due to its industrial heritage value
14	23-5-2023	Citizen	Go-along walk one-on-one	Social embedment in the village changed due to a widening social and spatial life circle Active in music association
15	9-6-2023 and 29-6-2023	Developer (non-citizen)	Conversation in office	The new development brings life back to this sleeping village and accelerates the sustainable transition with respect for the sense of place

4.1. Four Capacities

Through these affect economies, as shown in the deep map in Figure 2, we could identify four major capacities that drive the unfolding of socio-spatial changes in the neighborhood assemblage, namely place, people, municipality, and money.

4.1.1. Place

Place holds the capacity to affect and be affected through interactions in the neighborhood assemblage. One aspect of this relates to its symbolic and functional meaning. Participants produced knowledge about the significance of slow places in the street such as small chapels (Figure 2), trees throwing shade on the central village square (Figure 4), or pedestrian trails in their agency to facilitate connection between community members. The walking also illustrated the capacity of slow movement to connect to place. Still, much-planned change started from a rational commuter's logic, with a strong focus on car infrastructure. The go-along interview with Participant 6 showed that the recent increase in bike infrastructure remains subordinate to car and rail passage.

Figure 8. Deep map of affective flows based on shortened quote statements of the interviews illustrating various affective flows of belonging (see Supplementary File).

The place capacity also becomes visible through the existing patrimony. As Participant 13 explained, it was exactly the charm and edginess of the industrial site that attracted him to open his shop in that location. Participants emphasized how construction projects fostered neighborhood identity by repurposing existing spaces and materials, including the conversion of religious facilities into a community hub, school or food charity, the adaptation of industrial sites for housing or socio-cultural purposes, and the integration of authentic elements into new residential buildings. At the same time, there is a realization that some of these buildings are not easy to repurpose and bring up-to-date to today's standards.

4.1.2. People Make Place

The citizens themselves hold capacities that result in a rich and evolving civic life: caring for others and place, placemaking activities, or organizing themselves for a shared goal. Residents are active in embedded associations such as the gym, football club, youth movement, or schools. They organize many festive or socio-cultural initiatives that bring neighbors regularly together. Participants talked about the changing role the Catholic institutions played within this social fabric and their adapting materialities. The various placemaking events (such as the temporary use of the industrial site, the spatial plan proposed, the different

events organized, or renewed activities in the church) reinforced place attachment by triggering a renewed spatial sensitivity. Collaboration on a shared goal, such as the protest against the plan, created momentum and built on procedural and governance skills among citizens. This is seen in actions such as the poster campaign, the organization of events, or the joint legal objections filed with the support of a crowdsourced lawyer. However, suspicions and assumptions developed into stories that unfolded speculation over the spatial changes planned, which negatively affected trust between actors. The legal action resulted in significant changes to the approved plan (later canceled under appeal), which illustrates the capacity of the people and their protest to (partly) counter powerful interests. It also showed they were emotionally affected and that citizens have a role to play in ensuring spatial change improves the neighborhood and safeguards the wellbeing of its residents.

4.1.3. Governance

The municipality holds the capacity to maintain this assembling through the support of civic life, the physical environment, or the role they played in the sensitive repurposing process of the church, thus enhancing a sense of belonging. Nevertheless, governance can also be constraining, as illustrated by the growing sense of distrust towards authorities with regard to the uncertain sustainability of the sports infrastructure. The analysis has shown the potential challenges certain forms of governance can put to sense of belonging, as shown by the fragmented and ambiguous participatory process of the spatial plan. It was perceived that the results from the initial participatory moments were insufficiently translated into the proposed spatial plan (such as the sense of place and density). Moreover, it was felt that there was a disbalance between who was involved in the participatory process. The number of citizens was limited, while many of the participants represented specific interest groups without being residents of the village. As such there was a critique that it was not representative of the community's interest and thus the participatory process set up by the municipality did not foster a sense of belonging towards the larger municipality. In stark contrast, it showed how governance and planning enhanced a very local sense of belonging by bringing people together in protest over spatial change and closer to their neighborhood. Citizens mentioned this joint resistance developed spatial knowledge, civic skills, and local connections.

4.1.4. Money

As citizens felt that economic interests drive development and socio-spatial change over social and environmental interests, money, specifically the money related to development projects, also holds capacity in the affective flows of the neighborhood. Change was described as increasing in speed and scale, bringing both benefits and challenges. On the one hand, the developer, himself an inhabitant of the broader municipality, held affective relations with many local associations, e.g., by supporting their activities. Moreover, the pop-up use of the milk factory site (Figure 6) over which he holds the development rights, brought in new enterprises and other activities, bringing together inhabitants. This produced new place symbols and attachments through different socio-spatial practices. Many of these activities were welcomed by citizens as meaningful for the community, while others were still critiqued by some interviewees as out of place. On the other hand, the larger developments hold a capacity to change not only the physical outlook but also reshape social dynamics and planning incentives, thereby affecting village qualities. The lack of transparency in combination with a perceived neglect of local knowledge and identity, led to a sense of nostalgia and fear of losing the charm and identity of the industrial site among citizens.

4.2. Micropolitical Consequences on the Sense of Belonging

The socio-spatial analysis of our (walking) interviews also looked at how these affective flows in these place assemblages contributed to the sense of belonging and loss on a micropolitical level. A first sense of loss relates to the affordability of housing, leading to a fear that in the future "locals" would no longer be able to afford living in the area and the previous economic diversity of inhabitants would no longer hold up. The new and planned constructions feed into a sense of loss associated with individual and community wellbeing, with a potential loss of personal gardens, access to light and open space, and quietness. Moreover, the changing physical state provokes a sense of losing rural identity, qualities, and social connectedness. Acceleration of change on different levels makes community members feel they lost control. They look for assurance that their concerns are taken into account and that the change happening is well thought through. The snippets of acceleration they see—such as the allotment development (Figure 1)—are not reassuring. One participant stated it as follows: "Don't misunderstand our protest. We are not against change, but change has to be an improvement" (Participant 3). This suggests that change has to be more than solely for economic improvement but should also benefit the community. This raises questions about who the community is and what the boundaries of the community are.

While the spatial transformations trigger emotions of nostalgia and loss, they also bring excitement and joy, sometimes even in the same locations, as illustrated by the milk factory. These contrasting emotions create tension, as can be seen in the reservation towards newcomers and the resistance against rapid change. Another micropolitical affect is the wavering trust in the authorities. The lack of transparency and clarity in decision-making and planning makes citizens suspect a hidden spatial agenda of the municipality. At the same time, there is also an increased sense of belonging through the increased uptake of civic duty and the coming together of citizens, old and new, to define and protect the sense of place. New spatial and social connections are being established in the neighborhood-in-flux. Our deep map in Figure 8 shows a glimpse of how different senses of belonging emerge and evolve.

4.3. How Walking Methodologies Shaped the Affective Flows

The walking methodology triggered serendipitous social and spatial encounters, which organically moved the conversation in new directions and towards new insights. When sharing the purpose of our go-alongs, a spontaneous encounter with an inhabitant working on the construction of the development inspired discussion about what makes an inhabitant a local or not. Other encounters snowballed new interviewees and exposed the implicit social networks and relations rooted in the past. The encounters with specific places triggered memories, emotions, or folk tales about previous events or past spatial practices, such as the previous industrial use of the factory or the meeting room of a music group.

During the walks, participants also encountered small new changes in their familiar environments, such as the planting of a forest, the advancement of a construction site, or the disappearance of a building. At certain moments this provoked emotions of surprise, disappointment, regret, or pride, prompting spatial narratives about the lived experiences of these places. Something similar happened on a more conscious level when navigating the places affected by the proposed municipal development plan. Some of the participants used their bodies, gestures, and deictic references to paint a picture of the environment about the affects of the plan on their lived places.

Walking provided a broad sensory exposure to all aspects of place, disclosing a richer understanding of the connection between places and inhabitants. This sensory experience moved the conversations beyond the abstract level towards specific symbols, memories, social associations, and emotions attached to a place, offering nuanced glimpses of aspects of belonging. For example, Participant 14 mentioned how mischief while playing in a field as a child instantly traveled to his parents through social control. Seeing the physical fabric, spatial changes, or significant places with a symbolic meaning gained over a prolonged socio-spatial practice, like the gym or church, provoked stories about their emotional attachment. Changes or proposed changes to this physical fabric triggered an increased spatial awareness, as was made clear by Participant 3 describing the architecture of the milk factory (Figure 6):

> Usually, you only realize what you have when it is too late. What you see here now is a layering, different depths and relative heights, and the complexity of these arcs. Until today I did not notice how beautiful this is. But what will replace this won't have this layering and complexity.

Other senses were also activated during the walks. Slowing down to walking speed led to a richer emplaced narrative and new observations. The sounds of traffic, cars, cargo, or trains, materialized the increasing sense of speed and density. Sounds of children picked up after school underlined aspects of a changing demography and mobility with an affect on spatial practice. Participants grasped the sounds of animals to accentuate a rural image of the village. Tactical sensations not only made embodied feelings of distance, shade, or wind explicit, but they also strengthened spatial narratives by embodying their concerns about the future of the place. Participant 1 linked the tactical sensation of a broken footpath to a sense of neglected maintenance in this part of the village. The walks were diffractive, as unfolding through situational coincidences of weather, time of day and year, week or weekend day. This influenced who and what we encountered and in which state, making every walk unique.

5. Discussion

By combining walking, a new material analysis, and deep mapping, we aimed to explore what new forms of knowledge walking methodologies could generate. We noticed that walking advanced the multiplicity of meanings, lived experiences and perspectives materialized through the unfolding physical place as a common denominator. The go-along interviews used the movement and flow of both the body and environment to develop an entangled understanding through multiple and heterogenous actors, which aligns with Youkhana's (2015) relational conceptualization of sense of belonging being materialized through place. The passing through the material and social environment of the go-along interviews unraveled the different affective flows and capacities and generated embodied, sensory, and shared knowledge with a concrete emplacement.

5.1. Spatial Change as a Manifestation of a Growing Social Unease

Our analysis showed that spatial change and sense of belonging are reciprocal cross-pollinating concepts in which social unease plays a key role. The sense of loss described seems to be an expression of a growing sense of social unease. Social unease is a concern or anxiety about the precarious societal state, built on a sense of collective uncontrollability of the decline of society. Social unease is strongly characterized by a

sense of loss (in trust, human capacity, ideology, political power, and sense of community), an increase in socio-economic vulnerability, and a general societal pessimism (Geurkink & Miltenburg, 2023).

The deep map showed a growing focus on individualization, with loosening social ties on a local level, a strong focus on private space, the disappearance of certain social structures, and a growing sense of institutional distrust. The vivid objection against high rise is rooted in a belief that collective living in bigger blocks disrupts social cohesion compared to ground-based allotment living. This is in line with popular concerns about dense collective housing without sufficient care for socio-spatial wellbeing (De Decker et al., 2005). The multiple nostalgic references to a rural village identity contrast with the suburban lifestyle of most residents. The sense of community, however, persists with a certain aspect of exclusion towards who and what is not perceived as part of this authentic image, triggering a perception of the decline of community. Moreover, the focus on individual property rights produced a perceived threat to individual wellbeing and welfare (such as the affordability of housing for the next generation), resulting in societal pessimism and a perception of socio-economic vulnerability.

Our analysis has also illustrated that, while there is a strong social fabric in the neighborhood, socio-spatial changes produce underlying tensions. Societal pessimism is fueled by the sense of elusiveness over the change of place. Some participants mentioned they did not join the protest, not believing it could make a difference. The new constructions and their new inhabitants resulted in a diminishing recognizability of people and place, leading to a sense of losing social control. In combination with the growing outward mobility over the last decades, these changing demographics led to an increasing heterogeneity in society with seemingly insurmountable contradictory visions. Finally, our analysis showed that citizens perceive a decline in political power with the private sector taking over responsibilities considered of general interest, such as public space and housing or steering change.

5.2. Walking Uncovers Multiple Belongings

The various go-along conversations exposed a multitude of belongings in the village, such as belonging to a specific age group with children, to a middle-class economic group, to a professional circle, a group of friends, a festive, cultural, or sports organization, or a street committee. It is connected to an emotional and spatial attachment shared and built over time. This touches upon dimensions of belonging as social locations and individual identification or emotional attachment as established by Yuval-Davis (2011). We also noticed aspects of the third dimension of belonging, namely the politics of belonging when it came to inhabitants who did not grow up in the village. While inhabitants that moved to the village later in life often managed to integrate through civic engagement, they kept on being referred to—by others or themselves—as not *fully* belonging to the community. Our findings demonstrated that this facet of identity and community building during childhood possesses an irreplaceable quality when compared to joining the community later in life.

Our analysis revealed a mainly binary and static thinking about place, as if place has reached or will reach an ideal state in the past or future to hang on to. Citizens often compare spatial change against a benchmarked time in the past, mainly their childhood or the moment they settled in the neighborhood. While they all talked extensively about the spatial change happening or planned, they used this moment as a benchmark to fixate on the identity of the village. A sense of belonging is cultivated through the imaginative connection to different spatial temporalities, with nostalgia serving as a key component in understanding these

temporal-spatial experiences (Colin, 2021). Some forms of spatial change felt "in place" and were welcomed, such as the establishment of the—crowdsourced—new daycare, while other forms perceived "out of place" were resisted—like the latest dense residential site developed (Figure 1). This spatial temporality also defined individual living standards for traffic or allotment types. The individual allotment type is therefore set as a standard, even with a growing realization of the limited extent of this model. In contrast, the developer and municipality envisioned a renewed neighborhood, locking the physical state of the neighborhood through vision plans. This suggests an insufficient awareness of the entanglement of spatial change and the social fabric.

The go-along interviews were well-suited to capture feelings of belonging and loss as they connected these emotions to specific place aspects and spatial practices. Walking proved especially appropriate for examining belonging through flow and movement, as suggested by Youkhana (2015). By engaging lived experiences within the dynamic physical reality of a village-in-flux, walking facilitated deeper insights. The repeated movement through the evolving physical and social environment, combined with the authors' own place connection in the reciprocal interviews, enabled a more intricate, collaborative meaning-making process.

5.3. Strengths and Limitations of the Go-Along Methodology

Walking through the neighborhood materialized the turn to matter in a new materialist understanding and facilitated the demonstration of affective flows. The extensive use of spatial and temporal deictic references illustrates the value of walking to articulate and share tacit emplaced knowledge and spatial experiences. Not only did these references facilitate the communication and co-production of knowledge about the village, but they also illustrate the agency of place itself in the conversation. Emplaced encounters (in the form of hearing traffic, seeing the impact of new constructions, or the feeling of mud on the boots or the crooked sidewalk) or ad-hoc meetings unfolded new avenues of data that would perhaps not have been mentioned during classic interviews behind a desk.

The walks have been particularly suited to investigate sense of belonging given how they facilitate rich and multidimensional emplaced narratives about the socio-spatial changing village. Navigating the social and physical elements together with participants, advanced a multiplicity of meanings and lived experiences, allowing for a nuanced understanding, as represented in the deep map. Participant 12 mentioned that "walking was a slowing down" (walking in contrast to taking the car on a daily basis) which made her reflect on her daily environment, physical changes, and what remains.

Walking methodologies allow knowledge to be co-produced between place, interviewee, and interviewer. Sensing the environment while speaking about it helped to visualize the spatial dimensions of proposed plans and developments. Moreover, the emplaced conversation also prompted aspects the interviewee would otherwise not think about, leading to conversations that focused on more concrete aspects of place and community.

This led to the interviews being rather long with a lot of unexpected information and the noise of traffic. One participant expressed content for not needing to filter his stories, while others pointed out that the walking made it less abstract and more concrete. One interview was done with the citizens committee. This group walk brought together similar views. While we did not experience power dynamics that could have

affected the conversation, the interaction evolved organically as new ideas or stories were unfolded by other participants' words.

A certain bias could be identified on the sample level which could have provided an even broader perspective. Using opportunistic sampling, we followed diffractive leads to enact different perspectives. However, we did not reach saturation. Therefore, this narrative, even intended to be multivocal, must be read with a certain nuance as it cannot claim to cover a complete variation of perspectives.

Another limitation of this research is the specific period of data collection, especially unique due to the ongoing planning processes. The static project logic contrasts with the topics of concern as very dynamic processes of change. The annulment of the planning process was only one of the many ways the socio-spatial context has already changed compared to the situation during data collection. This spatial narrative must thus be read to understand this specific period in time. By staying connected to the dynamic community and stakeholders, we aim to counter the limitation of this static project logic.

This ongoing long-term connection to the village and community facilitated the co-production of a shared understanding as it enabled us to better understand the socio-spatial relations and the material markers people used to describe the changes. While this facilitated cognitive empathy, it did raise the risk for bias, and thus asked for additional attention to ensure the quality of our research and avoid over or under-interpretation of data. Using quality markers appropriate for qualitative research, namely credibility, transferability, dependability, and confirmability (Hannes, 2011), we integrated extensive and multiple active reflection moments, both among the authors as well as with the public. Specifically, this was done through ongoing peer debriefing, member checks, and member reflection.

5.4. Implications

The study highlights the significance of emplaced participation, both in research and practice. By studying the flows of affects, we demonstrated the interconnectedness of spatial change and social unease. This highlights the importance of considering the social implications of spatial change in urban planning and development. Cornwall (2008) points to two important questions participation has to ask, namely who participates and how participation influences decision-making.

While the municipality's pre-designed participatory frameworks might have limited citizen engagement to feedback or formal procedures, "in ways that domesticate [citizens] initiative and co-opt them into supporting the status quo" (Kindon et al., 2007, p. 22), the citizen committee demonstrated the potential to break free from these constraints. They successfully claimed an emplaced dialogue, revealing the power to influence the spatial future and demand the integration of tacit knowledge and local narratives that inform an emplaced vision. Walking methodologies offer a promising alternative, as they can facilitate community engagement, relationship-building, and a deeper sense of belonging (Kanstrup et al., 2014). By exploring the environment together with the community, planners, and designers can gain insider knowledge and challenge dominant narratives (Horgan et al., 2023).

However, the study also underscores the importance of inclusive and representative participation. The plan did not align with the input of the walks with the soundboard group, composed primarily of external

representatives and few neighbors, and failed to integrate the local sense of place. To ensure meaningful and well-defined participation, it is crucial to balance a diverse range of stakeholders. While the community is central, such participation goes beyond the static boundaries of the community and municipality and includes minority groups as well as representatives of other interests. Creating spaces for open and ongoing dialogue and critical reflection could take the form of a living lab set up by the municipality, which makes affective flows in the planning processes more transparent. Future participatory processes should prioritize emplaced approaches, walking methodologies, genuine engagement with local communities, and transparent communication. Such an approach would require a shift in mindset, time, resources, and ongoing negotiation of interests. However, it could significantly improve spatial planning and design processes by better reflecting the needs, aspirations, and unique character of specific places in a broader context. City policy could prescribe such participatory processes as ongoing networked dialogues in and beyond communities that invite continuous critical discussions of what entails the materiality of belonging, nostalgia, and power.

6. Conclusion

This article applied go-along interviews to investigate the sense of belonging in a neighborhood-in-flux. Data was analyzed using a new materialistic analytical approach (Fox & Alldred, 2022) and represented through a deep map. Our results showed how spatial and the resulting social change could be seen as a manifestation of growing social unease, triggering a nostalgia that served as a central element in producing a sense of belonging. At the same time, our results showed an unfolding of multiple entangled belongings in the changing socio-spatial fabric which are crucial to understand to plan and design for an inclusive future of a suburban village.

The go-along interviews generated embodied, sensory, and shared knowledge about the community, the neighborhood, and the affects of the transitions they are undergoing as the village's rural fabric morphs into a suburban one. The contributions of this article are manifold. First, we explored and confirmed the value of walking methodologies to explore the multidimensional and dynamic nature of sense of belonging. Second, we provided a useful example of applying a new materialist analytical model for neighborhood development purposes. Third, we shed light on the flows of affects that play a role in producing multiple senses of belonging in a changing neighborhood. By studying these affective flows, we demonstrated the interconnectedness of spatial change and social unease. This highlights the importance of considering the social implications of spatial change in urban planning and development.

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Conflict of Interests

As part of this study, we connected to the community advocacy group Leefbaar Veltem to sample participants and communicate with the community. The church board, with the support of the municipality, generously helped to organize the presentation of the findings and provided refreshments. While the first author had family ties in the village, the third author is a resident of Veltem-Beisem and runs a social innovation business there.

Supplementary Material

Supplementary material for this article is available online in the format provided by the authors (unedited).

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ARTICLE

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Tracing Walkability Through Disruption Assemblages in Aleppo's (Post-)Conflict Historic Core

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Abstract

War disrupts the symbiotic interplay between bodies and built environments, unravelling familiar routines and destabilizing urban life. Walking, thus, becomes a precarious tiptoeing through danger and continual re-routing, a spatial practice of survival and resistance, asserting presence and agency amid violence. Consequently, urbicidal practices and persistent insecurities reconfigure walkability, undermining patterns of normality and a collective sense of safety. Yet, post-conflict reconstruction, particularly in historic cores, rarely considers former or newly formed footpaths, further misaligning future project agendas with context-specific recovery needs. This article develops the "disruption assemblages" approach, a conceptual framework that captures the dynamic interplay of material, temporal, and human elements in conflict-ridden contexts, to examine war's impact on walkability. Using Aleppo's historic core as a case study, it highlights the inseparable connection between the urban fabric's sensory-spatial characteristics and its social-temporal layering of familiarity and generational presence. Qualitative methods—including historical analysis, sensory ethnography, and walking as a research tool—reveal how Aleppo's historic core has metamorphosed into a landscape of complex survival practices, danger-evasion tactics, and everyday resistance. These findings illuminate the contested spatio-temporality and lived experiences of reclaiming rights to and within urban space, demonstrating how walkability is deterritorialized and reterritorialized in war-torn landscapes and during sporadic (post-)conflict reconstruction. Ultimately, this article argues for re-centring walkability in (post-)conflict healing and proposes the "attract a foot" approach, emphasizing the imperative of re-enabling walking as a sociable and human-centred recovery strategy.

Keywords

Aleppo; assemblages; disruption; post-conflict; reconstruction; urbicide; walkability

1. Introduction

In *Domicide* (2023), the Syrian scholar Ammar Azzouz weaves memory and testimonies to trace the remnants of his war-torn hometown, Homs, where the destruction of homes marked the collapse of an entire way of living. Walking through what remains, Azzouz captures the echoes of Rania, one of his interlocutors, and her footsteps in her effort to find her home:

> Rania, the single mother, walks between the ruins and sings whilst searching for her home. It is the hope and the dream that she will eventually be able to return home. The road to her home was blocked by debris, so she had to take another route. "There is no home," she weeps suddenly, pointing to a pile of rubble where her home once was. She stands in front of a collapsed building, determined to climb onto the ruins, weeping, pointing at her home, at her neighbourhood. The hopes of being able to return home are all gone. She squats on the ruins, weeping, and then stands up, saying, "Oh God, Oh God." (Azzouz, 2023, p. 65)

Rania's pain echoed that of many other returnees, even amid the long-awaited and unexpected new dawn: the fall of the Assad regime on December 8, 2024, after more than 13 years of conflict and opposition. While return-home journeys were prominently featured across various news platforms, they occurred against a backdrop of destruction that underscored a persistent and difficult-to-ignore reality: Neighbourhoods once teeming with life were now reduced to unrecognizable skeletal ruins, and homes that had sheltered generations had now turned into rubble-strewn wastelands. Rania's return journey, like those of millions of others, is a confrontation with loss—a reckoning with the heavy weight of displacement, violent conflict, and fractured dreams. These journeys are thus Janus-faced: a victorious steadfastness and inheritance of shattered homeland, absent of not only bricks and mortar of life-sustaining structures but the very everyday fabric of society. Once silenced as inescapable and perilous survival endeavours, their footsteps echo today amid ruins and map topographies of grief and defiance—a pilgrimage from and to a home that no longer exists yet persists as an anchor to return.

The evolved nature of modern warfare, where densely populated urban centres become primary stages of conflict, inflicts deliberate and far-reaching consequences on the physical and social fabrics of cities (Azzouz, 2023; Dainese & Staničić, 2022; Munawar & Symonds, 2022). In many (post-)war zones, from Syrian cities to Palestinian Gaza, Sudanese Khartoum, and Ukrainian Mariupol and Bakhmut, millions flee on foot to escape relentless shelling while infrastructure collapses under the weight of catastrophic conflicts and perpetuated violence. Whether planned or collateral, prolonged violence and continuous assaults crack the socio-material assemblages (McFarlane, 2011) that constitute the foundations facilitating urban life. Everyday patterns are disrupted by material, temporal, and human elements: (sandbag) barriers, checkpoints, sniper stations controlled spatio-temporally by opposing groups, and temporal restrictions that condition access. The full or partial destruction and inaccessibility of everyday life-sustaining services, and the weaponization of public spaces, streets, and rooftops put social interactions on spatio-temporal hold. Dwellers confront insecurities, abrupt losses of families and friends, bombing, shelling, and public executions. The "shock and awe" (Stanley, 2017) encroaches into everydayness, slowly recalibrating a new normalcy in prolonged conflict.

While urban scholars, planners, and designers have advocated walkability as a way to heal and safeguard urban and ecological life, it often falls short when applied to war-ridden cities. Conflict elements and scars

create an environment where walking, once a taken-for-granted embodied aspect of everyday urban life (Bryant et al., 2016; Careri, 2017; Gros, 2014), transforms into an unavoidable practice tied to temporary survival. It becomes essential for fleeing and seeking refuge, evading danger within death traps shaped by distorted material conditions, social relationships, and altered temporalities that disrupt dwellers' life-worlds. The case of Aleppo (Syria) is yet another example of how "walking" is stripped of its broader meanings and reduced to its most basic function: a mode of mobility. Aleppo's historic core, where walkability once played a foundational role in shaping the urban fabric and facilitating socio-economic and cultural exchanges preserved across generations, now exists in recent war memories as a perilous act of survival—a desperate trek to escape and evade snipers and bombshells. The disruption of walkability in such contexts remains largely uncharted in discourses tying urban and post-war early recovery and reconstructions, with vast knowledge gaps demanding urgent attention. This article aims to address these gaps and argues for the urgent need to research how meaningful walking experiences can be restored.

To anchor our argument, this article first builds on Dovey and Pafka's (2020) framework of walkability as "a set of capacities embedded in urban morphologies" through the interplay of key elements of the broader urban DMA (density, mix, and access), which they describe as "the heart of what makes great cities tick." It then employs the assemblage approach (DeLanda, 2006; Deleuze & Guattari, 1987) in analysing walkability metamorphosis, which is particularly powerful for understanding and underpinning the temporal and prolonged disruptions that occur both during and after active warfare. This article aims to understand how walkability is redefined and experienced in the context of violent (post-)conflict dynamics. It seeks to explore how urban spaces embody memories and aspirations, asserting that recognizing walking as a vital component is essential to understanding how conflict-affected communities and spaces endure, heal, and rebuild. By re-centring the voices of former and current dwellers, we advocate for the development of strategies that enhance walkability and foster a sense of belonging in war-torn landscapes.

To support this argument, this article proceeds in five sections. First, it reframes walkability as it emerges in various urban-related disciplines to underpin how urbicidal and conflict-related disruptions transform walkability as experienced and practised. Second, it presents the research methods employed for this analysis, including the authors' positionalities, sources, and fieldwork. Third, it examines walkability and disruptions in Aleppo's historic core by reviewing historical and empirical evidence, highlighting how walkability's metamorphosis evoked danger-evasion tactics amidst crises and reconstruction attempts, and altered prior sensory experiences. Fourth, we reflect by conceptualizing how disruption assemblages distort and alter walking practices. Finally, the article emphasizes the importance of recognizing walkability as a critical lens for developing policies and strategies that re-centre walkability in post-conflict healing and human-centred reconstruction processes.

2. Walkability and Conflict Disruptions

2.1. Walkability as Complex Interplay of Embodied Encounters, Memory Lanes, and Claims to the City

Walkability is a dynamic and evolving concept, with a multidisciplinary nature resisting a fixed definition, and continuously reshaped as researchers engage with its spatial, social, and temporal dimensions. At the heart of contemporary urban discourse, walkability connects urban design to pressing global concerns—public health, climate change, economic vitality, and social equity. Emerging from the symbiosis between bodies

and their material surroundings, walkability flourishes when city dwellers' needs—such as comfort, safety, connectivity, and visual engagement—converge during walking experiences (Delavar et al., 2025). Walking, therefore, transcends mobility. The act of "going for a walk," a mundane phrase that many of us use, surpasses a functional necessity, becoming a way to engage with, reflect upon, and appreciate one's surroundings—a form of social activity, contemplation, artistic expression, and even political action (Bornioli et al., 2018; Middleton, 2021; Rybråten et al., 2019; Solnit, 2014). Everyday encounters on foot intertwine walking with the very essence of urban experience: the interactions of passers-by "rubbing shoulders" (Blokland, 2020), lingering in a place, and street exchanges that imbue spaces with meanings that constitute familiarities and sense of place (Bornioli et al., 2018; Gatrell, 2013; Witte, 2023).

Enhancing and promoting walkability, therefore, became a foundational remedy for urban issues linked to violence, poverty, and criminality and a driver for reinstating safety, public trust, collective and individual well-being, as well as quality, attractiveness, vitality, and vibrancy of public spaces and urban life (Abdulla et al., 2017; Cysek-Pawlak & Pabich, 2021). Urban revitalization and recovery projects in cities around the world, such as Medellín (Colombia), Seoul (South Korea), Milan (Italy), Tripoli (Libya), among others, have proven how walkability is foundational to reclaiming space and places rights at eye level, by bringing (back) safety, and weaving (back) together diverse social practices, place attachments, and lived experiences (Bornioli et al., 2018; Gatrell, 2013). Moreover, many urban heritage preservation and reconstruction policies incorporate reclaiming historic cores for walking. Efforts to recover urban qualities eroded by modernization have gained urgency, where walkability becomes the apparatus to reverse the lingering effects of car-centric planning and sprawling infrastructure (Lo, 2009).

However, while some urban revitalization projects embrace walkability as a means of social and spatial reconnection, much of the current "car-free" activism remain focused primarily on the material infrastructure that enables walking—treating walkability merely as a mode of transit between point A to point B. Such technocratic approaches often overlook the micropolitics and social textures of pedestrian life—the everyday interactions that shape complex and subtle power relations in movements' rhythms and tempos through space. Middleton (2021) captures this interplay as the "pedestrian politics of (non)encounters," shedding light on "what actually happens between A and B as people move on foot" (Middleton, 2010, p. 591). Such oversight becomes evident when considering walkability in areas associated with (war) violence. Here, the disconnection between urban design principles and the lived realities of conflict-ridden spaces underscores a critical gap in our ability to foster healing and reconstruction.

2.2. Conflict Disruptions and the Inescapable Practice of Walking

A wealth of scholarly research and terms has clearly demonstrated the far-reaching and long-lasting consequences of war violence on urban fabrics and existing modes of inhabitation. Terms such as "domicide" (Azzouz, 2023; Porteous & Smith, 2001), "urbicide" (Abujidi, 2014; Coward, 2009; Graham, 2003), and "spaciocide" (Huss & Altehe, 2024), among others, serve to theoretically frame how violence alters habitats' systems and life-worlds instilled within them. The -cide suffix is used to explain the voids created in these systems by describing a state of intentional acts when urbicidal violence deliberately strives to kill, discipline, or deny the city to its inhabitants by targeting and then reordering the socio-material urban assemblage (Graham, 2008). Examples of urbicide enacted fully or partially are still present in human living memories and can be traced across the globe, from Dresden (1945, Germany) and Hiroshima (1945, Japan) to Quang Tri

(1968, Vietnam), Sarajevo (1993, Bosnia and Herzegovina), Aleppo (2014, Syria), Kharkiv (2023, Ukraine), and Gaza (2025, Palestine).

Satellite images and photos clearly document the acute physical deformation into uninhabitable rubble and stones. Nonetheless, urban landscapes in conflict or post-conflict contexts are not simply a static setting but a dynamic network of interacting elements, where multi-layered violence and conflict remnants slowly grow in the gaps of ruptured life-worlds of those who survived. During active conflicts, processes of deterritorialization and reterritorialization that compete to (re)assert dominance often materialize, paralysing movement and disrupting the everyday rhythms of urban life with anxieties and insecurities. Azzouz (2023) captures these processes vividly:

> Tanks enter neighbourhoods, snipers occupy buildings, and fighting groups knock down walls across shops and homes…dividing lines emerge to control people's mobility and separate communities from one another. Public spaces become contested territories over who has the right to access them….Conflict infrastructure like walls, fences, buffer zones, cement blocks, and checkpoints emerge within the built environment to segregate communities….As a result, different ways of living emerge, as if different cities exist within the same city, reshaping spaces through these divisions and fostering fear and suspicion among communities. (p. 8)

By violent processes of deterritorialization and reterritorialization, conflict infrastructures and actors not only fragment cities spatially; they also disrupt and alter temporalities of presence through movement restrictions and curfews, tainting sensory experiences with terror and uncertainties. Ristic's (2018) work on Sarajevo also illuminates how opposing groups weaponized the city's topography and urban morphology. Through strategic siege lines, lethal vantage points and asymmetric visibility, snipers reterritorialized dominance over movement, depriving residents of their most fundamental rights and freedoms and deterritorialized once-vibrant public areas into perilous zones. This violent distortion, subversion, and weaponization ultimately recast public space into a *landscape of fear*, escalating aggression, fracturing daily life, and deepening social divisions that persisted into postwar times (Ristic, 2018).

In conflict-ridden geographies, violence recalibrates the spatio-temporal rhythms of movement, which are "trapped in a complex and dynamic feedback-based relation with the forces operating within it" (Weizman, 2006, p. 8). Acute and prolonged disruptions, distortions, and destructions caused by urbicide significantly deform how walkability is experienced by different groups and force a reconfiguration of what constitutes the walkable, but also when. Daylight hours, typically associated with active confrontation, become fraught with danger due to the constant visibility of exchanging fire threats. Night hours, on the other hand, coincide with bombing and shelling, curfews and restrictions on movement.

Nonetheless, war not only "deprives people of their regular everyday routines and their basic rights to the city and its services" but also "liberates possibilities for new spatial organizational patterns beyond the limits imposed by any authority" (Kittana & De Meulder, 2019). Spatial knowledge of safe routes becomes, therefore, a fundamental danger-evasion tactic of survival, deepening the reliance on informal networks for spatio-temporal recognition of when to move and when to stay. These tactics coincide with spatially reconfigured elements of underground tunnels and basements as safe havens. What further dictates these danger-evasion tactics' patterns and tempos is attending to daily needs, forcing residents to adapt to

irregular and unpredictable schedules of availability. The case of Sarajevo provides, again, a stark example of how the 1992–1996 siege altered city dwellers' walkability patterns:

> Threats and attacks brought forth new uses of public spaces and new ways of moving through them. Sarajevans learned to complete tasks…as quickly as possible. The practice of walking through the city was replaced by running over bridges, through squares, and across crossroads, since the widest intersections…were often the most exposed to the gaze of the enemy and were therefore continually attacked….Bridges that once connected people, communities, and neighbourhoods now exposed Sarajevans to the gaze of the sniper. (Mandić, 2019, p. 89)

Walkability, therefore, is no longer just about streets and sidewalks but about creatively utilizing any available space for safe and strategic footpaths temporally deterritorialized and reterritorialized to minimize exposure to danger with hurried dashes across open areas (Pilav, 2012; see Figures 1a and 1b). Kittana and De Meulder (2019) underscore similar spatio-temporal complexities and reconfigurations in Palestinian Nablus (see Figure 1c). They map how the coexistence of two conflicting spatial matrixes of control and *sumoud* (steadfastness) manifests spatially and temporally as forms of attack and rescue routes without directly intersecting.

Figure 1. Disrupted walkability during conflict: (a) Detail of Sarajevo Survival Map 1992–1996; (b) "Protected pedestrian paths during the war," photograph by Miguel Ruiz; (c) a rescue path in Nablus's historic core, indicated in blue. Sources: (a) FAMA Collection (1996); (b) Pilav (2015); (c) Kittana and De Meulder (2019).

2.3. Post-War Walkability

War-wounded cities do rise from the rubble, yet they rarely heal from such disruptions unscarred. Between distortion and triggers, healing processes linger in assemblages of war remnants. Traces of the past and spatio-material voids of loss and displacement impede residents' ability to familiarize themselves with and reclaim a sense of place and normalcy (Czarnecki & Chodorowski, 2021; Ujang & Zakariya, 2015). In post-war contexts, the erosion of walkability is frequently treated as collateral damage sidelined by violence and a safekeeping measure reshaping urban realities. Post-war reconstruction of Beirut's historic district in the early 2000s created what Nagel (2002) terms a "forgetful landscape," neglecting the war-induced disruptions of the original socio-spatial fabric. The mirage of contemporary luxury, a pedestrian-friendly urban centre that appears at once vibrant and disconnected from (post-)war realities, ultimately rendered many inhabitants "out of place" (Azzouz, 2023).

In conditions of civil conflicts, damages root deeper and differ proportionally based on the power dynamics between opposing parties on the ground, resulting in fragmented and divided cities with severely separated communities. Whether conflict infrastructures disappear or not, instability, insecurity, and mistrust often persist long after the formal end of hostilities, hindering healing, delaying reconstruction and recovery efforts, and even reinforcing ruptures. In post-war Sarajevo, Ristic (2015) highlights how "intangible borders" ingrained in residents' minds amplify how mental barriers of division endure despite urban spaces' apparent permeability. The deformation of what walkability once allowed of everyday familiarization practices fostering urban bonds further deepens (imposed) social fragmentation. While many physical barricades decayed, "bottom-up instruments of spatial micro-politics of division" of intervened street names, colours, and scripts serve as territorializing mechanisms, solidifying identities while rendering others invisible (Ristic, 2015). The Peace Wall in Belfast (Northern Ireland) and the Bridge on the River Ibar in Mitrovica (Kosovo) serve as examples of how conflict-related assemblages symbolically reinforce the post-war division between communities (Bátora et al., 2021; Boal, 2002) and how face-to-face street encounters are spatially demarcated and reconfigured. With prolonged separation, everyday familiarities become spatially enclaved, where unmatched war experiences and narratives remain uncommunicated and slowly erode any possibility of future healing.

3. Note on Assemblage Approach, Case Study, Positionalities, and Research Methods

This article situates walkability as a critical multi-dimensional lens to examine how urbicidal practices and conflict infrastructures disrupt and violate everyday "rights to encounter" (Middleton, 2021) that sustain the humanity of city dwellers as social beings who walk (Ingold & Vergunst, 2008). It builds on the assemblage approach developed by Deleuze and Guattari (1987) and DeLanda (2006), which reconceptualizes reality as a fluid constellation of human and non-human actors, discourses, and materialities, perpetually in flux through processes of deterritorialization (disintegration of established orders) and reterritorialization (reconfiguration into new formations), which provides a potent lens for examining the non-linear, contested trajectories of cities—particularly those navigating the aftermath of violence. Therefore, the assemblage approach serves to examine how walkability metamorphosizes in conflict-ridden cities, offering a fertile analytical framework for understanding how heterogeneous elements—materialities, temporalities, socio-cultural practices, human contested agencies, and conflict legacies—trigger processes of deterritorialization and reterritorialization to produce (or inhibit) walkable spaces.

Our case study is Aleppo's historic core, one of the world's oldest continuously inhabited urban centres and a UNESCO World Heritage Site since 1985. Trapped in a prolonged crisis, Aleppo and its (contemporary) history highlight walkability's profound role in generationally co-constructing its historic core and how violent (post-)conflict dynamics have altered how walkability is practised and perceived. The selection of this case is by no means an accident. Both authors are displaced Syrians carrying personal histories and attachments with Aleppo, yet they have different previous engagements with walking the site. The researchers' positionality provided a critical reflexive dialogue, as each author had different inherent knowledge about the case study. Moreover, the article draws on various primary and secondary resources (maps, reports, literature, images) underpinning an analysis of pre-, during, and post-conflict walkability disruptions and metamorphosis. This data collection began in the context of a collaboration with young Syrian architects during a joint project by Brandenburg University of Technology (BTU) in Cottbus and the American University of Beirut in November 2021 (BTU, n.d.). This experience allowed for the initial mapping

of the young Syrian architects' lived experiences and memories embedded within Aleppo's historic core (see Salahieh et al., 2024, for insights derived from this collaboration). Empirically grounding the analysis, researchers employed a sensory ethnographic approach, centring "walking the site" as a fundamental research tool for its "productive ways to address broader questions surrounding power, scale, mobility, embodiment, and knowledge production" (Mason et al., 2023, p. 1). Exploratory slow walks in 2021–2022, involving firsthand encounters with the material and sensory transformations brought by conflict, illuminated insights into how conflict alters ordinary movements through a city and how individuals attempt to re-establish normalcy. Immersing the body in the fieldwork enabled encounters that evolved into informal hangouts, which provided valuable insights into the living experiences within contested spatio-temporality of pre-, during, and post-conflict realities.

In addition, building on previous research (dataset M, interviews collected by Asaaed, 2023, and by Salahieh et al., 2024) and ongoing investigation (dataset D, comprising follow-up interviews conducted remotely between 2024–2025), 16 semi-structured interviews were conducted on-site (2022) and online (2022–2025) with current and former Aleppo dwellers, spanning diverse ages, genders, and ethnic and religious backgrounds. Interviewees were selected through a snowball sampling approach, building trust amid an atmosphere of fear and scepticism. For anonymity protection, each interviewee was assigned a unique number and coded initials (M and D), indicating the dataset they belonged to and the timeframe of the interviews. These conversations revealed how the conflict reshaped daily embodied experiences, altering physical and emotional landscapes of safety, familiarity, and change.

4. Walkability in the Historic Core of Aleppo Between Past and Present

4.1. Pre-War Conditions

The city of Aleppo, once an active commercial node on the Silk Road, imprinted by morphological characteristics of historic Arab-Islamic cities, has survived and flourished as an urban centre for centuries. Its historic core's interconnected layout, crafted over generations, was not an incidental feature but a structured mechanism, balancing density, ethnic and religious diversity, and socio-economic activities. This arrangement is evident in the distribution of key landmarks, such as the Citadel, the Great Umayyad Mosque, the Medina Souq, and the Al-Jdeideh quarter, among others, serving as public hubs of socio-cultural and economic significance for the entire city. What constituted thresholds of access and modes of social interactions are the spatio-temporal rights to use and occupy, based on organizational socio-spatial-governance hierarchies materialized in series of doors, walls, and gates from the housing unit to the city as a whole (see Akbar, 1988). Distinct neighbourhoods, each with its own local markets and gathering spaces, developed specialized and homogeneous economic foundations intertwined with generationally maintained shared professions such as milling, lime production, brick making, dyeing, tanning, coppersmithing, and blacksmithing. The souqs (marketplaces), and khans (caravanserais or commercial inns) within these areas were named directly after these dominant professions (Akbar, 1988). British historian Mansel (2016) describes the breadth of these souqs:

> By 1600, there were fifty-three khans and fifty-six souqs in Aleppo, stretching over twelve kilometers. The souqs of the rope-makers, saddlers, tanners, and spice-merchants formed a labyrinth of commerce where even a blind man could navigate by scent alone. (Mansel, 2016, p. 132)

Such concentration of high-skilled craftsmanship in adjacent spaces led to the emergence of souqs from producer to consumer and necessitated the enhancement of on-foot accessibility. These markets grew under Ottoman rule (1516–1918), leveraging opportunities afforded by international trade (Watenpaugh, 2004). This growth necessitated an environment that enabled complex negotiations to unfold, supported sustained trade exchanges, continuous commercial activity, and extended stays. Therefore, accommodating these needs meant enhancing spatial organization through walkable souq markets, the presence and visibility of specific mosques, caravanserais, and endowment structures from the pedestrian level (Watenpaugh, 2004):

> The integration of caravanserais within the market ensured that traders, pilgrims, and travellers could move through the city on foot, reinforcing Aleppo's identity as a walkable, merchant-driven metropolis. (Eldem et al., 2005, p. 75)

These structures and urban elements facilitated the deliberate distribution and density of commercial activities and goods throughout the urban fabric (Starkey, 2012). Walkability, thus, was not only woven into the city's socio-spatial fabric but was essential for it to be continuously inhabited and vivid.

Between the late 19th and mid-20th centuries, Aleppo's historic core witnessed two major challenges: successive migratory waves into the city and the introduction of modern infrastructure and planning. These changes led to new "modern" neighbourhoods emerging on the historic core's edges, with efforts to connect them to its centre. Moreover, emphasizing automobile traffic and modern urban approaches resulted in the destruction of parts of the historic core to make way for avenues and modern high-rise buildings (Lafi, 2017). These transformations disrupted "the traditional urban and social structures" (Starkey, 2012) with subsequent economic implications for trade within the historic core. However, by the 1970s, the prevailing modernist destructive master plans provoked Syrian architects and conservationists to take action to value the historic core as a national heritage (Lafi, 2017; Starkey, 2012). Their advocacy and pursuit led to the 1985 UNESCO recognition, which in turn spawned the 1998 Development Plan. This plan provided a flexible framework for revitalizing the historic core, mainly aimed at enhancing living conditions while preserving its fabric beyond monument restoration. Nonetheless, unfulfilled promises, gentrification, overlooked urban decay, and traffic congestion in the historic core (Zeido, 2023) led to the 1998 Development Plan's reformulation into a structured framework by the 2000s. By advancing revitalization, management, and conservation while promoting car-free walkability, several targeted areas, such as the Al-Jdeideh quarter, a home for various historic religious monuments, evolved into vibrant hubs encompassing a diverse range of tourist, cultural, and socio-economic walkable activities (Salahieh et al., 2024).

4.2. The Battle of Aleppo (2012–2016)

The revitalization flourishment ended as instabilities arising in 2011 reached Aleppo in 2012, to become a war that lasted for four years. The historic core, viewed as a symbolic territory over which control was bitterly fought, became a battlefield, resulting in significant destruction of its fabric. During the "Battle of Aleppo" years, urbicidal practices and acute violence ripped apart the intricate urban fabric, leaving substantial voids in the historic landmarks and everyday spaces. Satellite imagery reveals how entire commercial districts were flattened, leaving gaps in the once-cohesive pedestrian network (Kurgan, 2017). The historic core was left

in ruins: Around 30% destroyed and 60% severely damaged ("UNESCO reports on extensive damage," 2017; see Figure 2).

Between 2012–2016, conflict lines divided Aleppo into two parts: the eastern side, including the historic core, controlled by armed opposition forces, and the western side, controlled by Assad's troops. Conflict lines were in constant flux, continuously deterritorializing and reterritorializing the historic core through a conflict infrastructure of dense networks of imposed barricades and checkpoints that subverted everyday elements (such as public buses and curtains) into markers dividing the zones of control of each side:

> Walking became a nightmare. We avoided main roads because of the shelling, taking back alleys instead. Some days, stepping outside just to fetch water or bread felt like an adventure. Once, we had to reach my grandfather's house near Bab al-Nasr. We encountered a security checkpoint [and then heard] a sudden explosion nearby. The ground was covered in rubble, and the wailing of ambulance sirens never stopped. It felt as if the city itself was weeping. (Interview, 2025, D3)

Conflict infrastructure was interlaced with the (often concealed) presence of human actors, including snipers, opposing troops, and militia groups, whose movements and tactics dramatically deterritorialized and

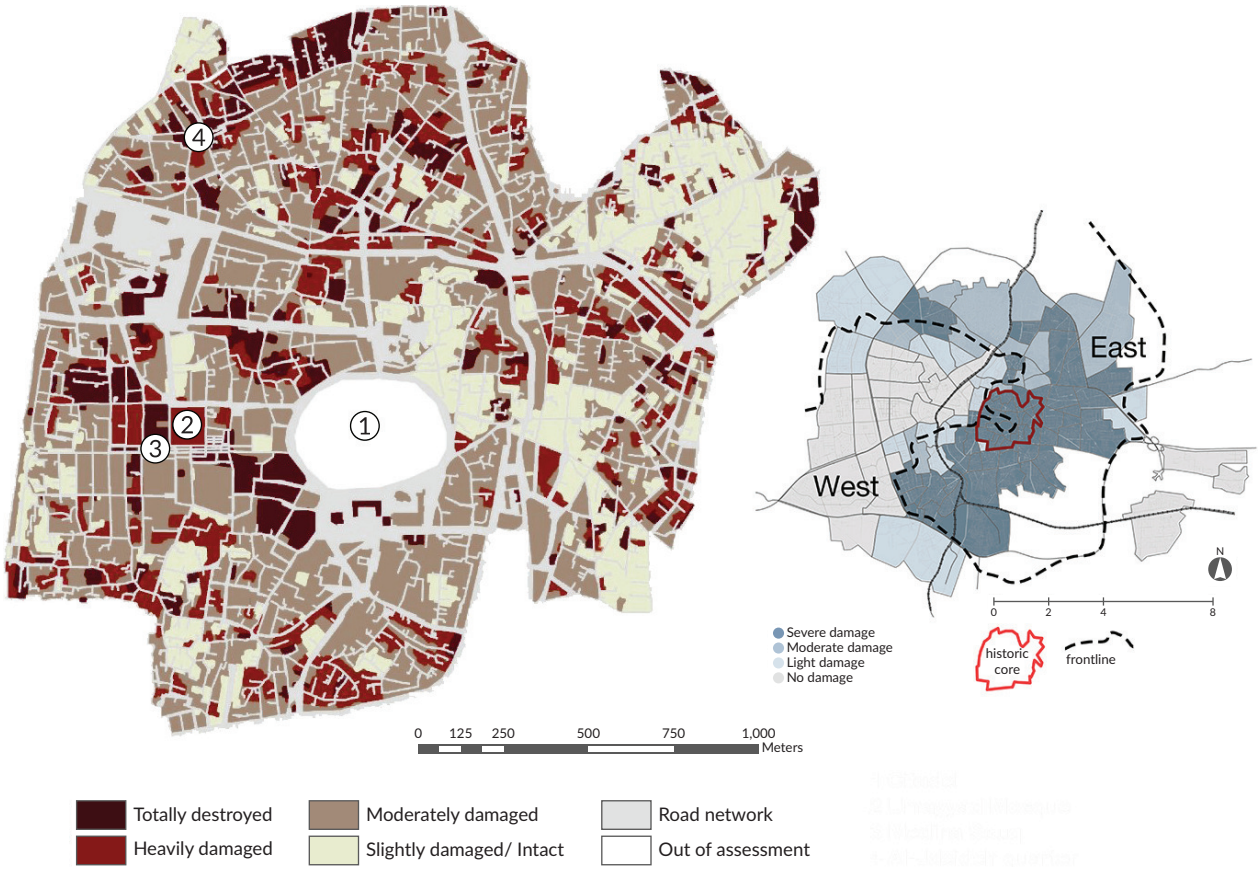

Figure 2. Severe conflict damage in Aleppo's historic core due to frontline positioning: (left) Damage assessment map of Aleppo's historic core (1- Citadel; 2- Umayyad Mosque; 3- Medina Souq; 4- AlJdeideh); (right) Map of Aleppo's dividing frontline crossing through the historic core during peak conflict. Sources: (left) Affaki (2021); (right) adapted from UrbAN-S (2019).

sabotaged the urban fabric. Traces of holes in various sizes, once crafted for shooting or troop mobility, still mark walls of historic buildings. Furthermore, unpredictable periods of assault and halt ranging from temporal restrictions, curfews, and the final siege enforced significant spatio-temporal disruptions of everyday normalcy. The long periods of inaccessibility to the historic core caused severe discontinuities. For example, the Al-Jdeideh quarter was at the front line during armed confrontations, and the massive destruction of religious monuments forced an extended period of spiritual discontinuity (Salahieh et al., 2024). Similarly, the inaccessibility to the Medina Souqs and subsequent destruction led merchants and shops to "temporally" relocate outside the historic core (Knudsen & Tobin, 2024), which was not just an economic catastrophe (Bishara, 2022) but a rupture in the city's pedestrian and social life. These discontinuities and ruptures not only immobilized the deeply embedded socio-cultural and economic practices maintained over generations but also inflicted lasting scars on the collective meanings and memories (Affaki, 2021; Munawar & Symonds, 2022), once slowly crafted and spatially anchored.

Like Nablus and Sarajevo, navigating Aleppo's historic core necessitated danger-evasion tactics, which in turn required careful mental mapping and tuning a heightened sense to the unpredictability of threat. These tactics recognized spatio-temporal disruptions—identifying which streets and areas to avoid—and produced reconfigured routes to safer, necessary destinations. Neighbourhoods had their own community patrols to instil protection and safety. While their presence guided residents, it equally reminded their necessity to guard. Destruction remnants, empty structures, and mounds of rubble became material compositions that served intermittently as safe footpaths and escape routes within the distorted familiarities. These tactics, therefore, became foundational for the reterritorialization of "pockets of survival" within the deterritorialized urban fabric and gave "a reassuring (illusion) of a vital non-passive state of [war-affected] society" (Dayoub, 2015, p. 79).

By the end of 2016, Assad's troops carried out an intense military offensive that ended with them taking control of the city and its old core, celebrated as a "victory against terrorism" ("'We waited for this day for five years,'" 2016). The estimated human loss was a death toll of 31,000, hundreds of thousands forcibly displaced, and others suffering dire living situations.

4.3. Stagnant Restoration

Despite the severe damage from the conflict, the urban layout of Aleppo's historic core, with its main paths connecting the city gates to the central monuments and the Citadel, as well as its quarter and neighbourhood structures, remains largely intact (Nagler et al., 2019). To architectural experts, the dramatic destruction of significant architecture is met with the optimism of the standing walls and preserved foundations and ground plans. The severely burnt vaults of the Souq, the entirely collapsed historic houses, schools, baths, and public buildings will require careful architectural reconstruction (Nagler et al., 2019). Signs of reconstruction efforts started to emerge in the historic core in 2017. Most streets and alleys have been cleared of rubble, allowing pedestrian and automobile movements to resume through the historic core (see Figure 3).

Nonetheless, the decision of where and what to revitalize reflects political statements of both private (international and local) actors and the Assad government's allusion to a "post-conflict" phase and a restored sense of normalcy. Disparities of revitalizing efforts are evident in the reconstruction of the city's iconic landmarks and religious and commercial centres, such as the renowned Medina Souqs. The Al-Jdeideh

Figure 3. Walkability (re)activation in Aleppo's historic core in 2017: (a) Families navigating between rubble; (b) a young couple taking a walk near the Citadel; (c) military men raising the flag to signal victory in front of the Citadel; (d) stacked buses as background shields while people repopulate the streets once again. Source: "Halep'in doğusu 'harap'" (2017).

quarter, for instance, has witnessed a complete reconstruction of all its cathedrals and churches, yet the revival of walkability has remained limited and mostly confined to its eastern edge. Furthermore, Al-Hatab Square—once a massive crater bordered by partially collapsed structures due to years of war—was levelled and refurbished in 2022. Its restoration served Assad's victory narrative by facilitating space for pop-up activities, yet they only marked the temporal activation of life that stopped along the torn buildings' edges. The sporadic nature of these physical reconstruction efforts re-enables walkability, which once moulded the city's fabric, albeit in a fragmented manner (see Figure 4):

> Walking through the city now feels like visiting an abandoned museum. Some places have been rebuilt, but the soul of the city has changed. The markets have lost their crowds, and some shops have closed forever. Even the scent of roasted coffee doesn't feel the same anymore. (Interview, 2025, D3)

Though these emblematic spaces have been physically rebuilt and opened to the public once more, they now stand devoid of the vibrant urban life and activity that once animated them. Various obstacles hinder the possibilities of returning, reconstructing, and reviving the former familiar urban life, i.e., constant looting, economic degradation, severely damaged infrastructure, lack of private funds, the negligence of the Assad government, and the lengthy bureaucratic procedures of conservation policies (Asaaed, 2023; Mahfouz, 2021; Sabri et al., 2023). Therefore, the stark disconnection between restoration ambitions, post-war realities, and the absence of human presence highlights how physical reconstruction alone cannot recapture the intricate, symbiotic interplay between the urban environment, present urgent needs, and the lived experiences of the city's inhabitants.

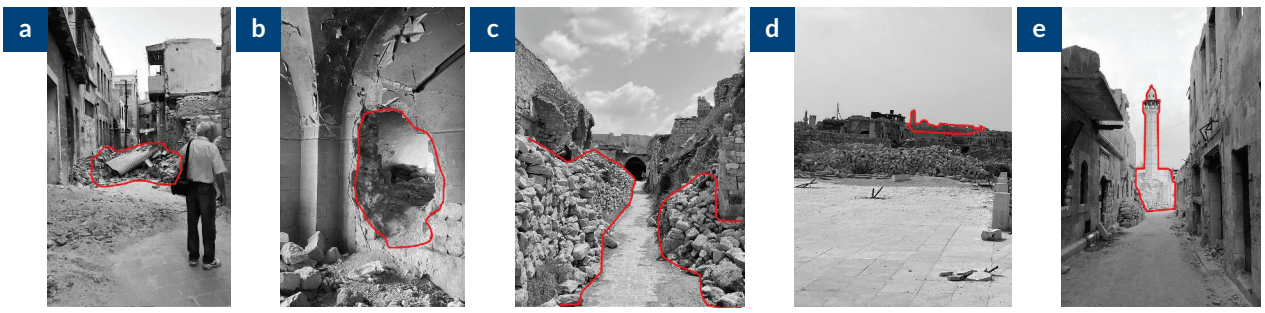

Figure 4. (Post-)conflict material disruptions of walkability in the historic core of Aleppo in 2022: (a) Inaccessibility due to rubble; (b) traces of militia violence; (c) mounds of rubble; (d) voids of collapsed buildings forming new vistas; (e) uneven and prioritized reconstructions.

5. Between Rubble and Stones: Walkability in the Remnants of Conflict

Navigating the everyday within (post-)war remnants carries its heavy weight. While much conflict infrastructure and many opposing groups (partially) disappear, their latent effects continue to tweak mobility patterns. Spatio-temporal and socio-economic dynamics are in constant flux, adapting to the slow reawakening and recovery of (pre-)war everyday landscapes. Such adaptions enable on-foot navigation between post-war changes (re-)establishing and expanding (former) pockets of survival:

> Nothing improved after the war….Life kept getting worse—economically, socially, in terms of healthcare….The only difference is that the shelling stopped, but people even started wishing for the war to return because at least back then, they could afford to live. (Interview, 2025, D4)

Post-war realities and economic hardship have impacted people and places unequally. The severe economic crisis—exacerbated by international sanctions, restrictions, and geopolitical instabilities—has hindered the basic recovery of infrastructure, particularly systems reliant on scarce electricity and fuel. What were once affordable mobility means, such as (micro)buses and taxis, have become increasingly inaccessible due to skyrocketing prices, high demand, overcrowding, and insufficient supply. These scarce transport options now operate within damaged route networks, further complicating movement across the city's remnants. Consequently, walking becomes inescapable, dictated by physical barriers of rubble and debris, persistent insecurities, and limited access to the scarce everyday services of grocery stores, schools, and medical services. As a result, spatial proximity, safety, and economic affordability condition the everyday decisions and (on-foot) navigation:

> Walking isn't a luxury anymore, especially when you are forced to walk daily for transportation purposes. It becomes exhausting to walk. If it's really nice weather in the evening, it gets you excited to go for a walk around your neighbourhood where it's safe and close. (Interview, 2024, D2)

Beyond the visible challenges of navigating the historic core during the day, another layer of spatial inequality emerges at night. Most streets are poorly lit or entirely dark, creating a sense of insecurity that discourages people lingering or moving freely after dark. In effect, the absence of lighting serves as a silent cue to leave the area, reinforcing exclusion and limiting nighttime social life. Certain cultural monuments are conspicuously well-lit, reinforcing their "importance" in stark contrast to barely lit public streets (see Figure 5). The contrast in illumination reveals economic disparities: Shops that remain open and can afford electricity stand out, while others are left in darkness. In some areas, the absence of lighting conditions creates a more precarious, necessity-driven pattern of walking, particularly for those who must attend to early morning work responsibilities. Therefore, the distribution of lighting in the historic core is not just a matter of infrastructure—it reflects reterritorialized deeper inequalities and power structures within the city:

> In 2019, my friend told me to go together to Al-Jdeideh to buy wool for knitting like we used to do. We took a cab to Telal Street; it was as lively as before. As we walked further into the quarter, the walls turned black. I started getting scared. I wanted to get out. I asked my friend, "Where are you going? Why did you bring me here!" Then we found the alley leading to Souq El Souf [the wool market]. It wasn't as destroyed as the rest of the area. It wasn't as dark and scary. But all the shops were closed. Only one man had his place open, but all his stuff was in boxes. We didn't buy anything; we left quickly. (Interview, 2024, D1)

Urban sensory experiences, once integral to the collective memory of walking and imbuing the historic core with familiarity, have been irrevocably distorted by (post-)conflict disruptions. Interviewees recalled both pleasant and unpleasant sensory memories. While some streets in the historic core are now physically walkable, the loss of local figures and the consequent defamiliarization are underscored by the absence of sensory cues. For instance, in the Al-Jdeideh quarter, the smell of the hot fava beans from Abou Abdo—which once guided and lured passers-by—has been replaced by the scent of polished stones and dust from rubble. Neither "the rhythmic chants of merchants selling baby-finger-size cucumbers, red tomatoes, mint of lust, and green salad" (Interview, 2022, M1) nor "the smell of lemon trees and the sounds of birds and the noise of air conditioning" (Interview, 2022, M2), which once signalled vibrant street life, can now be found. Meanwhile, the sounds emanating from private reconstruction efforts and children playing on the renovated square attest to a sense of inevitable return to everydayness as the city awaits full recovery (see Figure 5):

> Life [in the historic core] was vibrant, full of movement and beauty. The narrow streets were steeped in history, and the markets—like Souq al-Attarin and Souq al-Saboun—were filled with the scents of laurel, thyme, and spices. I worked in a fabric shop with my father, near Souq al-Atmeh. I used to walk toward the Umayyad Mosque and through historic core of Aleppo….My favourite path was from Bab al-Faraj to Souq al-Manadhra, passing by the copper shops where artisans crafted masterpieces using traditional techniques….Some corners still feel familiar, like parts of the citadel, but for the most part, it feels like history itself has been wounded here. I miss the bustling voices of merchants, the aroma of incense in Khan al-Wazir…and the "Sheikh Najib" café, where we used to listen to the stories of the elderly. (Interview, 2025, D3)

The conflict's embedded consequences in Aleppo's historic core have not only deterritorialized its physical and sensory landscape but also disrupted generationally interwoven socio-cultural networks that once underpinned everyday life. The enduring physical remnants of pre-war structures serve as powerful mnemonic triggers, evoking vivid recollections of the past and a deep longing for the familiar. As a result, walking in the historic core now elicits profound feelings of nostalgia and disorientation as residents who remained grapple to confront the reality that places they once knew can never be entirely recaptured. Voids left behind by the absence of (multi-generational) dwellers, coupled with the prolonged periods of inaccessibility to the historic core, have radically altered socio-urban dynamics and perpetuated long-term disruptions to spatially embedded social networks. Prolonged economic discontinuity and long-family-line merchants' displacements have further eroded familiarities and embodied practices that once constituted and shaped walkability patterns. This erosion, tied to voids of generational presence, has engendered a sense of estrangement tied to the loss of both comfort and safety provided by traditional "eyes on the street." This estrangement has been exacerbated by the new (displaced) occupants who have filled vacant and (partially) inhabitable structures. According to interviews, unlike former dwellers, these new occupants lack the socio-cultural knowledge and social norms of Aleppian society that were once ingrained spatially in the historic core (Salahieh et al., 2024). Consequently, these prolonged disruptions—marked by unfamiliar faces and altered activities—further deepen a profound sense of irrevocable loss.

Figure 5. (Post-)conflict sensory walkability in the historic core of Aleppo in 2022: (a) Breadsticks bakery reactivating sensory urban life amidst the heavily destroyed Al-Jdeideh quarter; (b) newly reconstructed souq empty of life; (c) children playing on a newly renovated square in Al-Jdeideh; (d) streets at night lit only by moving cars; (e) selected night lights illuminating monuments; (f) urban life between ruins, selectively reconstructed, and resilient residents in Al-Jdeideh.

6. Re-Centring Walkability's Significance in Conflict-Ridden Cities

The experiences of walkability in conflict-ridden cities and their post-war realities are inherently intertwined with the material, temporal, and human elements that constitute and shape them. In conflict-ridden cities, pre-war everyday normalcy is continuously distorted and reconfigured by urbicidal practices, pervasive threats, remnants of violence, and contested human agencies. Consequently, walking—often taken for granted—becomes an inescapable survival practice shaped by danger-evasion tactics. Similar to Nablus and Sarajevo, the case of Aleppo's historic core, which remains in ruins today, underscores how the walkability experiences that once (re)shaped its urban fabric and the life-worlds embedded within it remain significant in reclaiming human agency, as well as the right to memory and life, amidst disruptions and alterations conditioned by armed conflict and its aftermath. To re-centre walkability's significance in conflict-ridden cities, this article identifies two dimensions: first, what disrupts and alters walkability, conceptualized as disruption assemblages, and second, the policies and strategies through which post-war reconstruction efforts can acknowledge, address, and mitigate these disruptions.

6.1. Disruption Assemblages

Disruption assemblages refer to the intertwined configurations of material, temporal, and human elements that emerge in conflict or post-conflict contexts and disrupt urban lives within them. These assemblages capture how everyday practices—such as walking through a city—are transformed into acts of survival within landscapes marked by disruption. The use of assemblage theory (DeLanda, 2006; Deleuze & Guattari, 1987) in analysing armed conflicts and violent wars has been instrumental in understanding and underpinning the temporal and prolonged disruptions that occur both during and after active warfare (Ristic, 2018). In conflict settings, conflict infrastructure and destruction remnants are not isolated entities; rather, they interact with temporal disruptions and are actively mediated by human agency and adaptive behaviours. This interlaced

network of elements creates a fluid, emergent assemblage in which urban spaces are constantly deterritorialized and reterritorialized, both during active hostilities and in the protracted aftermath of conflict. While some elements of these assemblages survive and scar, others vanish, leaving disruptive traces that remain. These elements are as follows.

6.1.1. Materially Disruptive Elements

Materially disruptive elements encompass the spatial emergence and persistence of a network of conflict infrastructure, destruction remnants, and scattered (incomplete) reconstruction projects. In active assaults, these elements deterritorialize and reterritorialize thresholds of accessibility and zones of control. They include improvised temporary dividers (barricades, checkpoints, walls, sandbags, tanks), repurposed everyday elements (buses, curtains, doors, furniture), and shattered remnants of collapsing buildings, debris, and inaccessible roads. These elements signal (partially) unsafe zones, which, in turn, permits the reconfiguration of footpaths, shields, and survival pockets in times of active assault. Beyond these barriers, the urban fabric itself becomes a disruptive tool as military actions subvert and weaponize space. Open areas and major routes are targeted to instil fear, while walls are breached and repurposed, reshaping access and security. After the active conflict ends, while some of these materialities decay, others survive and endure, leaving visible scars that hinder human presence, deepen a sense of insecurity, and trigger traumatic memories of loss and death.

6.1.2. Temporally Disruptive Elements

Temporal disruptions are closely tied to the material ones and underpin various inaccessibility durations: a few hours, a whole night, or even longer periods of days and months. These elements include assault-halt temporalities (on-the-ground confrontation, shelling, airstrikes) and temporal restrictions of movement (curfews, sieges, surveillance). These disruptions also reintroduce a new rhythm of everyday activities, not only in terms of duration within a geographical scope but also tempos of (de-)acceleration of how fast they should be executed. Walking becomes a survival practice of danger-evasion tactics (de-)activated by the altered materialities and human presence. For instance, in a sniper-controlled area, walking transforms into running in exposed spaces, hiding behind walls or cars, and quietly walking within rubble. Temporal disruptions have prolonged, paralysing impacts on essential services, economic activities, and everyday social interactions, creating an atmosphere of uncertainty and instability.

6.1.3. Human Disruptive Elements

Both material and temporal disruptions are enacted and mediated through the presence and absence of contested human agency. The human element involves troops, snipers, security groups, community surveillance and protection units, dwellers, neighbourhood figures, and displaced groups. The (concealed) presence of opposing armed actors creates an atmosphere of heightened tension, a constant threat of violence and insecurity and a deepened sense of unfamiliarity, while the voluntary presence of some civilian units reinstates a sense of temporal safety within survival pockets. Absence, on the other hand, signals an imminent danger, where the voids created by displacement and death evacuate spaces from their social control and vibrancy, converting spaces into (un)predictable death traps and landscapes of loss.

6.2. "Attracting a Foot" as a Post-War Reconstruction Strategy

Drawing on assemblage theory's emphasis on the complex interplay between the material manifestations, temporal layering, and contested human agency, re-anchoring walkability within post-conflict reconstruction strategies requires a shift in perspective: moving beyond Western-centric discourses of "car-free" zones to cultivate a holistic, human-centric layered approach. This approach challenges experts to view walkability not as a technical endeavour but as a living assemblage—one that evolves through the interplay of memory, materiality, and collective action. Walking, therefore, allows the mapping of how disruption assemblages continue to influence urban spaces after active hostilities cease, which can, in turn, inform the development of context-sensitive strategies that address these disruptions through both post-war early recovery and reconstruction strategies:

> Maybe one day, Aleppo will shine like a jewel again…but the road is long. Aleppo is not just stone; it is the memory of those who lived in it. Every step in its streets was a story…and now, we are trying to write a new chapter. (Interview, 2025, D3)

In the Aleppien dialect, numerous proverbs interconnect concepts of movement, social familiarity, cultural rituals, and economic prosperity, all of which originate from historical circumstances that have ensured their persistence. In the context of reconstituting walkability to revitalize lived urban spaces in post-war reconstruction, three proverbs are particularly salient: "attracting a foot," "movement is a blessing," and "let their feet drive them." These expressions exemplify a sustained practice of on-foot mobility that is believed, through repetition, to foster trust-based social relationships and to secure a prolonged, spatially anchored continuity within the community. These proverbs, as they resonate in contemporary Aleppo, encapsulate a multifaceted ethos of post-war revitalization, calling for a re-anchoring of individuals within spaces and memories that meld the past, present, and future. In response, we propose an "attracting a foot" approach—one that re-centres walkability as a critical lens for early recovery and reconstruction strategies in post-conflict contexts. This critical lens not only foregrounds the tangible act of walking as a means of reclaiming and reimagining urban life but also underscores the importance of acknowledging conflict legacies and reconnecting communities to their historical and spatial narratives.

Historic urban cores, like in Aleppo, are material palimpsests of layered temporalities and sociabilities, where historically crafted urban fabrics, war scars, and post-war reconstruction efforts interlace. Everyday life, prolonged human presence, and community-led interventions that (re)emerge within Aleppo's historic core are evident signs of urgent needs, latent opportunities, and an inescapable yearning to return, which are foundational to triggering a co-production calling for renewed collective confidence in public life. Therefore, these signs necessitate policies that embrace emergent interactions, where "movement is a blessing," to collaboratively work with former dwellers and new occupants' assemblies in mapping (new) safe routes, forgotten alleyways, and damaged pathways. This mapping of what remained not only resists universalist templates and allows repairs of physical connectivity but also embraces contextual fluidity that evolves with contemporary needs and social material dynamics. Interventions may include participatory mapping, (digital) memories crowdsourced from displaced dwellers, removing debris, repairing cobblestones, and installing context-sensitive lighting. By engaging with local narratives, oral histories, and everyday footpaths that emerged amid conflict, policymakers can "attract a foot" and ensure that walkability interventions align with community realities rather than reproduce systemic exclusions.

Furthermore, incorporating similar policies of repurposing the scarred landscapes beyond the participatory socio-material repair is essential to engage reflexively with loss, trauma, and steadfastness, and foster critical dialogue between erasure and reconstruction. Such interventions deterritorialize trauma by repurposing its material remnants while reterritorializing renewed meanings of resilience. As the interviews revealed, walking scarred landscapes enables survival, lingering to the past, anchoring in the present, acknowledging and confronting loss and difference, and aspiring for a better future, all essential for sustained recovery. Walking the scars also "attracts a foot." It necessitates policies focused on developing and designating memorial corridors and time-stacked pedestrian circuits that bridge the scars, memorialize trauma, and integrate remembrances into daily foot pathways. Interventions may include exposing excavated war remnants (e.g., bullet casings, hidden bunkers) along pedestrian routes, installing signage in specific styles and materials, and incorporating lighting, and soundscapes. Such methods of contorting the past ensure that these lived traces do not remain marginalized.

Moreover, in conflict-ridden cities, where long-standing and cumulative conflict disruptions slowly ingrain the living collective memory, healing requires more than physical restoration and urban life (re)activation. At times of acute crisis, footpaths transform; they become vital arteries for basic survival, scarred by traumatic events, forging ephemeral socio-urban dynamics that endure well after the conflict subsides. By respecting and discussing the footprints of conflict, policymakers can foster reconciliation that intertwines material rebuilding with the slower, more fragile process of social and psychological recovery. When articulated through "let their feet drive them" and with a focus on slowness—on careful observation, community participation, and iterative design—walkability becomes a vehicle for reasserting human connections, acknowledging painful histories, and ultimately charting more inclusive, resilient futures.

7. Conclusion

This article has examined how conflict disrupts and transforms walkability in urban environments, using Aleppo's historic core as a critical case study. Through the lens of assemblage theory (DeLanda, 2006; Deleuze & Guattari, 1987), we have demonstrated how disruption assemblages—comprising material, temporal, and human elements—fundamentally alter the practice and perception of walking in conflict-ridden cities. The analysis reveals that walkability in conflict zones metamorphoses from a taken-for-granted aspect of urban practices into complex survival practices and danger-evasion tactics, at the same time in constant negotiation with disruption assemblages, thus serving as a form of resistance and place-making in post-conflict contexts.

The case of Aleppo's historic core illustrates how war not only destroys physical infrastructure but also disrupts and ruptures the intricate socio-economic fabric and temporal rhythms that once defined and moulded urban life. The findings highlight that while physical reconstruction efforts may restore buildings and clear rubble, they often fail to address the full complexity of walkability disruptions to social networks, sensory experiences, and collective memories that once made walking meaningful. The sporadic nature of reconstruction efforts, coupled with economic hardship and displacement, has created a disconnected landscape where walking becomes an inescapable necessity rather than a choice, further perpetuating a sense of loss, inequalities, and communal distrust. The recent political change in Syria, marked by the fall of Bashar al-Assad in December 2024, has introduced a new wave of hope, caution, and uncertainty. During

this transitional phase, time is needed to reassess prevailing conditions and develop a strategic vision with robust policy recommendations for the city's reconstruction.

Our research contributes to both theoretical and practical understanding of post-conflict urban recovery. Theoretically, it advances the concept of disruption assemblages as a framework for analysing how violence, through processes of deterritorialization and reterritorialization, scars urban fabrics, distorts accessibility, and ruptures life-worlds. Moreover, this research argues for a paradigm shift in post-conflict recovery and reconstruction efforts. Approaches to walkability must incorporate situated perspectives in a conflict-affected context. Practically, it advocates for an "attracting a foot" approach to reconstruction strategies that re-centres walkability as a critical lens for understanding and fostering recovery and post-conflict healing. This approach goes beyond the physical restoration and walkability metrics and involves re-centring the focus on the newly emerged survival patterns and re-weaving the human connections and sensory experiences within urban spaces. Further, it emphasizes the need for policies that engage with emergent community interventions and collective memories, acknowledge conflict legacies and trauma, and support the slow re-weaving of social bonds through walking practices.

By re-centring walkability in post-war recovery and reconstruction processes, urban planners and architects can engage in more contextual needs-based healing processes within war-torn realities. As cities worldwide face increasing challenges, the lessons learned from studying walkability in extreme conditions can inform broader urban planning strategies, promoting more liveable and sustainable urban futures. Future research should explore how these insights might be applied to other conflict-affected cities, examining variations in how walkability disruptions manifest across different cultural and spatial contexts. Additionally, longitudinal studies tracking the evolution of walking practices during post-conflict recovery could provide valuable insights for urban planning and reconstruction policies. Ultimately, this article argues that successful post-conflict reconstruction must move beyond physical restoration to address the complex assemblages of disruption that continue to shape how people navigate and inhabit war-wounded cities.

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Conflict of Interests

The authors declare no conflict of interests.

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ARTICLE

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Walkability and Flood Resilience: Public Space Design in Climate-Sensitive Urban Environments

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Abstract

In the contemporary urban landscape, walkability is shaped by the spatial characteristics of the built environment and its ability to adapt to environmental risks, particularly those posed by climate change. This study explores the intersection of walkability and flood adaptation strategies in waterfront public spaces across nine cities in the Baltic Sea Region, analysing their morphological characteristics with a focus on connectivity, accessibility, and climate adaptability. Using a mixed-method approach that integrates spatial mapping, quantitative metrics, qualitative analysis, and comparative case studies, this research evaluates the effectiveness of urban structure transformations and the introduction of blue-green infrastructure, floating structures, and nature-based solutions in enhancing walkability while mitigating flood risks. The findings reveal significant improvements in connectivity, as indicated by extended pedestrian route networks (increases of 6%–28%), enhanced link–node ratios (increases of 24%–39%), and a substantial rise in the number of urban nodes with direct water access (150%–1900%). These results demonstrate that climate-adaptive urban design not only strengthens flood resilience but also fosters vibrant, walkable, and socially inclusive public spaces. This study provides valuable insights for urban planners, architects, and policymakers, proposing strategies to integrate flood resilience into walkable urban environments. By emphasising the synergy between walkability and climate adaptation, this research advances the discourse on sustainable urban planning. The findings highlight the potential of adaptable waterfronts, incorporating blue-green infrastructure and flexible design principles, to enhance urban resilience while maintaining public space quality and accessibility.

Keywords

blue-green infrastructure; flood risk; public space design; sustainability; urban resilience; walkability

1. Introduction

In recent years, walkability has become increasingly relevant in urban studies, reflecting its essential role in promoting sustainable, healthy, and vibrant cities (Gehl, 2010; Maghelal & Capp, 2011; Pafka & Dovey, 2016). Defined as the extent to which the built environment encourages walking as a mode of transport, leisure, or physical activity, walkability has been linked to many benefits, including enhanced public health, reduced environmental impact, and increased social interaction (Westenhöfer et al., 2023). However, as the consequences of climate change grow, walkability becomes increasingly linked to the concept of urban resilience, understood as the ability of urban spaces to adapt and respond to climate-related natural disasters (Davoudi et al., 2013, pp. 307–322; Goldhill & Fitzgibbon, 2021).

Flooding is one of the most pressing environmental risks facing urban environments today, especially in coastal areas. Rising sea levels and the increasing frequency of extreme weather events due to climate change have heightened flood risks in many cities, which demands the integration of climate adaptation strategies to create more walkable and resilient environments (Burda & Nyka, 2017; Dal Cin et al., 2021, p. 218; Intergovernmental Panel on Climate Change, 2014). This issue is particularly relevant for coastal cities in the Baltic Sea Region, where low-lying urban areas located by water are increasingly vulnerable not only to coastal, riverine, but also urban flash flooding. Simultaneously, there is a strong impulse to develop new systems of public spaces along waterfronts and even extend them towards water to provide liveable urban environments and enhance the urban experience. Consequently, there is a growing demand for adaptable, resilient urban design approaches that can safeguard waterfront public spaces while maintaining pedestrian accessibility and usability (Dal Cin et al., 2021, p. 218; Wamsler & Brink, 2014). Emerging approaches are rooted in the principles of adaptive architecture, green infrastructure, nature-based solutions, and flexible design (Meerow et al., 2016, pp. 38–49; Silva, 2020).

Given the growing threats of climate-induced consequences for urban environments, this study explores the intersection of walkability, urban resilience, and flood risk management, taking waterfront public space design in flood-prone urban areas as the key aspect of the study (Leichenko & O'Brien, 2019). It focuses on morphological features of public spaces, particularly those related to their connectivity, resiliency, and adaptability to flooding events. The research focuses on nine coastal cities in the Baltic Sea Region, where newly created waterfront public spaces are analysed for their capacity to enhance walkability and maintain usability while adapting to flood hazards. Through this analysis, the study aims to identify design strategies for public spaces that foster vibrant, walkable waterfront urban environments that are flood-resilient.

The findings of this study are expected to provide useful tools for urban planners, architects, and policymakers in proposing more resilient urban scenarios. By emphasising the dual goals of enhancing walkability and increasing flood resilience, this research advances an evolving knowledge base on the links between flood risk and urban design. It highlights how resilient public spaces, incorporating blue-green infrastructure and adaptive structures of different proximity to water, including floating architecture, can respond to climate-related risks while maintaining pedestrian accessibility. These insights encourage the development of comprehensive design strategies that integrate resilience without compromising public space usability and quality. Ultimately, this study offers practical insights into how cities can adapt to climate change while continuing to support sustainable, pedestrian-friendly, and walkable waterfront environments.

This article is structured as follows: The next section outlines the theoretical framework and methodology employed in the study, followed by an analysis of the selected cities and their public spaces. The results section presents the findings, highlighting key design strategies. Finally, the discussion and conclusions reflect on the implications of these findings for urban theory, planning practice, and policy recommendations, and suggest avenues for further research.

1.1. Theoretical Framework

This theoretical framework synthesises core research topics to establish a comprehensive foundation for examining walkability, resilience, and flood risk management in climate-sensitive waterfront urban areas.

1.1.1. Walkability

Walkability has emerged in recent years as one of the key indicators of high-quality urban environments (Delavar et al., 2025; Kim & Gong, 2023). This topic, however, has been researched for decades, dating back to the seminal works of Jacobs (1961) on urban vitality and Ewing and Handy (2009) on urban design qualities related to walkability. Research indicates that walkable urban environments encourage physical activity, which is associated with lower rates of obesity, cardiovascular disease, and other health conditions (Ewing & Handy, 2009; Forsyth, 2015). Walkable cities support active lifestyles, mental well-being, and social cohesion, facilitating social interactions that contribute to the liveability and vibrancy of urban spaces (Ewing & Handy, 2009). They also promote community engagement and a sense of belonging, enhancing place identity (Handy et al., 2002, pp. 64–73). This aligns with broader sustainability goals, as walkability supports environmentally friendly transportation choices and helps reduce the carbon footprint of urban areas.

The morphological properties of urban structure play a pivotal role in supporting walkability (Hillier, 2007; Maghelal & Capp, 2011; Pafka & Dovey, 2016). Among these, permeability is a key determinant of pedestrian movement, referring to the extent to which an urban area is accessible via interconnected public spaces (S. Marshall, 2005). Permeability is often evaluated based on block size, street network density, and the availability of multiple route choices for pedestrians (Jacobs, 1961; Stangl, 2015). Research suggests that permeable, fine-grained urban grids support vibrant urban life (Carmona, 2021; Pafka & Dovey, 2016). For this reason, one of the most widely used metrics in walkability research are block size-based connectivity measures, which evaluate the relationship between block configuration and pedestrian accessibility (Boeing, 2021; Stangl, 2015).

Studies have shown that smaller block sizes and higher intersection densities contribute to greater walkability by providing shorter and more direct routes for pedestrians (Huang & Khalil, 2023; W. E. Marshall & Garrick, 2010; Stangl, 2015). In addition to traditional connectivity measures, recent studies emphasise the significance of “interface catchments” in walkability assessments and the “area-weighted average perimeter,” which provides a refined approach to evaluating permeability (Pafka & Dovey, 2016). Some authors have indicated that walkability measures relying exclusively on intersection density and block size may overlook other important factors such as street orientation, permeability, and land use distribution. For instance, Boeing (2021) critiques overreliance on network-based metrics, while Knight and Marshall (2015) highlight the role of street alignment and connectivity hierarchy. Similarly, Pafka and Dovey (2016) emphasise the importance of considering spatial morphology and interface density in walkability analysis.

To support measuring walkability, the Global Walkability Index was created, becoming an internationally recognised tool for assessing urban walkability and identifying gaps in pedestrian infrastructure. Developed through collaborations with the World Bank and other organisations, the index evaluates critical aspects of walkability, including pedestrian safety, infrastructure quality, accessibility, land use, and access to essential services (World Bank, 2018). These elements serve as benchmarks for enhancing walkability, which has been linked to numerous urban benefits, such as reduced traffic congestion, improved air quality, and better public health outcomes (Frank et al., 2009, pp. 924–933; Lee & Talen, 2014; Litman, 2018, pp. 3–11). Connectivity is one of the key indicators used in the Global Walkability Index, relying on various data, including the link–node ratio, which is a strong morphological feature of public spaces (Knight & Marshall, 2015; World Bank, 2018).

Waterfront spaces are unique, often defined by rigid, linear post-industrial embankments. Analytical studies have examined the transition from these single-use lines to more complex configurations of blue public spaces (Proença et al., 2023). These spaces not only follow the lines of embankments—now often transformed into boulevards—but also extend towards water bodies in intricate forms, elevated or floating, creating a setting for dynamic urban activity (Burda & Nyka, 2023). However, these findings have not yet been supported by calculations of link–node ratio shifts and identification of new nodes located near or on the waterbodies. This study seeks to address this gap.

1.1.2. Climate Adaptation and Resilience

In flood-prone areas, creating walkable environments involves the added challenge of responding to extreme weather events. The City Resilience Index, developed by Arup in collaboration with the Rockefeller Foundation, provides a broad and holistic framework for assessing a city's capacity to respond to and recover from various shocks and stresses, including natural disasters, social challenges, and economic disruptions. This framework emphasises the role of blue-green infrastructure as a key indicator of urban resilience, particularly in addressing climate change threats (Arup, 2016; Arup & The Rockefeller Foundation, 2015).

Blue-green infrastructure—a strategy that incorporates natural elements like permeable surfaces, bioswales, wetlands, retention ponds, and rain gardens—offers a valuable approach to urban adaptation. Implementing blue-green infrastructure in flood-prone areas provides numerous benefits, allowing cities to manage surface water effectively and reduce runoff (Azadgar et al., 2025; Fletcher et al., 2015, pp. 525–542; Thomson & Newman, 2021). By facilitating the retention and gradual infiltration of stormwater, this infrastructure alleviates pressure on drainage systems and mitigates the risks of surface flooding (Liu et al., 2019). Moreover, blue-green infrastructure supports walkability by maintaining the accessibility of urban spaces even during adverse weather. It not only enhances flood resilience but also boosts urban biodiversity, improves air quality, and enhances the aesthetic appeal of public spaces (Benedict & McMahon, 2006; Coutts & Hahn, 2015). Integrating blue-green infrastructure with walkability initiatives allows cities to create multifunctional spaces that are visually appealing, environmentally sustainable, and resilient to climate challenges (Kuitert & van Buuren, 2022).

Cities' efforts to enhance walkability and urban resilience are closely linked to flood risk management strategies (Porębska et al., 2019; van den Brink et al., 2014). As climate change intensifies, urban areas are increasingly exposed to risks associated with rising sea levels, more frequent storms, and unpredictable

weather patterns (Dangendorf et al., 2019, pp. 705–710; Leichenko, 2011, pp. 164–168). Consequently, climate adaptation in urban planning has become a priority for cities aiming to preserve functionality and liveability amid these challenges (Hallegatte et al., 2013, pp. 802–806; Neumann et al., 2015). Notable case studies in cities like Rotterdam, New York, and Copenhagen highlight the successful integration of climate adaptation measures in waterfront areas, with features such as elevated walkways, flood-resilient parks, and multi-use public spaces that function in both dry and flood conditions (Djenontin & Meadow, 2018; Moe & Müller, 2024). These examples provide practical models for integrating flood risk management, resilience, and walkability, offering adaptive frameworks for other cities to consider.

In flood-prone urban areas, climate-adaptive infrastructure ensures that public spaces remain accessible and functional under both regular and extreme conditions. Research on coastal cities in the Baltic Sea Region demonstrates that adaptable urban design is crucial for managing flood risks while enhancing urban resilience and public space quality (Nyka & Burda, 2020). By transforming hard land–water boundaries into more flexible zones, waterfront spaces maintain functionality and accessibility for communities during extreme weather events (Aerts et al., 2014, pp. 473–475; Tonmoy et al., 2020).

This study explores the intersection of walkability and flood resilience by proposing a novel analytical framework that can be applied across cities to evaluate public space development strategies. By incorporating objective variables such as the use of specific nature-based solutions, calculating the added length of pedestrian routes, analysing the link–node ratio shift, and assessing the increase in the number of nodes with a direct relationship to riverine or coastal water basins, the study contributes to a better understanding of waterfront public space morphology. The proposed approach provides insights into the walkability of waterfront areas in relation to climate adaptability, identifying key design principles tailored to Baltic coastal cities. The framework thus supports the creation of sustainable, walkable urban environments that are resilient to climate-related challenges.

2. Methodology

This study employs a mixed-method approach to evaluate walkability, resilience, and flood-risk management in public spaces across nine coastal cities in the Baltic Sea Region: Stockholm, Jönköping, Gothenburg, Copenhagen, Vejle, Gdańsk, Pärnu, Helsinki, and Turku. The analysis assesses the ability of waterfront public spaces to support walkability while mitigating flood and environmental risks. The integration of analytical components allows for a structured assessment of urban characteristics, facilitating comparisons across diverse urban scales, designs, and resilience strategies.

The methodology consists of four main phases, illustrated in Figure 1 and described in more detail in the next sections.

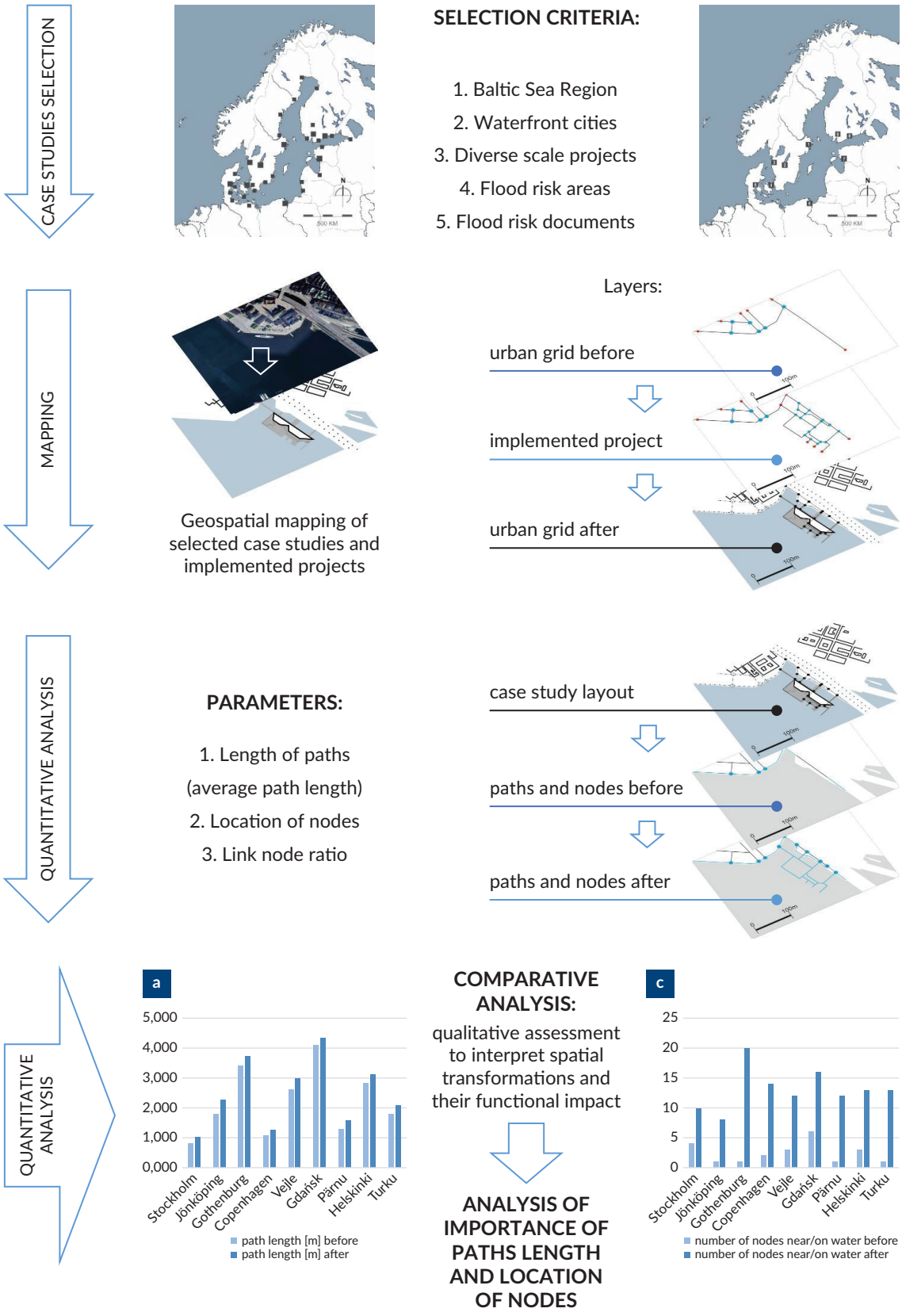

Figure 1. Methodology flowchart.

2.1. Case Study Selection

A systematic selection process was applied based on predefined criteria to ensure consistency and relevance. The study focused on waterfront cities in the Baltic Sea Region, selected from 33 pre-identified cases. The final selection was based on the following criteria:

- Location within the Baltic Sea Region, ensuring a shared climatic, cultural, and economic context (Michałowska & Głowienka, 2022).
- Urban projects featuring documented flood-risk management strategies (Irvine et al., 2023).
- Availability of spatial and policy documentation related to interventions (Ruskule et al., 2021).
- Representation of varied urban scales, from small-scale modifications to large-scale planning initiatives (Bielecka et al., 2020; Mabrouk et al., 2024).

All selected projects were situated in areas classified as flood-prone, ensuring that resilience measures were integrated into their planning (Burda & Nyka, 2023). This selection process enabled an evidence-based assessment of the spatial adaptation strategies, implementation effectiveness, and planning considerations (Doornkamp et al., 2024; Prashar et al., 2024, pp. 8235–8265).

2.2. Mapping

Following the selection of case studies, a geospatial mapping process was conducted to analyse the transformation of the public spaces. Online geoportals (such as national GIS platforms and municipal planning databases) were used to map existing waterfront public spaces and water bodies. In cases of conceptual projects (pre-implementation), geoportal-based maps were supplemented with design proposals illustrating the planned transformations.

The mapping process included:

- Spatial representations of projects before and after implementation.
- Multi-layer analysis of the urban grid and pedestrian pathways (Molaei et al., 2021, pp. 49–61).
- Assessment of connections between flood protection elements and urban accessibility (Batica & Gourbesville, 2014; Porębska et al., 2019).

This step provided both a visual and analytical basis for evaluating the urban transformation and flood resilience measures (Michałowska & Głowienka, 2022; Rezvani et al., 2024).

2.3. Quantitative Analysis

This phase focused on measuring the effects of urban interventions through spatial parameters. Three primary indicators were analysed:

- Path Length: Measures changes in connectivity by calculating the average path length.
- Location of Nodes: Assesses the number of nodes located near or on waterbodies.
- Link–Node Ratio: Assesses changes in the relationship between pedestrian paths and nodes (Gunn et al., 2017; Knight & Marshall, 2015).

Each parameter was analysed before and after the project implementation to quantify the urban transformation effects. Additional assessments included:

- Nodes located near or on the water, essential for evaluating waterfront accessibility (Molaei et al., 2021, pp. 49–61).
- Connectivity between project sites and the existing urban fabric (Ewing et al., 2020; Suits et al., 2023).

A comparative analysis was conducted using AutoCAD 2024 tools to calculate pedestrian route lengths and link–node ratios. These indicators were standardised per 100 metres to facilitate cross-city comparisons. To support the analysis of flood resilience, geospatial methods were employed to examine the spatial relationships between the connectivity and resilience features, ensuring a comprehensive urban assessment (Baltranaitė et al., 2020; Irvine et al., 2023).

2.4. Qualitative Analysis

The final phase involved a comparative qualitative assessment to interpret spatial transformations and functional impacts. This analysis focused on:

- The role of path length and node location in shaping urban accessibility.
- Morphological changes in public spaces (Porębska et al., 2019).
- Integration of floating structures, blue-green infrastructure, and stormwater management elements (Doornkamp et al., 2024; Prashar et al., 2024).

By systematically integrating quantitative and qualitative methods (Baxter & Jack, 2008), this study provides a comprehensive assessment of public space resilience and walkability in Baltic coastal cities. The methodological framework ensures rigorous data collection, comparative analysis, and actionable insights for urban planning and flood adaptation strategies (Furlan & Sinclair, 2021; Molaei et al., 2021, pp. 49–61).

3. Case Studies

This study examines the practical application of walkability and resilience in nine waterfront areas within the Baltic Sea Region (Figure 2): Stockholm, Jönköping, Gothenburg (Sweden), Copenhagen, Vejle (Denmark), Gdańsk (Poland), Pärnu (Estonia), Helsinki, and Turku (Finland). These case studies encompass diverse geographical and urban contexts, including coastal, estuarine, and riverine environments, representing both major cities like Stockholm and smaller urban centres such as Vejle and Pärnu. The selection criteria included varied urban adaptation approaches to flood risks and climate variability, reflecting different governance structures, socio-economic conditions, and urban forms.

Despite facing common hydrological challenges in the Baltic Sea Region, these cities have implemented distinct adaptive strategies. Their interventions combine conventional flood risk management with innovative blue-green infrastructure solutions, integrating contemporary flood mitigation methodologies into municipal planning. This comparative analysis highlights how adaptable design strategies enhance walkability, resilience, and community engagement in flood-prone areas. Collectively, the case studies

Figure 2. Study area. Analysed cases' locations in the Baltic Sea Region: 1. Stockholm (Sweden); 2. Jönköping (Sweden); 3. Gothenburg (Sweden); 4. Copenhagen (Denmark); 5. Vejle (Denmark); 6. Gdańsk (Poland); 7. Pärnu (Estonia); 8. Helsinki (Finland); 9. Turku (Finland).

provide a comprehensive foundation for analysing adaptive urban design, offering transferable lessons for other cities facing similar climate challenges.

The redevelopment of Stockholm's *Hamnbad* area exemplifies a comprehensive intervention aimed at revitalising a previously underutilised waterfront while enhancing climate resilience (Oopeaa, n.d.). Stockholm, Sweden's largest city, faces unique flood risks due to its archipelagic geography. The 2.5-hectare project incorporated floating pools capable of functioning during high-water events, green roofs on adjacent buildings, and permeable pavements along pedestrian pathways. These measures, outlined in municipal planning documents (Stockholms Stad, 2020, 2021, 2023), were implemented to improve stormwater management and mitigate flood risks. Beyond their hydrological benefits, these interventions contributed to the revitalisation of the public realm, strengthening urban connectivity and expanding pedestrian networks. Stockholm exemplifies the integration of public waterfront accessibility with adaptive flood mitigation, effectively addressing rising sea levels and stormwater challenges.

The *Vattenstaden* project in Jönköping is a strategic urban adaptation initiative addressing fluctuating water levels in Lake Vättern while ensuring urban connectivity (Vilhelm Lauritzen Architects, n.d.). Covering 3.0 hectares, it integrates floating walkways, modular platforms, and bioswales that function both as retention systems and pedestrian access points. Unlike coastal cities facing storm surges, Jönköping's

adaptation focuses on fluctuating lake water levels, demonstrating how mid-sized inland cities can implement flood-resilient public space design. Municipal strategies (Länsstyrelsen i Jönköpings län, 2016; Municipality of Jönköping, 2013) emphasise the importance of uninterrupted pedestrian mobility, even during significant hydrological variations. The project underscores how flexible infrastructure can mitigate flood impacts while fostering a more connected urban environment.

The *Frihamnen* district of Gothenburg, with a transformed former industrial area of approximately 4.0 hectares, is an example of adaptive urban regeneration (NG Architects, 2016). Situated at the mouth of the Göta River, Gothenburg contends with both riverine and coastal flooding. The redevelopment integrates elevated walkways and floating platforms to ensure that pedestrian access routes remain functional during flood events. Gothenburg combines flood barriers with urban regeneration, ensuring resilience while maintaining economic viability—a key contrast to cities like Vejle, where nature-based solutions predominate. The city has invested in major infrastructural adaptations, such as the Göta River flood barrier, while also enhancing waterfront accessibility (Göteborgs Stad, 2015, 2021). This redevelopment exemplifies how industrialised cities can blend recreational and economic spaces in flood-prone areas.

The *Urban Rigger* project in Copenhagen is an innovative response to high population density and flood resilience (Iype, 2020). The initiative, which covers an area of 2.0 hectares, comprises modular floating housing units that adapt dynamically to fluctuating water levels, as well as an extensive network of new pedestrian pathways. Copenhagen's approach demonstrates how modular floating housing can simultaneously address urban densification and flood resilience, optimising limited waterfront space. The citywide integration of blue-green infrastructure, including cloudburst roads and stormwater parks (Københavns Kommune, 2011, 2017, 2024), serves as a model for other urban environments.

The *Floating Gardens* initiative in Vejle transforms 1.8 hectares of waterfront into a multifunctional public space, integrating flood management with ecological enhancement (Entropic, 2020). Given Vejle's vulnerability to fjord flooding, its approach prioritises nature-based solutions over large-scale infrastructural interventions, contrasting with cities like Gothenburg. This intervention combines landscaped green spaces, floating platforms, and pedestrian connectivity, improving both urban ecology and flood resilience. Municipal strategies (Vejle Kommune, 2014, 2016, 2020) emphasise community engagement, demonstrating how scalable, cost-effective strategies enhance walkability and flood adaptation.

The redevelopment of *Granary Island* in Gdańsk integrates flood resilience with heritage conservation, transforming 2.2 hectares of historic waterfront into an accessible, climate-adaptive space (Granaria, n.d.). As a city vulnerable to sea and river flooding, Gdańsk's approach illustrates the harmonisation of modern resilience features with historical landscapes, an essential consideration for cities with cultural landmarks. The project features elevated walkways and strategically positioned flood barriers, ensuring pedestrian safety while maintaining historical integrity (Gdańsk City Council, 2020). This model demonstrates how urban resilience can be integrated without compromising architectural heritage.

The *Baltic Sea Art Park* in Pärnu, a 1.5-hectare site, exemplifies cost-effective, small-scale flood adaptation strategies, integrating floating art installations, permeable paving, and pedestrian pathways (WXCA, n.d.). As a tourism-dependent city with limited resources, Pärnu prioritises small-scale interventions over large-scale infrastructure, contrasting with cities like Stockholm. This approach demonstrates how cities with budget

constraints can implement flood resilience while maintaining waterfront accessibility (Government of Estonia, 2022; Keskkonnaministeerium, 2022).

Helsinki and Turku integrate flood resilience with multifunctional public spaces, but with distinct approaches. Helsinki mitigates storm surges through permeable surfaces, green roofs, and floating residential units in the *Verkkosaari* floating neighborhood (3.5 hectares; Asuntomarkkina ja maankäyttö, 2020; Helsingin kaupunki, 2017, 2024; Helsingin seudun ympäristöpalvelut – kuntayhtymä, 2012). Turku, along the Aura River, prioritises river flood management, using elevated walkways and permeable surfaces in the *Linnanniemi* district (30 hectares; Turun kaupunki, 2021, 2022, 2024). These interventions underscore how flood adaptation strategies vary based on geographic and hydrological risks, offering transferable insights for other cities.

By analysing both conceptual and completed projects, this study enables a systematic comparison between the intended outcomes and real-world impacts, providing transferable lessons for cities facing similar climate risks. The integration of flood resilience with walkability strategies demonstrates a holistic, context-specific planning approach, emphasising multifunctional public spaces and blue-green infrastructure. This comparative analysis underscores how cities can tailor their flood adaptation measures based on local geography, economic conditions, and governance structures. The findings offer a replicable model for sustainable urban development, aligning with global calls for climate-resilient cities.

4. Results

This study presents a comprehensive comparative analysis of transformative urban design interventions undertaken across nine strategically selected coastal cities within the Baltic Sea Region. Each of these cities faces distinct yet comparable challenges related to the escalating impacts of flooding, climate variability, and urban population pressures on public space functionality and resilience. In response, these cities have engaged in proactive adaptation by implementing many innovative strategies designed to enhance urban walkability, integrate blue-green infrastructure, strengthen flood resilience, and foster active community engagement within public spaces.

Table 1 summarises the investigated urban morphology transformations across the nine cities, focusing on walkability and flood resilience. For clarity and brevity, each case study is assigned a code (CS1 = Stockholm, CS2 = Jönköping, etc.), which is used consistently in the tables throughout the article. Key metrics include path length, link–node ratio, and number of nodes with a direct relationship to water, comparing pre- and post-intervention conditions. All the case studies show an increased path length (ranging from +200 m to +480 m) and improved link–node ratios, indicating enhanced connectivity. The number of nodes near or on water rises significantly, particularly in Gothenburg (1 to 20) and Gdańsk (6 to 16), reinforcing water-integrated urbanism. Floating interventions vary, including pools, platforms, docks, modular housing, and green spaces, demonstrating diverse adaptive strategies. These changes enhance walkability, accessibility, and climate resilience, offering a scalable model for sustainable waterfront development.

Table 1. Urban morphology changes: Enhancing walkability and flood resilience.

Code/city/project	Change in morphology	Path length before (m)	Path length after (m)	Path length added (m)	Link–node ratio before	Link–node ratio after	No. of nodes near/on water before	No. of nodes near/on water after	Floating structures enhancing walkability
CS1/Stockholm/ Hamnbad	Expanded with floating pools	794	1,014	+220	2.8	3.5	4	10	Floating pools
CS2/Jönköping/ Vattenstaden	Extended lakefront with floating paths	1,789	2,269	+480	3.1	4.2	1	8	Floating platforms
CS3/Gothenburg/ Frihamnen	Redesigned with river docks	3,405	3,720	+315	2.9	3.9	1	20	Floating pools and docks
CS4/Copenhagen/ Urban Rigger	Modular floating housing added	1,059	1,259	+200	2.6	3.6	2	14	Floating housing
CS5/Vejle/Floating Gardens	Blends green paths with fjord access	2,613	3,013	+400	3.0	3.8	3	12	Floating green spaces
CS6/Gdańsk/ Granary Island	Historical area reconnected to river	4,093	4,343	+250	2.7	3.5	6	16	Elevated pathways only
CS7/Pärnu/Baltic Sea Art Park	New water square with floating pavilions	1,294	1,574	+280	2.9	3.6	1	12	Floating art structures
CS8/Helsinki/ Verkkosaari	System of interconnected piers for a floating residential neighbourhood	2,831	3,131	+300	3.2	4.1	3	13	Floating housing units
CS9/Turku/ Linnanniemi	Integrated floating gardens	1,804	2,084	+280	2.8	3.9	1	13	Floating gardens

The graphs in Figure 3 indicate that, in the analysed case studies, compared to the pre-implementation state, moderate increases in path lengths were observed (depending on the project, the path length increase ranged from 6% to 28%), and there was a moderate rise in the link–node ratio, which increased by 24% to 39% depending on the project. However, a comparison of the number of nodes located near or on the water reveals a marked increase, ranging from 150% to 1900%, depending on the project. The placement of a greater number of intersections along waterfront paths or on water-based structures significantly enhances movement opportunities towards and along the water (Figure 4). Taken together, these three increased values highlight the shift towards more extensive, connected, and integrated urban spaces, providing an assessment of the extent to which the projects improve pedestrian connectivity.

The comparative analysis of waterfront resilience strategies can be further elaborated using the gathered data (Table 1). The data reveal measurable improvements in walkability and flood adaptation through the integration of floating structures and redesigned pedestrian networks. The increase in path lengths after the interventions indicates a substantial enhancement in pedestrian accessibility. Jönköping's Vattenstaden project recorded the highest absolute increase in pedestrian pathways (+480 m), followed by Vejle's Floating Gardens (+400 m) and Gothenburg's Frihamnen (+315 m). These cities have effectively leveraged floating platforms and docks to create continuous pedestrian networks, ensuring uninterrupted accessibility even in flood-prone areas. Similarly, Stockholm's Hamnbad demonstrates a significant improvement in its link–node

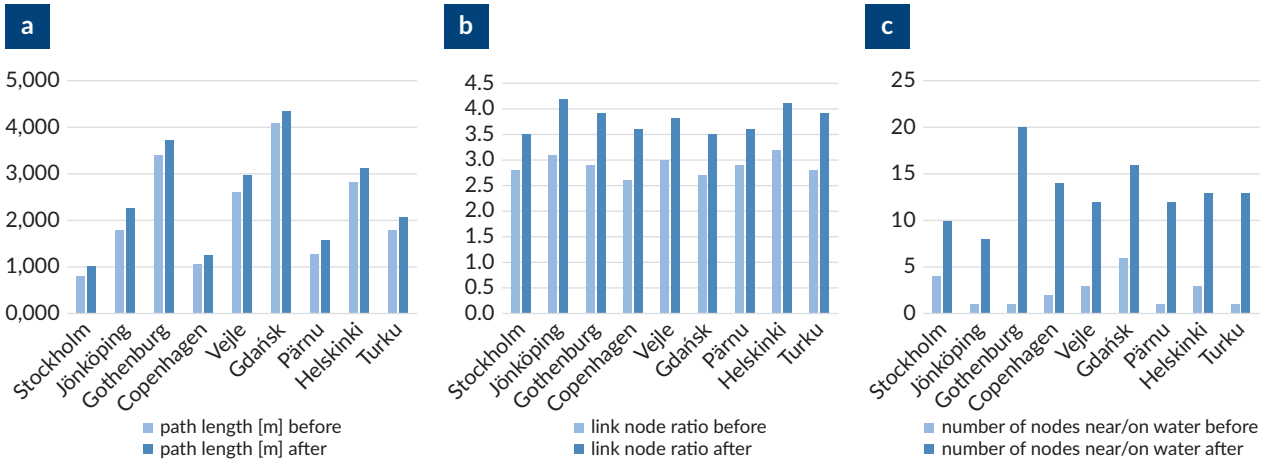

Figure 3. Comparison of the nine case studies (CS1–CS9) according to: (a) path length; (b) link–node ratio; and (c) number of nodes located near or on water.

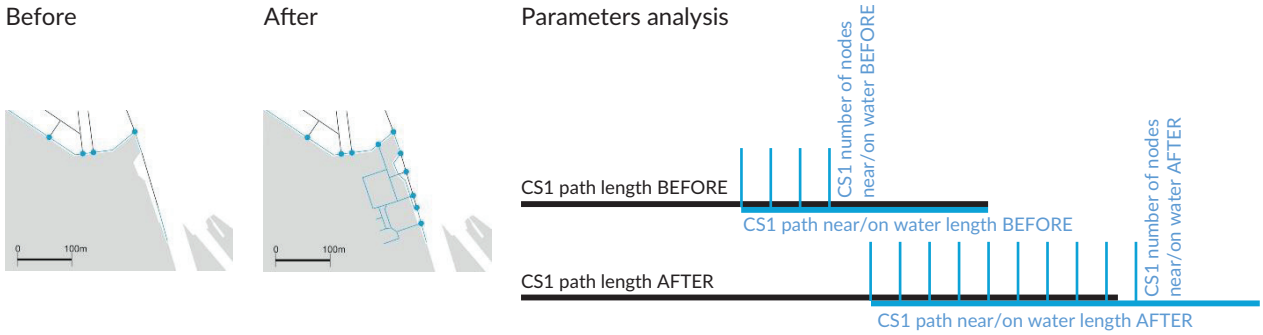

Figure 4. Visualisation of parameter analysis according to the gathered data.

ratio, increasing from 2.8 to 3.5, which suggests a more interconnected and accessible waterfront. Likewise, Helsinki's Verkkosaari and Jönköping exhibit some of the highest increases in link–node ratios (3.2 to 4.1 and 3.1 to 4.2, respectively), reinforcing the role of floating infrastructure in enhancing urban walkability.

A key differentiating factor among these cities' approaches is the type of floating infrastructure used. While Stockholm, Gothenburg, and Pärnu incorporate floating pools and art structures, emphasising recreational and cultural integration, Copenhagen and Helsinki focus on floating housing solutions, integrating residential resilience with urban adaptability. Meanwhile, Vejle and Turku prioritise floating green spaces, demonstrating a nature-based approach to flood adaptation. In contrast to these floating solutions, Gdańsk follows a different path by using elevated pathways rather than floating structures. This allows the city to integrate flood resilience while preserving its historic urban character, making it a valuable reference case for other heritage waterfront cities.

The data also reveal distinct strategic differences between historic waterfronts and newly developed areas. Gdańsk's Granary Island represents a heritage-sensitive approach where flood resilience measures are seamlessly incorporated into the existing urban morphology without altering its historical aesthetics. On the other hand, cities like Copenhagen (Urban Rigger) and Helsinki (Verkkosaari) showcase large-scale floating urban expansions, aligning their resilience strategies with broader municipal climate adaptation plans rather than site-specific interventions. This contrast highlights how different urban contexts require tailored resilience solutions that balance historic preservation with modern infrastructure.

Another important distinction emerging from the data is the contrast between small-scale, cost-effective resilience strategies and large-scale infrastructural approaches. Smaller cities like Pärnu and Vejle employ high-impact, low-cost solutions, such as floating gardens and art-driven placemaking, which enhance urban resilience while maintaining local vibrancy. Conversely, larger cities like Stockholm, Gothenburg, and Helsinki incorporate flood resilience into comprehensive urban development plans, integrating multiple functions such as housing, public spaces, and green stormwater management. This demonstrates how scale and context play a significant role in determining the feasibility and effectiveness of climate-adaptive waterfront solutions.

Figure 5 offers visual representations of the adaptive design strategies employed across the studied cities, including morphological changes, and enhancements in walkability and connectivity. These visuals provide a clearer comparison of each city's approach to flood resilience and walkability, helping to contextualise the study's findings and emphasise the diversity in adaptive urban design across regions.

Overall, the increase in link–node ratios and pedestrian path lengths across these projects confirms that floating infrastructure and adaptive waterfront design significantly improve walkability in flood-prone urban environments. Cities like Jönköping, Stockholm, and Helsinki, with some of the highest link–node ratio improvements, set a strong precedent for integrating climate resilience into pedestrian networks. Meanwhile, cities like Gdańsk and Pärnu highlight that even historic or small-scale urban areas can adopt context-sensitive solutions without compromising cultural integrity. This dataset underscores the growing importance of climate-adaptive urban design and floating infrastructure, including modular housing, in supporting pedestrian connectivity.

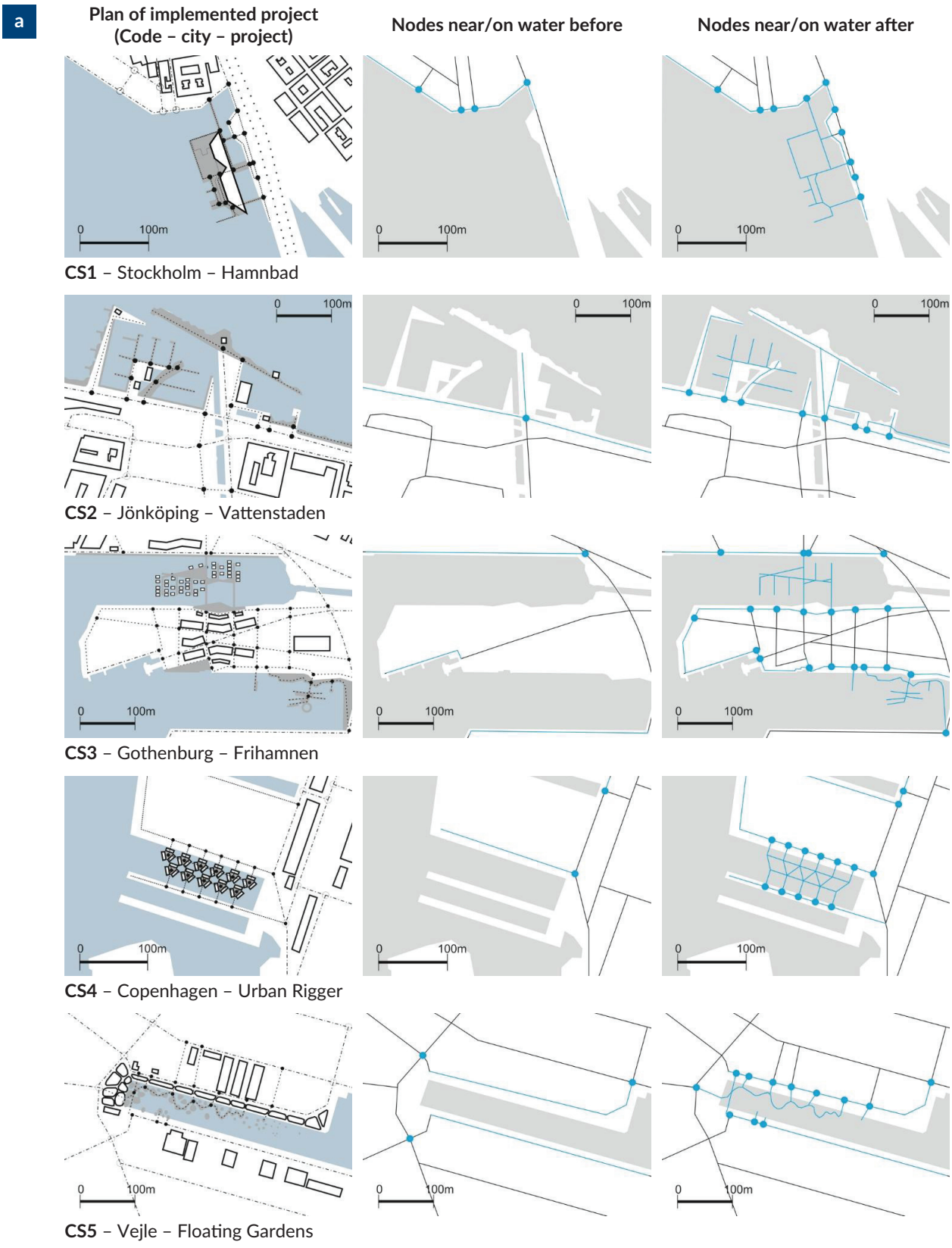

Figure 5. Layouts of the morphology of the case studies—(a) Stockholm, Jönköping, Gothenburg, Copenhagen, and Vejle; (b) Gdańsk, Pärnu, Helsinki, and Turku—and schemes for parameters analysis.

Figure 5. (Cont.) Layouts of the morphology of the case studies—(a) Stockholm, Jönköping, Gothenburg, Copenhagen, and Vejle; (b) Gdańsk, Pärnu, Helsinki, and Turku—and schemes for parameters analysis.

Table 2 summarises the adaptation strategies across the nine case studies, integrating floating structures, blue-green infrastructure, permeable surfaces, and flood risk management. All cases incorporate floating elements (e.g., pools, walkways, housing) adaptable to water-level changes. Blue-green infrastructure

(bioswales, retention ponds, green roofs) supports water absorption, while permeable surfaces enhance drainage. Flood management includes elevated pathways, flood barriers, and adaptive zones to maintain functionality during extreme weather. These strategies combine floating infrastructure and nature-based solutions, creating flood-resistant, adaptable, and accessible urban spaces.

Table 2. Adaptation strategies. Source: own elaboration based on planning documents and descriptions of implemented projects referenced in Section 3.

Code	Incorporated solutions	Blue-green infrastructure	Permeable surfaces	Flood risk management	Presence of floating structures	Overall adaptation strategy
CS1	Floating pools adaptable to changing water levels	Green roofs, permeable paths	Increased permeable paving	Floodable zones	Yes	Integration of floating infrastructure for recreation allowing the area to remain usable during floods
CS2	Floating walkways and houses, elevated pathways	Proposed bioswales, greenspaces	Permeable materials planned	New flood barriers and floodable zones	Yes	Floating structures for flood resilience in housing and walkways
CS3	Elevated walkways and retention basins, floating houses and pathways	Retention ponds, green roofs	Shift to permeable surfaces	Elevated walkways	Yes	Elevated infrastructure and retention systems for public access and flood management
CS4	Floating student dormitories designed to rise with changing water levels	Planned bioswales, green islands	Permeable pathways	Naturally adapted to water	Yes	Modular floating housing units addressing housing shortages and flood risks
CS5	Water retention systems within public spaces, floating platforms and winding paths	Native vegetation, bioswales	Permeable walkways	Flood-absorbent pathways	Yes	Blue-green infrastructure integrated with aesthetic garden design to manage water
CS6	Elevated walkways and flood-resilient public areas	Retention ponds	Combination of permeable paving	Flood barriers	Yes	Mixed-use waterfront redevelopment with flood-resistant infrastructure
CS7	Floating platforms as part of art park and water square with art installations	Natural plantings	Permeable materials used	Adaptive to high tides	Yes	Floating platforms extended towards the water to ensure functionality during high water periods

Table 2. (Cont.) Adaptation strategies. Source: own elaboration based on planning documents and descriptions of implemented projects referenced in Section 3.

Code	Incorporated solutions	Blue-green infrastructure	Permeable surfaces	Flood risk management	Presence of floating structures	Overall adaptation strategy
CS8	Floating housing and public pathways	Green installations	Permeable paths around units	Flood-resilient floating units	Yes	Floating residential and public spaces resilient to water-level changes
CS9	Elevated walkways and water plazas	Green roofs, water-absorbent paths	Shift to permeable surfaces	Elevated paths, floating gardens	Yes	Elevated pathways with flood risk management and social spaces integrated

Table 3 presents the integration of blue-green infrastructure and environmental sustainability across the nine case studies. Key elements include bioswales, retention ponds, permeable surfaces, green roofs, and water-sensitive urban design. Most of the cases incorporate permeable surfaces to enhance stormwater management, with exceptions (CS1/Stockholm, CS4/Copenhagen) that focus on floating structures but have potential for future green infrastructure integration. Several cases (CS3/Gothenburg, CS5/Vejle,

Table 3. Blue-green infrastructure and environmental sustainability. Source: own elaboration based on planning documents and descriptions of implemented projects referenced in Section 3.

Code	Blue-green infrastructure features	Permeable surfaces	Environmental sustainability
CS1	Limited integration of blue-green infrastructure	Yes	Focus on recreational floating structures with potential for future blue-green infrastructure integration
CS2	Retention ponds and natural water management systems	Yes	Blue-green infrastructure to manage stormwater and improve environmental quality
CS3	Bioswales, permeable pavements, green roofs	Yes	Comprehensive integration of blue-green infrastructure to mitigate stormwater and flood risks
CS4	Limited blue-green infrastructure but potential for rooftop gardens	Yes	Focus on floating housing; green roof additions would enhance sustainability
CS5	Bioswales, permeable pavements, water retention gardens	Yes	Strong integration of water management features with public garden design
CS6	Green roofs, permeable surfaces, water-sensitive urban design	Yes	Sustainable redevelopment with focus on environmental quality and flood management
CS7	Floating platforms with green spaces integrated	Yes	Use of floating structures and water gardens to enhance resilience
CS8	Water gardens, permeable surfaces, green roofs	Yes	Strong focus on environmental sustainability and blue-green infrastructure
CS9	Green spaces, permeable pavements	Yes	Designed for resilience with emphasis on environmental quality and stormwater management

CS8/Helsinki) demonstrate comprehensive blue-green strategies, improving flood resilience and ecological quality. The findings highlight the synergy between floating infrastructure and nature-based solutions, reinforcing urban resilience, environmental quality, and sustainable water management.

Table 4 evaluates the walkability, public accessibility to water, and social interaction across the nine case studies. All the projects emphasise high walkability, incorporating floating paths, elevated walkways, and integrated public spaces to enhance pedestrian connectivity. Most of the cases provide high public accessibility to water, supporting recreational, cultural, and social engagement. Notably, CS1/Stockholm and CS3/Gothenburg include public swimming areas, while CS7/Pärnu integrates art-focused spaces for cultural interaction. CS4/Copenhagen, featuring student housing, has moderate accessibility, with the potential for further community integration. The findings highlight the role of floating and waterfront infrastructure in fostering walkable, socially vibrant, and interactive urban environments, promoting community engagement and connectivity in water-adjacent spaces.

Table 4. Walkability, connectivity, and social use.

Code	Walkability	Public accessibility to water	Social interaction
CS1	High walkability with floating pools accessible to the public	High	Public engagement through recreational swimming pools along the waterfront
CS2	High walkability with well-designed pathways along the water	High	Residential and public spaces designed for interaction and leisure along the waterfront
CS3	High walkability with elevated walkways and public paths	High	Focus on public engagement through leisure spaces such as public pools and social plazas
CS4	Floating structures create new pedestrian routes along the waterfront	Moderate	Focus on student housing, but could expand social engagement with more public spaces
CS5	High walkability with garden pathways and integrated public spaces	High	Strong focus on community interaction within garden spaces; designed for social engagement
CS6	High walkability with pathways along the revitalised waterfront	High	Mixed-use spaces encourage public interaction along the water, creating a vibrant social environment
CS7	Floating platforms provide walkable public paths and access to art installations	High	Art-focused public spaces designed for cultural and social engagement
CS8	High walkability with public pathways connecting floating homes to the urban core	High	Residential spaces are connected with public pathways, encouraging social interaction in a water-adjacent area
CS9	High walkability with elevated public paths and social spaces	High	Public spaces designed to enhance interaction along the waterfront

4.1. Key Insights From the Analysis

The analysis of the nine case studies revealed several recurring patterns and design principles that support walkability, blue-green infrastructure integration, and urban resilience. These key insights are summarised below:

1. Increasing walkway lengths and node density (link–node ratio parameter) significantly enhances the urban connectivity and fosters social cohesion by ensuring accessible, well-integrated public spaces.
2. An increase in the number of nodes directly connected to riverine or coastal water basins enhances the walkability by providing opportunities to view or spend time on the water, which serves as an important attractor.
3. Nearly all the projects integrate blue-green infrastructure to manage stormwater, as evidenced by the use of bioswales, retention ponds, and permeable surfaces.
4. The study's focus on floating structures—demonstrated by projects such as Urban Rigger in Copenhagen and Hamnbad in Stockholm—highlights an effective strategy for adaptive design that delivers both flood resilience and social value.
5. Cities like Gdańsk and Pärnu successfully incorporate cultural and historical elements into their resilience strategies, merging heritage conservation with flood adaptation.

5. Discussion

This research underscores the critical potential of integrating walkability principles and urban resilience frameworks into the design and adaptation of waterfront public spaces in flood-prone urban areas. The comparative analysis across nine Northern European cities, ranging from major metropolitan hubs like Stockholm and Copenhagen to medium-sized and smaller cities such as Pärnu and Vejle, reveals a spectrum of effective approaches to environmental adaptation. The findings emphasise the necessity of incorporating adaptive infrastructure and walkability as interconnected components that not only bolster urban resilience but also significantly enhance the quality of life (Childers et al., 2015; Le et al., 2019; Wamsler et al., 2014).

The results demonstrate that blue-green infrastructure plays a fundamental role in promoting both flood resilience and walkability. The integration of permeable surfaces, urban greenery, and bioswales not only mitigates flooding risks but also contributes to the creation of aesthetically pleasing and socially engaging public spaces (Kabisch et al., 2016; Mell, 2016). For instance, both the Frihamnen project in Gothenburg and Vejle's Floating Gardens illustrate how adaptive urban design can serve a dual function—as both flood protection measures and as catalysts for community interaction (Hansen & Pauleit, 2014; Thorne et al., 2018, pp. 960–972). These findings align with previous research emphasising the environmental, social, and economic benefits of blue-green infrastructure in contemporary urban planning (Houghton & Castillo-Salgado, 2017; Sussams et al., 2015, pp. 184–193).

A notable transformative insight from this research is the reconceptualisation of waterfronts from traditionally peripheral, underutilised areas to dynamic, multifunctional urban hubs. Projects such as Stockholm's Hamnbad exemplify how floating infrastructure can revitalise urban waterfronts, enhancing accessibility, vibrancy, and climate resilience (Meyer et al., 2016). In this context, the lowering and reconfiguration of waterfront zones facilitates greater public interaction with natural water-based environments, blending recreational spaces with

resilient urban planning. This shift aligns with a broader transformation in urban design, where waterfronts are increasingly seen not as rigid barriers but as dynamic connectors linking cities to their aquatic surroundings, strengthening both urban usability and ecological integration (Gyurkovich et al., 2021; Valencia et al., 2019, pp. 4–23). Crucially, water reservoirs should not be treated as impassable barriers within the urban structure. Instead, they should be seamlessly integrated into the walkability framework through floating architectural elements, extending pedestrian networks beyond conventional land-based infrastructure.

This study also highlights the pivotal role of adaptive design strategies in enhancing urban connectivity. Innovative projects such as Copenhagen's Urban Rigger, which incorporates floating student housing, demonstrate the potential to integrate previously isolated waterfronts into seamless pedestrian networks. Such design interventions foster social cohesion and reinforce urban walkability (Davids & Thaler, 2021). By increasing the number of pathway intersections and nodes, these strategies bolster community resilience, ensuring that waterfront urban areas remain accessible even in the face of flooding events (Armitage et al., 2007; Chidambara, 2019, pp. 183–195). The implemented projects have not only resulted in the creation of nodes connecting transformed urban areas with existing urban spaces, but have also led to the emergence of additional nodes related to water, which in turn influence overall mobility. In the context of walkability analysis, the locations of the individual nodes are crucial.

The incorporation of flood resilience within public space design transforms these areas into multifunctional environments that serve environmental, social, and cultural purposes (Frumkin et al., 2017; Rega & Bonifazi, 2020). For example, Pärnu's Baltic Sea Art Park, with its floating art installations, exemplifies how resilience measures can also function as valuable cultural and social assets (Avendano-Uribe et al., 2022, pp. 278–294). These multifunctional spaces align with the contemporary paradigm of resilient urbanism, prioritising inclusivity, adaptability, and long-term environmental sustainability.

The comparative analysis of both realised developments and conceptual proposals offers crucial lessons for adaptive urban planning. Implemented projects, such as Gdańsk's Granary Island and Stockholm's Hamnbad, provide empirical evidence of the feasibility, social impact, and long-term benefits of these design strategies. In contrast, conceptual initiatives, such as Vattenstaden in Jönköping (CS2), explore emerging and experimental solutions, including 3D-printed floating structures, that may define future resilience paradigms (Brandt et al., 2021, pp. 258–271; Ghasemzadeh et al., 2021). This dual perspective highlights the importance of integrating both proven and cutting-edge approaches in response to evolving climate challenges (Meerow & Newell, 2016).

Indicating limitations of the study, it should be noted that evaluating the link–node ratio shift does not fully capture the permeability of urban environments or the pedestrian accessibility of flood-prone zones. Integrating additional parameters, such as the pedestrian catchment area, which may become a topic of further studies, can provide a supplementary framework for evaluating walkable access to urban waterfronts (Pafka & Dovey, 2016). Additionally, future studies may leverage the development of GIS tools and computational models that give rise to new opportunities for advanced analysis of urban areas, including the structural features that contribute to walkability (Sevtsuk & Mekonnen, 2012).

Importantly, this study did not delve into how flood risk affects walkability, which could become a field of further research. Future research should focus on developing scalable and adaptable urban resilience models

that address local environmental and socio-economic contexts. A key opportunity lies in integrating emerging smart technologies for real-time climate monitoring, responsive flood mitigation, and data-driven urban management (Delavar et al., 2025; Swanson, 2021, pp. 287–297). Additionally, analysing the long-term viability of floating structures in conditions of limited energy access and off-grid functionality will be crucial for future urban resilience efforts (Gorzka et al., 2024, pp. 42–60; Ilugbusi et al., 2024, pp. 18–23). Future studies should also focus on identifying key pedestrian catchment areas and mapping critical points that enhance the continuity of pedestrian networks. Instead of emphasising specific project contact points, which are often undeveloped or undergoing transformation, a broader systemic approach to resilient, walkable urban environments is required. Positioning waterfront areas as living laboratories for sustainable innovation can foster experimental urbanism and dynamic community engagement (Sharp & Raven, 2021).

Moreover, a comprehensive approach should actively involve local communities in real-time communication networks and participatory flood risk monitoring systems, empowering residents and enhancing localised resilience strategies (Witte et al., 2021, pp. 283–294; Wolff et al., 2021, pp. 351–364). Ensuring that flood resilience strategies do not merely address risk mitigation but actively enhance walkability and public engagement is key to fostering a more adaptable, socially inclusive urban future.

6. Conclusions

This study underscores the importance of integrating walkability, adaptive infrastructure, and urban resilience to create dynamic and sustainable public spaces in flood-prone areas. The research reveals that successful urban resilience strategies must balance ecological, social, and technological considerations. By enhancing pedestrian connectivity and integrating water-adaptive solutions, cities can foster environments that are both resilient and accessible. The analysed projects illustrate the effectiveness of floating structures that offer promising avenues for future urban adaptation. The use of blue-green infrastructure, improved connectivity, and multifunctional urban spaces promotes environmental sustainability while enhancing community well-being. Key findings emphasise the broader applicability of these approaches, suggesting that many cities in Europe can adopt similar strategies to address climate-related challenges. This research demonstrates that flood resilience and walkability should not be treated as separate challenges, but rather as interdependent components of an adaptive urban framework. Water reservoirs and waterfronts, rather than being viewed as barriers, can serve as extensions of pedestrian networks through floating pathways, adaptable public spaces, and water-integrated mobility solutions.

In all the analysed cases, specific nature-based solutions were identified. Moreover, the calculations revealed an increase in pedestrian route lengths ranging from 6% to 28%, a rise in the link–node ratio by 24% to 39%, and a significant growth in the number of nodes with direct connections to riverine or coastal water basins, ranging from 150% to 1900%. This study enhances the understanding of waterfront public space transformations aimed at improving walkability and urban resilience. The proposed approach offers valuable insights into the walkability of waterfront areas in the context of climate adaptability, identifying key design principles tailored to Baltic coastal cities. The framework thus supports the development of sustainable, walkable urban environments that are resilient to climate-related challenges.

In conclusion, this research provides a robust framework for understanding how urban resilience can be harmonised with walkability and social inclusivity. By prioritising community engagement, environmental

stewardship, and innovative design, cities can transform climate challenges into opportunities for sustainable and adaptive urban development, fostering vibrant public spaces that are both resilient and inviting for future generations.

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Conflict of Interests

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ARTICLE

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Reclaiming Urban Spaces: A Systemic Approach to Integrated Pedestrian-Centric City Design in Rio de Janeiro

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Abstract

Quality public spaces, especially pedestrian areas, play an essential role in cities. Communities gather in these spaces and benefit from the proximity to activities in a safe and car-free environment. Pedestrian areas can have greenery, which helps address the issues raised by climate change. Repurposing existing roads is a priority in many cities worldwide whose aim is to improve their social and environmental performance. This study presents a systemic, data-based approach that supports the transition from the current pervasive car-based mobility model to a people-centric, pedestrian-based one. This transformative model leverages the structural properties of urban systems to reconfigure streets as integral components of a comprehensive strategy aimed at mitigating the effects of climate change. Image segmentation is used to assess the presence of people in the streets. The numerical evidence provided by metrics and indicators is complemented by visual evidence from local-scale maps. The proposed method is tested on a portion of Bairro Cidade Nova in Rio de Janeiro within the framework of the Integrated and Sustainable Urban Regeneration Milan–Rio (REMIRIO) project, a city-to-city cooperation project between Milan (Italy) and Rio de Janeiro (Brazil) funded by the European Union which aims to implement pilot nature-based solutions to address local environmental issues such as flooding and overheating. In particular, five North–South streets are compared to define customised pedestrianisation interventions within a more comprehensive super-block strategy with the aim of improving the continuity of the existing green system and the ecosystem services. This precise network diagnostic process can be easily transferred to any urban system.

Keywords

pedestrian-centric design; Rio de Janeiro; space syntax; urban mobility

1. Introduction

As climate change intensifies, cities play a critical role in addressing its challenges. Urban life significantly contributes to the global carbon footprint, and phenomena like the urban heat island effect exacerbate environmental risks such as flooding, air pollution, and extreme temperatures (Oke et al., 2017; Santamouris, 2015). At the same time, cities hold great potential to develop sustainable, climate-responsive solutions. Through thoughtful planning and design, urban centres can reduce emissions, manage risks, and foster resilient ecosystems, positioning themselves as both frontlines of climate adaptation and testing grounds for innovative environmental strategies.

A critical component of this transformation lies in the design and use of public spaces, especially walkways. As urbanisation accelerates globally, the importance of these spaces has become increasingly evident, not only as connectors between places but as fundamental elements for the creation of sustainable, vibrant urban environments (Forsyth & Southworth, 2008; Gehl, 2011). Walkability has emerged as a key factor in fostering cities that are both liveable and resilient. Well-designed pedestrian areas promote non-motorised mobility while reducing reliance on private vehicles, the social cost (Gössling et al., 2019), and the environmental impacts of urban sprawl. These spaces offer multiple benefits, from enhancing public health and encouraging social interaction to supporting local economies and strengthening civic engagement. The built environment in walkable neighbourhoods encourages movement, interaction with surroundings, and community life, contributing to a stronger sense of place and identity.

Beyond their social and economic value, walkways and public spaces are also critical for a sustainable environment. They can help mitigate urban heat islands when designed with greenery and trees, while also improving air quality and facilitating better management of stormwater (Bowler et al., 2010; Nowak & Dwyer, 2007). When integrated with green infrastructure such as parks, greenways, and tree-lined streets, pedestrian areas provide not only aesthetic and recreational value but also ecological benefits that help cities adapt to climate change. As the recognition of these benefits grows, cities are increasingly prioritising pedestrian-friendly planning. However, achieving walkability requires strategic thinking, thoughtful design, and a commitment to ensuring that these spaces are accessible, interconnected, and inclusive for all urban residents.

The transition to more pedestrian-friendly cities involves rethinking urban mobility and the spaces that support it. Pedestrianisation—converting streets and areas to prioritise pedestrian use, often alongside other forms of non-motorised mobility—has emerged as a key strategy for cities aiming to reduce their environmental impact, improve public health, and foster vibrant, equitable communities (Litman, 2003). This concept encompasses varying degrees of pedestrian priority, from fully car-free zones to shared spaces where pedestrians coexist with limited vehicular access. Beyond spatial configuration, the success of pedestrianisation often hinges on land use planning, as the activities and amenities present in these spaces significantly influence their vibrancy and utility. However, the decision of when and where to prioritise pedestrianisation requires a nuanced understanding of urban dynamics, such as the density of urban areas, existing infrastructure, and socio-economic conditions. In areas with overwhelming traffic congestion or pollution, pedestrianisation can be transformative, but its success depends on a balanced approach that addresses competing needs such as maintaining access to services, supporting local businesses, and improving public transportation links to mention a few.

This article situates itself within the Integrated and Sustainable Urban Regeneration Milan–Rio (REMIRIO) project in Rio de Janeiro, which seeks to transform a local area into a more pedestrian-friendly environment. As part of the European Union's Partnership for Sustainable Cities programme, REMIRIO represents the cooperation between the municipalities of Milan and Rio de Janeiro. This initiative seeks to establish common visions and strategies to address the 2030 Agenda for Sustainable Development and the goals outlined by the C40 Cities Climate Leadership Group. The project aims to develop an Integrated Sustainable Urban Regeneration Plan (ISURP) for the Vila Operária Salvador de Sá area, emphasising environmental sustainability, social inclusion, and economic growth. Vila Operária is a historic housing district where architectural charm is coupled with maintenance and preservation issues. The neighbourhood is vulnerable to the urban heat island effect (de Faria Peres et al., 2018) and to flooding (Nunes et al., 2020). Therefore it presents an opportunity to explore strategies to mitigate these challenges through urban design interventions and green infrastructure. Moreover, its socio-economic complexity underscores the importance of addressing equity concerns in urban regeneration initiatives.

The project follows a diagnosis-based approach adopting the integrated modification methodology (IMM) to identify malfunctioning subsystems within the local urban structure. IMM (Mohammad Zadeh et al., 2024) is a comprehensive procedure that uses various scientific techniques to analyse and evaluate the built environment at multiple scales. IMM is characterised by an integrative and system-oriented approach, a focus on sustainability, the use of data-driven methods, and alignment with global sustainable development goals (SDGs). The methodology is structured in phases, starting with a diagnostic phase based on geospatial data, leading to the design and optimisation of solutions.

The aim of this article is to explore the challenges and opportunities of pedestrianisation in urban contexts, using the REMIRIO project as a lens to investigate how different urban dimensions interplay to influence walkability and environmental resilience. Specifically, the article proposes a simplified, flexible, and data-based multi-criteria approach to evaluate the suitability of a street link to various types of pedestrianisation interventions. The determination of a set of monitoring and evaluating criteria with an impact on the quality of urban space aligns with the work of Ewing and Clemente (2013). This article introduces measures obtained with GIS-based simulations on urban systems linked to vegetation and public transport. As a result, this study contributes to the broader discourse on sustainable urban design and its role in fostering liveable, resilient cities. The proposed approach has been tested on five neighbouring streets involved in a larger strategy that aims at improving the continuity of the green system in the area. This study is part of a participatory process based on a continuous feedback mechanism for the iterative refinement of proposed interventions based on community input, gathered during workshops and consultations.

2. Literature Review

Although pedestrianisation has gained recent prominence as an urban design strategy, historical evidence proves that cities were inherently pedestrian-oriented before the advent of automobiles. In classical antiquity and pre-industrial urban contexts, streets were primarily designed for walking and for transportation with carts, carriages, and other modes of transport (Fruin, 1971; Hass-Klau, 2014). This indicates that non-motorised mobility is not a merely contemporary environmental strategy to control traffic and reduce pollution. Rather, the natural flow of pedestrians within urban spaces is a fundamental aspect of the human–environment relationship, offering numerous benefits (Diaconu, 2011). In their 2016 review,

Nikhil and Neetishree Soni classified these benefits into five categories: transportation, society, environment, economics, and health (Soni & Soni, 2016). However, to fully harness the potential of pedestrianisation in urban planning, transition strategies must be designed to engage the structural parameters that influence non-motorised mobility (Blaga, 2013); most significantly, carefully considering these parameters across different scales of urban form. Pedestrianisation, defined as the removal or restriction of vehicular traffic in favour of pedestrian use (Monheim, 1980), involves numerous overlapping criteria that can be broadly categorised into two phases: The first is the identification of areas with the highest potential for car limitation at the intermediate scale; the second is the application of encouraging design principles and supportive policies at the local scale (Nassar et al., 2018).

The literature reveals key factors promoting non-motorised mobility on meso and local scales. Among these, a minimal population density is widely recognised as essential for fostering a walkable environment at the intermediate urban scale. In one of the most influential studies of the 20th century, Newman and Kenworthy demonstrated a strong inverse relationship between population density and fuel consumption in urban areas (Newman & Kenworthy, 1989). Numerous other scholars have emphasised high density as a prerequisite for encouraging walking as a mode of travel (Kott & Eells, 2016; Oakes et al., 2007; Tanishita & van Wee, 2017). Dense areas naturally facilitate the concentration of diverse land uses within shorter distances, thereby increasing the likelihood of walking. Consequently, mixed-use development is frequently cited alongside density as a structural parameter critical to the success of pedestrianisation efforts (Carmona, 2015; Ewing et al., 2018; Mehta, 2014; Nakamura, 2016; Soni & Soni, 2016).

Although a dense urban fabric at the neighbourhood scale is essential for facilitating the transition to non-motorised mobility, it is not sufficient on its own. Over the past three decades, it has been well established that spatial configuration and network connectivity have direct and measurable effects on the dynamics of pedestrian movement and land-use patterns (Al-Sayed et al., 2014). In this context, space syntax is a widely referenced theoretical framework that enables the study of network qualities by providing measures for the evaluation of integration, metric distances, and angular choice (Hillier, 1996). While it is widely accepted that the metric distance between points of interest (POIs) significantly influences foot traffic (Sheng et al., 2021), numerous studies emphasise that the underlying topological structure of street patterns, rather than solely the scale of movement, plays a crucial role in determining pedestrian flow. Accordingly, Hillier and Lida (2005) advocate for synthetic methods that combine the evaluation of metric distance with topological distance, which is characterised by directional changes.

In their 2008 study, Peponis et al. (2008) examined the combined influence of geometric and topological properties on pedestrian movement. They confirmed that spatial cognition and function are fundamentally shaped by the topological interpretation of the network at intermediate scales, thus offering a more nuanced perspective than the traditional space syntax on metric and directional connectivity. As well as revealing movement patterns, they argued that these measures also help explain other attributes, such as density distribution and block size, which enhance the morphological understanding of street layouts and facilitate comparisons between different urban areas (Peponis et al., 2008).

In a more recent study, Duarte and Celani (2019) utilised topological measures to develop a framework aimed at enhancing walkability in urban streets through retrofitting. The authors integrated space syntax with shape grammar to create a design support method that facilitates the generation of urban street retrofitting scenarios.

While they affirm the importance of metric accessibility for ease of walking within specific distances, their proposed framework employs angular choice analyses conducted at varying radii to establish a hierarchical approach to identify which streets should be prioritised as non-motorised links.

Many scholars, including Jabbari et al. (2021), Jayasinghe et al. (2016), and Kubat et al. (2013), have emphasised the importance of considering both metric and directional accessibility in walking behaviour and their crucial roles in shaping pedestrianisation scenarios. Kubat et al. (2013) employ both metric and directional assessments to critique the official pedestrianisation choices in three historical zones in Istanbul. Their study provides valuable insights into effective pedestrianisation strategies, balancing urban design with functional needs to create more walkable environments.

While network configuration and overall connectivity at the neighbourhood scale provide the structural foundation for a successful non-motorised urban context, the execution of pedestrianisation on individual links is equally critical. As previously discussed, the second phase of an effective pedestrianisation project involves the implementation of policies, design principles, and strategies that encourage walking at both local and intermediate scales. Parajuli and Pojani (2018) concluded that, especially at the local level, the most persistent barriers to pedestrianisation tend to be political, institutional, and social, rather than technical or financial. Yassin (2019) advocates for tactical urbanism to address these barriers, especially in city centres. According to Lydon and Garcia (2015), tactical urbanism employs short-term actions for long-term change, using low-cost, scalable interventions to activate neighbourhoods. Analysing various global examples, Yassin (2019) highlights effective tactics such as temporary street closures and pop-up parks, arguing that tactical urbanism facilitates both top-down and bottom-up transitions. This dual approach engages many stakeholders, fostering greater community involvement.

Regarding the structural environment of pedestrian links, Gehl (2006) suggests that the ideal street that attracts pedestrian traffic is one with a “soft edge.” He describes such streets as being lined with shops and large windows at ground level, offering numerous openings and notable interruptions. However, these attributes appear to be typological outcomes of larger-scale urban characteristics, such as high-density layouts, optimal block sizes, well-functioning public space systems, and connected street networks. These desirable morphological properties at larger scales have already been partially discussed.

Greenways can be considered a cross-scale strategy that can be implemented not only independently on selected links but has the potential to unify a larger network as well. In a recent study, Dostal and Eisenman (2022) explored how pedestrianised streets can unlock underutilised road spaces in dense urban areas, transforming them into greenways. Through a systematic review of the available literature concerning pedestrian zones and greenways, they identified shared characteristics and the benefits of integrating these urban interventions. Greenways enhance urban liveability by providing various advantages, such as noise reduction, air filtration, additional shade, and mental health benefits. Additionally, they address urban challenges such as flooding when positioned near waterways and create safer, car-free environments that benefit both pedestrians and local wildlife. The study emphasises the synergy between pedestrian zones and greenways when planned together.

Pedestrianisation is gaining popularity in Brazilian cities as well as in many other countries. The city of Curitiba introduced car-limited links in the 1970s. In the 1980s the largest pedestrian area in the country

was developed in São Paulo (Rodriguez et al., 2012). Today, pedestrianisation initiatives are also being implemented in major cities like Rio de Janeiro and Salvador. In most cases, designers leverage the existing density of urban blocks and rich street networks to define revitalisation projects by enhancing structural elements. One key aspect to be considered in similar initiatives, as well as in many contemporary planning activities, relates to the involvement of citizens and relevant stakeholders. In a 2016 study, Sala Minucci and Righi (2016) examined the revitalization of Oscar Freire Street, one of São Paulo's most prominent commercial streets, known for high-end shopping. This project, initiated by local retailers and implemented in cooperation with the municipal government, included upgrades to the existing infrastructure such as burying electrical wires, installing street furniture, improving lighting, and landscaping to enhance pedestrian accessibility and aesthetic appeal. This can be considered a positive example which also emphasizes the importance of partnerships between public and private institutions in urban redevelopment projects, especially in busy commercial areas that depend on pedestrian traffic.

From another perspective, Thomas (2016) conducted a long-term investigation into state-led pacification projects in Brazilian cities aimed at transforming public spaces into safe pedestrian-friendly zones patrolled by the police force. Her study highlights the significant challenges decision-makers face in creating secure environments to ensure successful pedestrian experiences and dynamic public spaces. Thanks to a deep understanding of Brazil's social dynamics and urban architecture, Thomas questions the effectiveness of certain measures, such as an increase In the presence of the police, arguing that these often clash with the organic nature of urban environments. In response to these challenges, it seems that rather than imposing control mechanisms without elevating the urban environment's capacity, what is needed in such transformations is a systemic diagnosis of structural problems, the definition and evaluation of modification scenarios with higher potential for public engagement, and the adaptation of these strategies to official policies. Pedestrianisation is a cornerstone of sustainable urban design, balancing environmental imperatives with social and economic objectives. Its success relies on multi-scale planning, the integration of density, land use, and network connectivity with localised design adaptations. Emerging technologies and participatory approaches further strengthen its viability. By fostering walkable environments, cities can promote healthier, more inclusive, and more vibrant urban experiences.

3. Methodology

Space syntax measures, as discussed in the literature, offer a range of methodologies for assessing the topology of street networks, providing valuable insights into the spatial structure of cities. However, it is important to recognise that a city extends beyond its street network, which could also be analysed more accurately (Ratti, 2004). While the street layout significantly influences the organisation of other urban systems, these systems exhibit a degree of independence and flexibility. Despite correlations found in previous studies (Omer et al., 2017), urban systems are not entirely constrained by the street network, and other factors contribute to the evolutionary development of the overall urban fabric.

This study proposes an integrated approach, combining space syntax-based measures, commonly used to prioritise areas for pedestrianisation interventions, with additional urban characteristics. These supplementary factors are derived from post-implementation evaluations of pedestrianisation projects and include the presence of and proximity to green spaces, the connectivity with the existing public transportation infrastructure, the presence of ground-level commercial activities and services, and some

physical attributes of the built environment. In particular, this study has applied a method that uses street links as the morphological unit to gather simple measurable attributes referring to these dimensions. The aim is to provide a more comprehensive understanding of the street properties potentially affecting the success of pedestrianisation interventions. The proposed method allows for a nuanced decision-making process, where various urban characteristics can inform and orient towards the pedestrianisation of one street instead of another, while also giving insights into the choice of pedestrianisation model, whether it be full pedestrianisation, a combination of pedestrian and public transport, part-time pedestrianisation, or traffic calming measures.

As well as being aligned with the IMM approach discussed above (Mohammad Zadeh et al., 2024), this method is grounded in empirical data, leveraging geospatial datasets from the city of Rio de Janeiro. The datasets, provided by the Instituto Municipal de Urbanismo Pereira Passos, are visualised through maps that illustrate the phenomena under study. The methodology prioritises simplicity and accessibility, using user-friendly measures that avoid overly complex indices. For this study, simple counts of elements (e.g., shops, trees, routes) and percentages of the street length with certain characteristics were used. This approach is designed to facilitate adoption by key stakeholders, such as local authorities and urban planners, who are instrumental in shaping the urban environment. The use of basic, modifiable parameters ensures that the core principles of the methodology remain intact while allowing for flexibility in application.

Thematic maps were generated to illustrate aspects related to the IMM components—void, type of uses, networks, and volumes—describing the urban structure potential, and to investigate pedestrian presence, dealing with urban performances of street use. These maps served as analytical tools for the identification of priority areas and to inform urban planning.

3.1. Voids

The void component usually includes water bodies (blue) and paved spaces such as squares (grey). The present study analyses this component with a focus on green infrastructures, which are considered to be most relevant in this context. The presence of green spaces and trees can be evaluated from two perspectives. Firstly, the existing urban vegetation can be assessed to identify areas that are already well-endowed with greenery, with the aim of prioritising these areas for pedestrianisation interventions. This approach leverages existing resources, reducing the need for extensive investments in new infrastructure. Secondly, the potential to transform areas by connecting or enhancing green spaces is considered, with the goal of maximising the impact of pedestrianisation on the surrounding urban context.

The continuity of green systems in urban areas plays a critical role in enhancing biodiversity and improving the environmental quality of public spaces. To assess green continuity in the area considered in this study, a GIS-based approach was employed to identify streets that can facilitate the direct connection of green spaces, thereby improving the continuity of the urban green infrastructure. This method does not assume that these streets already contain substantial vegetation; rather, it focuses on their potential to link distinct green areas, thus contributing to a broader network of green spaces. The analysis was informed by the IMM green continuity key category, which evaluates the potential of street segments to support the continuous flow of green infrastructure (Biraghi et al., in press). It involves drawing the shortest path on the street network to connect each green area larger than a certain size. These routes are called potential continuity corridors (PCC)

and need to be counted to identify the street links with the highest value and prioritise them. Streets identified through this process may not host significant green elements at present, but their role in fostering green continuity could provide a strong rationale to prioritise them in pedestrianisation efforts. Enhancing green continuity through pedestrianisation can, in turn, contribute to increased urban biodiversity and improve the overall quality of urban life.

3.2. Type of Uses

Ground-level activities and services, often referred to as POIs, are key components in determining the suitability of a street for pedestrianisation. These activities attract people to public spaces, thereby increasing pedestrian footfall. To quantify the presence of these activities, data from the Imposto Sobre a Propriedade Predial e Territorial Urbana (IPTU) database were analysed to identify the types of services available along each street. Particular attention was given to businesses that tend to be successful in pedestrianised environments, such as bars, restaurants, schools, parks, and outdoor sports facilities. These activities not only foster social interaction but also align with the goals of pedestrianisation interventions.

Conversely, activities that rely heavily on car access, such as car repair shops, gas stations, and industrial facilities, were also considered. The objective here was to identify areas where the conversion of streets to pedestrian zones could disrupt essential services that depend on vehicle access, without penalising businesses that are integral to the urban fabric. Parking areas were also evaluated, not only for their impact on traffic but also for their potential to act as transition zones into car-free areas. By carefully balancing these factors, the proposed approach aims to optimise the street environment for both pedestrians and essential services, ensuring the long-term success of pedestrianisation initiatives.

3.3. Networks

Access to public transportation is another critical factor in determining the viability of pedestrianisation interventions. Access to public transport in densely populated urban areas is essential to ensure that pedestrianised zones remain accessible to a wide range of people, including those who rely on public transport for mobility. The degree to which the street network supports modal or line change (intermodality) was analysed using the City Transport Analyzer (Naro et al., 2024), a QGIS plugin designed to assess the potential for multimodal transport connections. This tool uses General Transit Feed Specification data to evaluate how effectively public transport stops are integrated into the street network. It assesses stops according to the number of lines passing through them, and, similarly to what was presented for green continuity, it draws potential multimodal routes (PMR) on the shortest path between any stop with no public transportation lines in common.

This analysis was particularly relevant in the context of Rio de Janeiro, where the bus network is pervasive and often exploits the same roadways as private vehicles, resulting in lower average commercial speeds. By considering the intermodality of public transportation, the study aims to ensure that the pedestrianisation of certain streets does not isolate them from the broader transit network, but rather enhances their integration within it.

3.4. Volumes

The physical characteristics of the built volumes along streets also play an important role in determining the suitability of an area for pedestrianisation. It must be said that modifications of building volumes are more complex and less feasible than interventions like greening or de-paving. For this reason, it is worth analysing the volume component as a sort of immutable framework for pedestrian activity. The street section determines the level of enclosure of spaces. This affects the presence of shadows on the streets, the perception of the space and the sky view factor (Zakšek et al., 2011), a relevant measure affecting the urban heat island effect (Dirksen et al., 2019; Zhong et al., 2024). This study adopts a simple measure developed by Biraghi and Pafka (2025) to synthetically describe these aspects. Block enclosure ratio (BER) describes the percentage of a block's perimeter with buildings aligned on it. This is complemented with the counting of sky pixels in Google Street View (GSV) images using segmentation techniques. This aspect is further analysed in Section 3.5.

A streetscape analysis was conducted through on-site visual inspections to gather essential information about the physical and functional characteristics of the street sections. Key parameters recorded included the width of the street, its configuration as one-way or two-way, traffic direction, the presence and arrangement of parking spaces, the number and dimensions of traffic lanes, and the presence and properties of sidewalks. Additionally, observations were made on the spatial dynamics of street use, such as instances of illegal parking or other factors influencing the occupation of public space. This qualitative assessment provided crucial context for understanding the functional and spatial dynamics of the streets under study.

3.5. People

Assessing pedestrian flows is important when dealing with pedestrianisation interventions. Traditional methods of people counting, such as on-site surveys, are resource-intensive and challenging to implement consistently. These methods require extensive planning, staff, and time to ensure that reliable data are collected across different locations and times. Data collected from mobile phones or internet usage are often skewed, excluding non-digital users such as elderly people and young children. Given the difficulties in obtaining very accurate data, it was decided to accept less precise data but to explore free methods capable of providing preliminary information over a potentially vast area.

In this study, alternative people-counting techniques were explored using image segmentation algorithms applied to GSV imagery. This method allows for the automated counting of pedestrians in street-level images, offering a cost-effective solution to obtain a preliminary approximation of pedestrian activity across a broad range of locations. The semantic segmentation tool, trained on the ADE20K dataset, classifies each pixel in an image into categories such as buildings, vegetation, roads, and pedestrians, providing spatial and activity data potentially useful for urban analysis. The data derived from these images were processed using algorithms to detect and quantify the presence of people, providing an estimate of pedestrian activity, and a rough estimation of the sky view factor by counting sky pixels. GSV images, captured regularly in 360-degree views, were sampled at 10 m and 100 m intervals for both detailed and broader analyses using a Google API. Pre-processing steps included resizing and normalisation to meet the requirements of the DeepLabV3+ model, a ResNet50-based segmentation framework. The model generated pixel-level class maps, enabling quantitative insights into urban features and pedestrian usage through pixel count analyses.

This method offers a cost-effective way to assess pedestrian behaviour and the distribution of urban elements, with the segmentation tool demonstrating high accuracy in identifying common features and clear boundary delineations. However, it faces some limitations, including computational intensity, API limitations and costs, and reduced accuracy for underrepresented features, which could be improved through localised fine-tuning. Additionally, the approach provides only a snapshot of pedestrian activity, capturing a single moment in time, and requires careful consideration of factors such as weather, day of the week, and holidays to ensure the validity and comparability of the data. In fact, among all the images downloaded, only those taken on a single day in May 2024 were eventually considered. Despite these challenges, the image-based approach remains a valuable tool for a rough estimate of pedestrian flows and the identification of streets suitable for pedestrianisation interventions at the neighbourhood scale.

4. Results

The proposed method has been tested on five north–south-oriented streets in the core of Vila Operária. The decision to involve a limited number of streets stems from the local yet scalable nature of the approach, aiming to address a question such as "why here and not there" in a context where streets may appear very similar and interchangeable. The streets under study are shown in Figure 1. All of the streets are one-way, characterised by typical two-storey, low-rise developments in a poor state of conservation, and by the presence of a chaotic network of electrical infrastructure above the streets. For clarity and ease of reference, the streets have been numbered sequentially, with their names provided for each. The streets included in the analysis are R. Correa Vasques (S1), R. Viscondessa de Piracinunga (S2), R. Laura de Araujo (S3), R. Carmo Neto (S4), and R. Anibal Benevolo (S5). These streets were selected for their centrality within Bairro Cidade Nova, where the REMIRIO project is implemented. The reasons for focusing specifically on these streets are numerous. They all intersect Avenida Salvador the Sá in the south, where the Municipality and the local community have proposed a greening project; they all feature a high level of enclosure and a high

Figure 1. Area of study with the five streets highlighted (base image from Bing Maps).

concentration of activities compared to the surrounding areas, two conditions considered favourable for promoting walkability; and most of the buildings in the area are owned by the Municipality.

The data were prepared and processed using QGIS 3.28.6, while the space syntax analyses were performed within DepthmapX, modelling the streets as Segments. The space syntax measures considered were choice, depth, and integration, using both angular and metric methods, for three different search radii: 400 m, 800 m, and the entire area ($r = \infty$). The area comprises 13 bairros (districts) spanning from the city centre to the east and up to Tijuca National Park to the west (Figure 2). The radii of 400 m and 800 m were chosen as representative of a 5-minute and 10-minute walk. This resulted in a total of 24 different metrics, which are reported in Table 1.

After evaluating the data, however, it was found that metric depth and metric integration exhibited minimal variance and were therefore excluded from further analysis. Angular choice and angular integration showed meaningful variation across the streets, with angular choice being prioritised for analysis due to its frequent use in the literature. Both angular depth and angular integration were significant and, as expected, negatively correlated, as they describe two inverse dimensions. Therefore, only angular integration was considered for its wider use in the literature. To simplify, from now on, these will be referred to simply as choice and integration, referring to the angular measures.

These two measures are considered to reflect key spatial characteristics: Choice indicates how likely a street segment is to be passed through on all shortest routes from all spaces to all other spaces in the entire system; integration is a normalised measure of distance from any space of origin to all others in a system. In both measures, high values are considered favourable for urban design purposes.

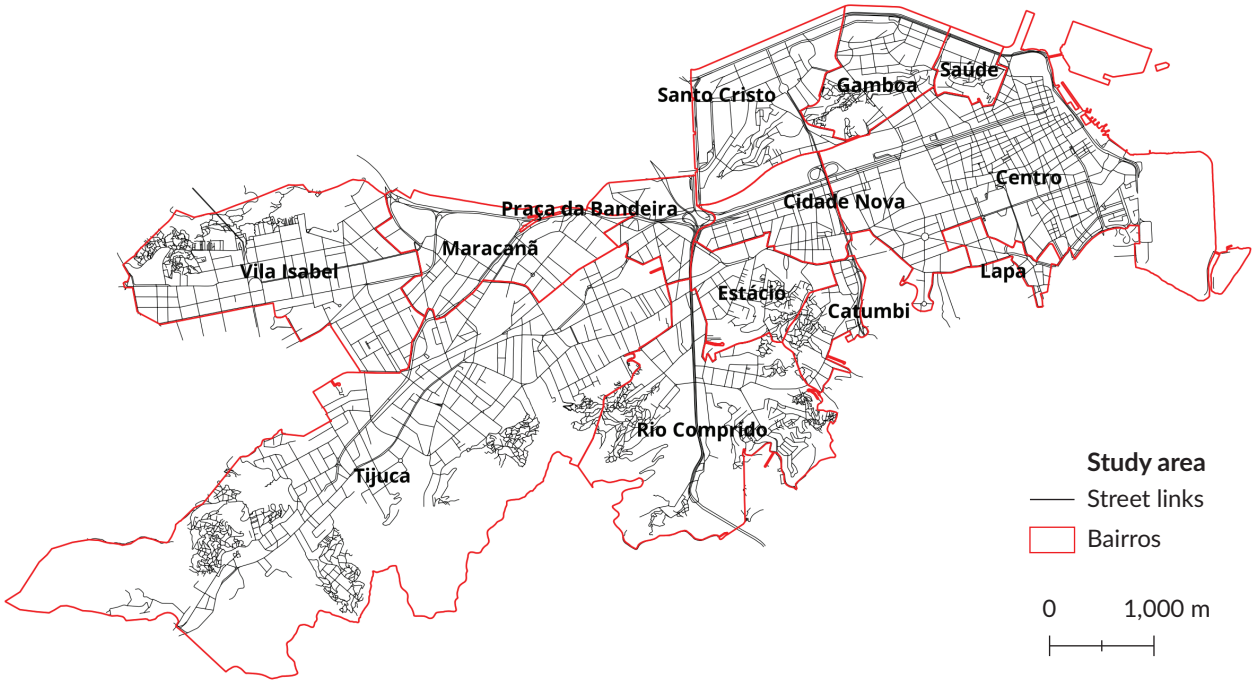

Figure 2. Study area considered for the space syntax analysis.

Table 1. Space syntax measures for the selected streets.

General	ID	S1	S2	S3	S4	S5
	Street name	R. Correa Vasques	R. Viscondessa de Piracinunga	R. Laura de Araujo	R. Carmo Neto	R. Anibal Benevolo
	cod_trecho	50469	50448	50446	50443	51440
	Length (m)	177.4	162.2	159.6	159.9	159.7
Space Syntax	Ang. Connectivity	2.8	4	3	4.2	3
	Connectivity	5	6	5	6	5
	M. Choice (∞)	814,856	2,293,925	40,326	28,189	114,005
	M. Choice 400 m	107	217	177	170	258
	M. Choice 800 m	885	1,528	935	931	1,730
	M. Mean Depth (∞)	3,379	3,398	3,467	3,471	3,486
	M. Mean Depth 400 m	278	251	271	263	257
	M. Mean Depth 800 m	539	523	517	516	500
	M. Total Integration (∞)	20,547,538	20,664,434	21,085,450	21,106,108	21,199,554
	M. Total Int. 400 m	11,695	15,050	15,158	16,831	15,950
	M. Total Int. 800 m	115,927	119,157	107,107	114,534	111,072
	Ang. Choice (∞)	33,474	3,153,576	17,234	682,017	13,508
	Ang. Choice 400 m	59	227	140	80	254
	Ang. Choice 800 m	735	2,201	790	1,281	1,217
	Ang. Integration (∞)	945	1,072	915	1,039	929
	Ang. Int. 400 m	32	53	43	49	43
	Ang. Int. 800 m	100	128	84	116	88
	Ang. Total Depth (∞)	39,161	34,496	40,447	35,586	39,832
	Ang. Total Depth 400 m	80	80	101	107	130
	Ang. Total Depth 800 m	586	411	543	525	484

The results of the space syntax analysis revealed several significant trends. S2 consistently exhibited the highest values for both choice and integration across all radii, indicating that this street plays a central role in the urban network. In contrast, S1 and S3 consistently showed low values for both measures, suggesting that these streets are more peripheral. S4 demonstrated intermediate values for choice, coupled with high values for integration, indicating that, although it is well-integrated into the network, it is not as central in terms of accessibility. S5 followed a similar pattern to S1 and S3, with the exception of the 400 m choice, where it ranked highest among all streets. Based on these values, it is only possible to establish a draft ranking of the streets, in terms of their spatial prominence, from the most to the least suitable: S2, S4, S5, S3, and S1. While these findings help establish a general hierarchy of streets in terms of spatial prominence, they do not provide sufficient information to determine the exact nature of pedestrianisation interventions. Choice ($r = \infty$) and weighted integration (considering all three radii) maps are presented in Figure 3.

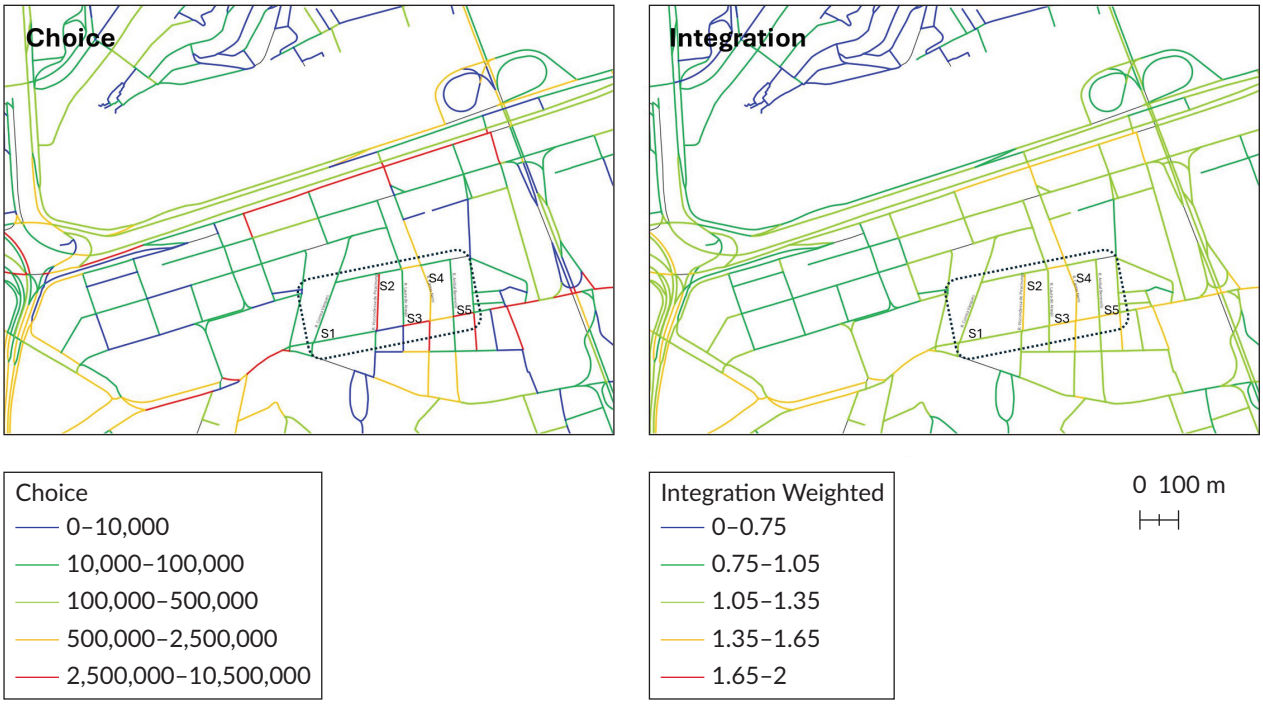

Figure 3. Angular choice (∞) and angular weighted integration maps.

Table 2 summarises all the measures proposed to size the IMM components. Voids are described by Green_% and Tree_%, which correspond to the percentage of link length within the buffer area of green areas or trees, as well as by the number of PCC (PCC_N). The type of uses divides the IPTU sub-plots data (Tot. sub-plots) into residential (Res. sub-plots) and non-residential (Non-res. sub-plots) categories. This metric differs from the number of POIs (POI_N) as it also includes vacant spaces and activities not considered relevant to proximity-related studies. The pedestrian activities such as cafes, restaurants, schools, and parks (POI_PED_N), and those reliant on cars (POI_CAR_N), have been highlighted from the POI_N dataset. The role of public transportation is quantified by counting the number of stops (PTS_N), lines (PTL_N), and PMRs (PMR_N). The volumes component is simply characterised by BER, which measures the percentage of street length with continuous building façades, and the percentage of sky pixels extracted from GSV images (Sky_%). Lastly, some aspects referring to observable features of the streetscape are reported, such as width, parking lanes, sidewalks, way, and car lanes. Figure 4 presents four maps, each representing one of the components, giving a visual understanding and evidence of the components-based measures gathered in Table 2. Figure 5 shows the results of the AI segmentation tool applied to GSV images at resolutions of 10 m and 100 m.

It is important to note that not all of these measures were ultimately relevant in informing pedestrianisation strategies. For instance, the number of POIs specifically associated with pedestrian activities (POI_PED_N) such as cafes, restaurants, and schools, ranged between 0 and 2 for the five streets considered in this study, with a total of 5 restaurants, 1 cafe, and no schools in the area. This suggests that POI_PED_N should not be considered a significant factor in determining the pedestrianisation potential of the streets. Similarly, the street width did not emerge as a meaningful distinguishing factor, with values ranging from 7.5 m (S2 and S3) to 9.1 m (S5), showing limited variation across the streets analysed. All the streets are one-way with a single car lane and parking on both sides. On S4 there are two lanes, no formal parking exists, and vehicles are parked

Table 2. Complementary measures inspired by the IMM components for the selected streets.

General	ID	S1	S2	S3	S4	S5
	Street name	R. Correa Vasques	R. Viscondessa de Piracinunga	R. Laura de Araujo	R. Carmo Neto	R. Anibal Benevolo
	cod_trecho	50469	50448	50446	50443	51440
	Length (m)	177.4	162.2	159.6	159.9	159.7
Voids	Green_%	17%	83%	4%	2%	1%
	Trees_%	30%	51%	0%	7%	19%
	PCC_N	0	0	0	2	0
Type of Uses	Tot. sub-plots (IPTU)	78	49	77	35	23
	Res. sub-plots	52	27	46	18	10
	Non-res. sub-plots	26	22	31	17	13
	POI_N	17	13	28	14	13
	POI_PED_N	2	1	1	0	1
	POI_CAR_N	4	2	4	7	1
Networks	PMR_N	7	3	0	6	0
	PTS_N	0	0	0	1	0
	PTL_N	0	0	0	5	0
Volumes	BER	1	1	1	1	1
	Sky_%	29%	16%	36%	44%	45%
Streetscape	Width (m)	8.8	7.5	7.5	7.9	9.1
	Parking lanes	2	2	2	0	2
	Sidewalks	2	2	2	2	2
	Way	1 up	1 down	1 up	1 down	1 up
	Car lanes	1	1	1	2	1
People	People pixels %	0.10%	0.04%	0.37%	0.13%	0.11%

illegally along the street. Additionally, BER was uniform across all streets with a value of 1 (indicating fully continuous building façades), further reinforcing that this measure was not useful in differentiating between the streets. However, this also indicates that all of them have a section that provides a good sense of enclosure, making them suitable as walkable environments.

4.1. Evaluations and Recommendations Based on Results

Turning to the individual streets, S1 stands out for having the highest percentage of residential sub-plots (52.67%) along with four car-related POIs. The street has a moderate amount of greenery and low pedestrian activity, as indicated by a very small percentage of people pixels (0.1%). It plays an important intermodal role, with seven PMRs passing through it. Given the combination of high residential density and the presence of car-related activities, it is recommended that car passage be maintained on S1, as other neighbouring streets may be more suitable for pedestrianisation measures. The suggested intervention for S1 includes widening

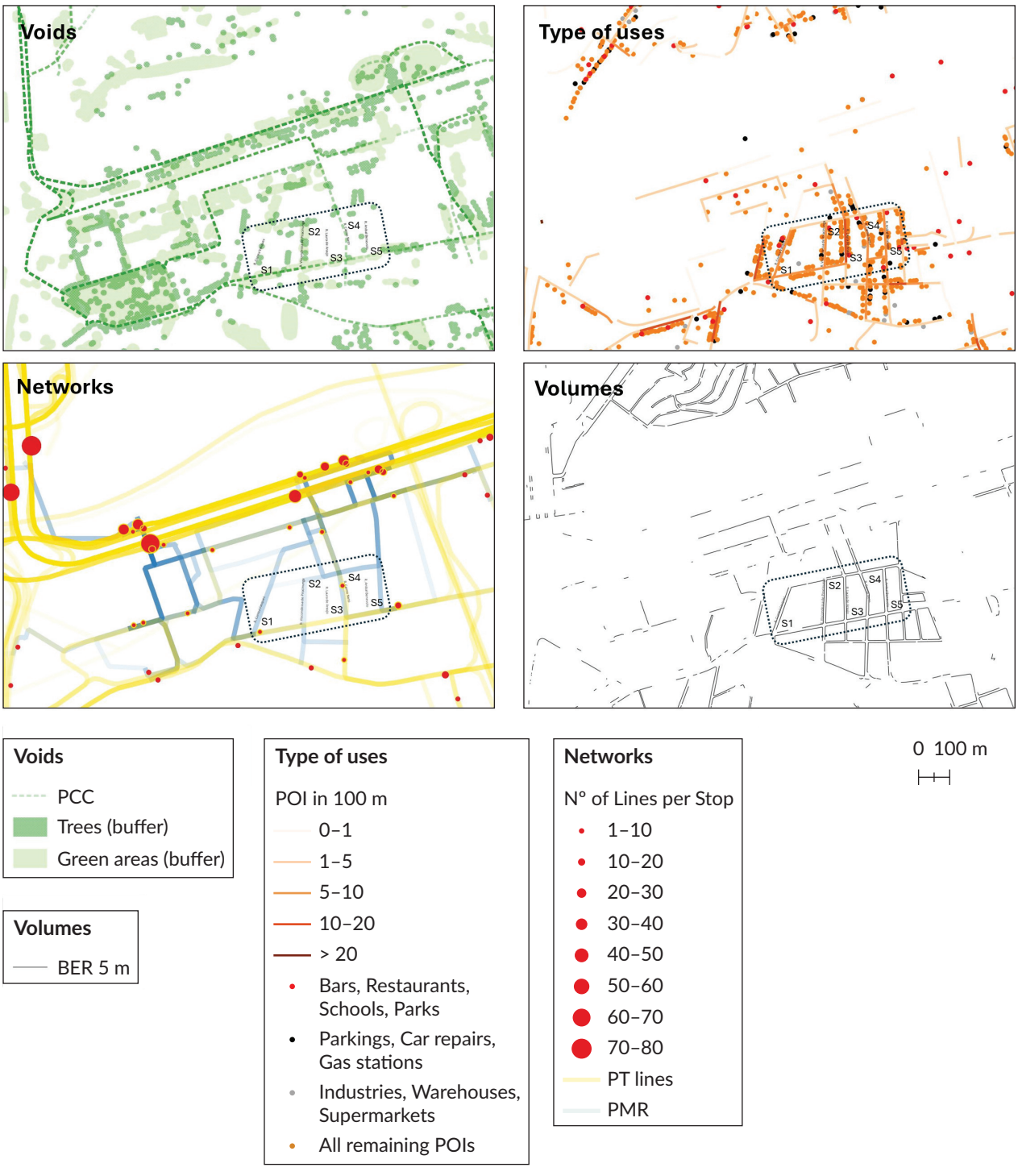

Figure 4. Voids, type of uses, networks, and volumes maps. Note: PT – Public Transportation.

the sidewalks by up to 1.2 m to accommodate additional greenery and trees, while also making the surface more permeable. Furthermore, a traffic calming intervention could be implemented by reducing the maximum speed limit to 15 or 30 km/h and potentially extending the surface to be repaved to include the car lanes. In the northern section of S1, where there is a concentration of shops, the sidewalks could be further expanded by removing one or both of the parking lanes.

Figure 5. People pixel count derived through segmentation of GSV images at 10 m and 100 m of resolution.

S2 presents a contrasting scenario. This street has a significantly higher green area and tree coverage compared to the others, resulting in a lower sky view factor. There are no public transport stops or lines, but it is crossed by three PMRs. Pedestrian activity, as shown by people's pixels, is the lowest in the study area: It equals one-third of the pedestrian activity found in S1, S4, and S5, and one-ninth of that in S3. Given the relatively low pedestrian density and the potential to improve the green infrastructure, S2 could either remain as it is with enhanced greenery or be fully pedestrianised to significantly improve its ecosystem services.

S3 exhibits the highest density of POIs (28) as well as a larger number of residential sub-plots (46%), which translates to higher pedestrian activity (with people pixels four times higher than the average). However, the street suffers from a lack of greenery and informal parking, particularly along its narrowest section. In fact, the car-related activities occupy much more public space than the shopfronts. This highlights the risk of encountering more resistance than expected in the case of a full pedestrianisation intervention, but also the risk of extending the current improper use of space if proposing a lighter approach (e.g., limiting access to residents and activities). Although no PMRs pass through S3, its high density of POIs suggests that pedestrianisation could be beneficial. The street could either remain as it is, with greenery introduced where

possible, or undergo a more substantial transformation to fully pedestrianise the area. In this case, displacing some car traffic to S2 might be considered, given that S2 has a lower density of activities. A coordinated strategy involving both S2 and S3 would be necessary, as interventions on one street would significantly influence the other. However, both S2 and S3 could be pedestrianised together as mobility through the area is granted by S1 on the left and on another road, R. Presidente Barroso, on the right.

S4 differs from the other streets as it is the only one with a public transport stop, which serves five different lines, making it a key street for PMRs (6). It also has no formal parking, with sidewalks illegally occupied by cars. S4 is moderately residential, with several car-related POIs, and lacks significant greenery. It is also the only street with two PCCs, suggesting that a significant greening intervention should be considered. Assuming that at least one street out of the five considered in this study must contain public transportation lines, there are no particular reasons or advantages for relocating the public transportation stop from S4 to other streets. Instead, the street should be made more pedestrian-friendly by providing dedicated lanes for public transport and bikes while widening the sidewalks by up to 2.5 m. A portion of this widened space should be dedicated to greenery and trees to improve the street's environmental quality.

Lastly, S5 does not exhibit any particular features that set it apart from the other streets. It has the lowest number of POIs and residential sub-plots, with average levels of people pixels and limited greenery. Given its lack of strategic importance for car traffic and the opportunity to significantly improve the urban environment, S5 could be fully pedestrianised. This transformation would provide much-needed space for green infrastructure and contribute to increasing soil permeability.

In summary, the analysis reveals that while space syntax measures such as choice and integration offer useful insights into the overall spatial structure of the streets, a more detailed investigation incorporating other factors such as green infrastructure, residential density, public transport accessibility, and POIs is crucial for determining the most appropriate pedestrianisation strategies. The suggested interventions for each street aim to prioritise pedestrian comfort and environmental quality, while considering the functional needs of the urban space and its inhabitants.

5. Discussion

The results highlight the complex nature of decision-making regarding pedestrianisation strategies, where multiple factors must be considered. The proposed multi-dimensional analysis for street links aims to provide better support to decision-making about potential pedestrianisation strategies. It includes many layers, often presenting conflicting results. For instance, POI density can lead to a high presence of cars as people try to park as close as possible to their destination. Similarly, there are often more trees in streets with fewer activities, as both need street space for their survival. The main point is that the interpretation of these data and the consequent pedestrianisation strategies to be implemented strongly depend on the general approach of the decision-makers who need to choose between minimising the negative impacts on car users or maximising the positive impacts for pedestrians and the environment. The latter would be preferable. However, it is necessary to consider the overall acceptability of the interventions, which could require some compromises with the local population. In this study, this applies in particular to S2, S3, and S5, while S1 and S4 have clearer and stronger reasons to support their modification. While the ideal solution may favour pedestrian-oriented interventions, political and social factors such as public acceptance must be

taken into account. Thus, more gradual, incremental approaches may be necessary to ensure that the interventions are not only effective but also broadly supported by the community.

A more transformative strategy that incorporates these findings is the proposal to convert the area between R. Correa Vasques (S1) and R. Presidente Barroso (to the left of S5) into a superblock. This superblock, approximately 150 m x 400 m in size, would limit the access to inner streets to residents, property users, and safety vehicles. Public transport would continue to operate on S4, with the benefits of a dedicated lane. Surrounding streets would maintain car passage in a clockwise loop, ensuring that vehicular accessibility is preserved while prioritising pedestrians within the core. This approach exemplifies how pedestrianisation can be scaled to address larger areas, balancing traffic management with the creation of walkable, socially vibrant spaces.

In addition, the superblocks concept can be easily adapted to the entire urban regeneration of the Vila Operária district in Rio de Janeiro as well. The neighbourhood has all the necessary geographical and geometric characteristics. It has an area of approximately 700,000 m^2, with a 1.4 km-width east–west and between 450 and 750 m north–south. This is similar to a square with an 830–840 m width. It is surrounded by main roads. It is served by two subway stops and a railway station, which implies that Mass Rapid Transit Systems (MRTS) accessibility is granted, as no individual location in Vila Operária is more than 500 m away from one of these stations. Moreover, perimetral roads are never more than 300 m away from any location in the neighbourhood. Existing blocks are sometimes several metres wide and the internal street network is quite dense, but a wide complex of public spaces is already in place along the north side of the prefecture. The world-famous Sambódromo lies on the east side. Vila Operária also has a very strong social identity and a lively cultural background. These aspects enhance the need for spaces where people can mingle and socialise. Consequently, a more ambitious mobility proposal is to perform an extensive pedestrianisation of the internal street network, making many streets exclusively accessible to pedestrian traffic and reducing the portion of road devoted to cars in many others, expanding sidewalks and introducing traffic and speed limitations (e.g., buses, residents only, and, in some cases, patrons as well). In addition to this, green spaces and urban finishes aimed at enhancing the socialization capabilities of streets have to be planned as well. The proportions of this plan must take into consideration an expected diminishing number of private cars, but perimetral parking should still be provided: Car owners will need to walk to the parking location similarly to commuters who need to walk to MRTS stations. A phased and incremental approach to pedestrianisation is suggested, starting with a single street, gradually upscaling to the five-street superblock, and finally including the entire Vila Operária. This would give citizens time to embrace the changes and to experience the positive impact of the transformations directly.

The fact that the superblock logic has already been implemented in Brazil further supports this idea. The urban regeneration of the Porto Maravilha district in Rio de Janeiro is a good example of wide strategic spaces turned from car-centric areas characteristic of the urban development in the 1960s and 1970s into more human-scaled ones focussed on liveability. Another interesting example is the Biotic Technology Park (BTP), an innovative and research-oriented masterplan in Brasilia. BTP was designed in 1955 by famous Brazilian architect and city planner Oscar Niemeyer together with urban planner Lúcio Costa with the aim of reconnecting people with nature and improving quality of life according to what nowadays are considered the basic principles of smart cities. In addition to this, BTP is based on the superblock concept, like most of Brasilia. In 2020, MIC-HUB supported Carlo Ratti Associati in conceiving a mobility and parking strategy

aligning with BTP's futuristic vision. The main mobility goal has been to strongly reduce drive-alone trips to BTP. To achieve such a result, the mobility plan first focused on a GIS-based city-scale analysis to inform the client of current and future accessibility patterns, travel times, and transit options. Secondly, the plan re-managed road network geometries, parking provision, and internal mobility. Replacing less sustainable transport modes with more virtuous solutions provides high accessibility and ensures both low emissions and also a remarkable reduction in soil consumption.

6. Conclusion

This study explores a method for the evaluation of street properties that recommends interventions for their improvement. It is applied in the context of five streets within a specified urban area, integrating space syntax analysis, urban morphology, and data on pedestrian activity to assess the potential for the transformation of these streets into more walkable environments.

The results highlighted that whereas space syntax metrics such as choice and integration could be useful for the identification of areas with higher pedestrian potential at the meso scale, other factors such as accessibility to POIs, public transport, and green spaces are more relevant for the local scale, providing useful insights on the type of pedestrianisation to be implemented.

The study proposes a multi-criteria assessment of suitability for pedestrianisation to support decision-making. Balancing the needs of pedestrians and car users is essential, as these two dimensions are often in conflict. This study advocates for a phased, incremental approach to pedestrianisation, where interventions are tailored to the specific needs of each street, within the framework of a general vision for an area, like in the proposed case study of Vila Operária in Rio de Janeiro.

The metrics proposed provide useful information to orient pedestrianisation projects. In particular, PCC_N and PCR_N represent simple but not trivial aspects of the current and potential arrangement of two urban components. The simple nature of the data used and the cost-effectiveness of the people-counting technique enable the scalability of the method to wider urban scales. However, increasing the number of streets to be surveyed and the related attributes would require the adoption of more systematic data interpretation techniques. Maps, in particular those related to the type of uses, could be integrated with views that highlight sub-sections of streets of particular interest (e.g., concentrations of car-based activities) requiring specific interventions. In addition, the comparison between official datasets from the Municipality and the observation of GSV images revealed some inconsistencies (e.g., 4 vs 11 POI_CAR_N and 0 vs 6 trees in S3). The results and the subsequent assumptions in the article are based on the official data, but the introduction of a validation procedure for input data would increase the overall reliability of the process. This can be done by including additional features in the image segmentation process (e.g., cars and trees). The image segmentation process can be applied to images different from GSV as well. Moreover, taking pictures on site at different times of day and night could significantly enrich the information to be derived.

In conclusion, this multi-dimensional approach offers valuable insights for urban planners and decision-makers seeking to implement pedestrianisation strategies providing a framework for the development of sustainable, walkable, and liveable urban spaces. The findings emphasize the need for a balanced, context-sensitive methodology that considers both the physical and social dimensions of urban

life, ensuring that pedestrianisation efforts contribute to more inclusive, accessible, vibrant, and healthier urban environments in line with the C40 Cities Climate Leadership Group and the SDGs.

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Conflict of Interests

The authors declare no conflict of interests.

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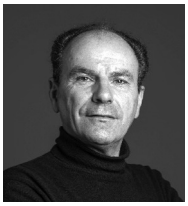

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ARTICLE

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Interactions Between Pedestrians and Street Vendors: Experiences From the Global North and South

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Abstract

Street vending evokes contrasting images of urban vibrancy and congestion. This comparative study explores the dynamics between street vendors and pedestrians in the Global North and South through four case studies—two in Brisbane, Australia, representing the North, and two in Nagpur, India, representing the South. Employing Kelum Palipane's sensory rhythms diagram, this research examines the sensory experiences—sight, sound, touch, smell, movement, taste—in urban environments where street vending is present. Findings reveal notable disparities in pedestrian activity. However, street vendors in all contexts influence pedestrian behaviour through common sensory cues. Brisbane represents a case where more street vending is encouraged, albeit under strict regulations. Here, further initiatives are needed to inject vitality into urban spaces. In contrast, Nagpur exemplifies India's rich street vending culture. In this context, street vending is positive in many ways but also presents challenges such as congestion, safety, and accessibility. Despite these differences, street vendors in both cities play a crucial role in enhancing the urban experience. The research highlights the need for balanced planning strategies that promote urban vibrancy while mitigating any adverse impacts of street vending on pedestrians.

Keywords

pedestrian behaviour; sensory rhythms diagram; street vending; urban vibrancy

1. Introduction

Street vending refers to the sale of goods or services in public spaces, such as open markets, streets, plazas, and even public transport stations, typically by informal or small-scale vendors (Etemadi, 2004; Devlin, 2011, as cited in Wungo et al., 2022). This activity evokes at least two contrasting images:

1. An otherwise drab urban environment is transformed into a vibrant hub of activity. Colourful stalls lining the streets offer an array of goods—delectable food, handcrafted jewellery, and unique clothing—enticing passersby to explore, savour, and engage in lively conversations with vendors. Buskers add excitement and charm. Amidst the hustle and bustle, each interaction becomes a mini-adventure, igniting the senses and creating lasting memories that enrich the urban experience. But once the festivities fade, the space falls silent again. Vibrancy only comes in fleeting waves.
2. The scene is chaotic. Sidewalks are cluttered and pathways are obstructed. The proliferation of stalls and merchandise strewn on the ground creates pedestrian congestion, frustrating passersby and potential customers. A lack of proper waste management exacerbates the issues, with discarded packaging and leftover food contributing to unsightly litter and sanitation concerns. This environment not only detracts from the urban experience but also poses safety hazards and impedes accessibility for all residents and visitors.

These descriptions could apply to street vending in various locations around the world—both in the Global North and the Global South. However, street vending—and urban space more broadly—tends to be more tightly regulated and proceeds in a more orderly fashion in the Global North, whereas, in the Global South, it is generally less regulated and more hectic (Hagos & Adnan, 2020; Sun et al., 2020; Torky & Heath, 2021).

There is extensive research on street vendors and their impact on society. However, international comparative literature that systematically evaluates street vending activities in contrasting settings is largely missing. Such literature is necessary to reveal aspects of street vending that have been overlooked in single case study research. To address this gap, this study seeks to answer the following questions empirically: In what ways do street vendors and pedestrians affect one another in (a) unregulated, high-density, and vibrant urban environments, and (b) highly regulated, quieter urban spaces where pedestrian traffic is scarce?

Four case studies are examined: two in Brisbane, Australia, and two in Nagpur, India. While these locations have been selected to represent the Global North and South respectively, it is important to note that similar cases can be found across different geographic contexts. For example, in Southern European cities, street vending is often informal and shares many characteristics with Nagpur. Meanwhile, cities like Cape Town, Singapore, and São Paulo—like Brisbane—have highly regulated street vending systems, with vendors required to register and/or follow zoning laws. In fact, some commentators (e.g., Dados & Connell, 2012) argue that, at this stage, terms like “Global North” and “Global South” are better understood as metaphors referring to certain development levels and regulatory regimes, rather than as contiguous geographic locations.

This study is based on multisensory non-participant observation, following a framework called “sensory rhythms diagram” (Palipane, 2019). This framework involves painstaking fieldwork employing all the senses. The findings contribute to urban studies by deepening our understanding of how street vending shapes perceptions and experiences of urban space. Such an understanding is necessary for formulating planning policies that enhance urban vibrancy while ensuring access, comfort, and safety for everyone. The study also highlights the role of informal economies and/or small businesses in making cities more dynamic—visually and financially.

Before discussing the method and case study settings in detail, a brief overview of key issues related to street vending and vendors is provided below. We define street vending and the context in which it takes place, delineate its benefits and challenges, and discuss the regulatory frameworks that govern it in various settings.

2. Background on Street Vending/Vendors

2.1. Definition and Context

Street vending has been an integral part of urban economies since ancient times. Historical accounts across civilisations describe itinerant merchants selling goods door-to-door thereby connecting neighbouring regions (Recchi, 2020). In the Global South, street vending has long been embedded in the urban fabric; with recent urbanisation trends, it has only expanded further (Sun et al., 2020; Wungo et al., 2022).

However, street vending is also present—and sometimes prominent—in Global North cities, particularly among impoverished and/or migrant communities (Recchi, 2020; Woldeamanuel et al., 2022). For example, in New York, migrants from various ethnic backgrounds make up 51% of street vendors (Carpenter, 2018). Kebab vans introduced by Middle Eastern migrants in Melbourne have become an integral part of the cityscape, despite initial reservations about their aesthetics (Rosmarin & Sintusingha, 2019).

Dovey et al. (2022) categorise street vending into three types: fixed, semi-mobile, and mobile. Fixed vending involves small structures or kiosks that are not easily movable (Dovey et al., 2022). Semi-mobile vendors utilise temporary setups that can be disassembled daily but remain stationary during trading. Mobile vendors engage in trading activities that can be instantly moved. While fixed structures are spatially spread out due to their nature, mobile and semi-mobile structures are commonly found in public areas. These typologies illustrate the diversity of street vending operations in urban environments and the adaptability of vendors to different spatial and regulatory contexts.

The items and services offered by street vendors vary significantly depending on cultural contexts, local needs, and geographical location, with notable differences between the Global North and Global South. In some cases, the goods sold on the street complement those found in stores (Voltolini, 2006).

The indoor lifestyle of the Global North contrasts with popular street food activity in the Global South. In Northern cities, vendors primarily sell food, handmade crafts, jewellery, and artwork (Carpenter, 2018). Traditionally in these contexts, food was served indoors in restaurants or semi-open cafés, but the rise of international migrants has popularised street food vending (Carpenter, 2018). Street vendors often offer unique or culturally significant goods that may not be readily available in larger retail establishments. In contrast, the diversity of street vending in Southern cities extends beyond food, encompassing products such as phone accessories, casual wear, and even fresh meat and fish sold in open-air environments (Hagos & Adnan, 2020). In some places, particularly in East and Southeast Asia, services like haircuts, massages, and ear cleaning, which are considered private in the North, are performed in public spaces.

2.2. Benefits and Challenges

While the scale and nature of street vending varies across countries, this activity offers social and economic benefits everywhere. It stimulates social interaction while providing a range of affordable goods and services in accessible locations. It is also a source of income for the poor, particularly those who lack access to formal employment opportunities in growing cities (Voltolini, 2006; Wungo et al., 2022). Hence its prominence in parts of Africa (Acharya & Jagari, 2023; Warlina et al., 2021), Asia (Acharya & Jagari, 2023), and Latin America (Woldeamanuel et al., 2022).

In North America, Europe, and Australia, street vending is less about economic survival and more about enriching urban life. While in Global South metropolises street vendors cater to the lower socioeconomic class with affordable items, weekly markets in the North are leisure destinations for the upper-middle class. Commentators in New York have noted that vendors activate sidewalks by engaging pedestrians in spontaneous activities such as queuing for food or negotiating prices (Voltolini, 2006).

By being mobile, street vendors can take their business to where customers are located, thus reducing the need for buyers to travel to distant locations. This convenience saves consumers time and money, especially in areas where access to traditional brick-and-mortar stores is limited or where transportation is scarce. Vendors appear to have a remarkable instinct for pedestrian density and foot traffic. Continuously monitoring market dynamics, they quickly identify high-demand zones and strategically cluster in these prime spots (Whyte, 1980). This positioning allows them to capitalize on impulse shopping decisions by passersby (Peimani & Kamalipour, 2022a). Vendors' efforts to advertise their products and services—for example, food or cosmetics—also activate urban spaces. Vendors frequently offer samples to capture the interest of passersby (Peimani & Kamalipour, 2022b).

While vendors' presence is beneficial in many ways, the dense crowds they attract may also encourage littering or pickpocketing (Woldeamanuel et al., 2022). Issues also arise when vendors install stalls or tents in ways that obstruct pedestrian flow and decrease the pedestrian level of service, a measure of pedestrian comfort and the functionality of pedestrian services (Acharya & Jagari, 2023; Hidayat et al., 2010; Sumabrata & Gurning, 2011). People with disabilities or those pushing prams and shopping carts may find it particularly challenging to navigate crowded streets and sidewalks. Problems are exacerbated by noise pollution, waste accumulation, and, at times, smoke from poorly functioning cooking devices (Hagos & Adnan, 2020; Warlina et al., 2021).

2.3. Regulatory Frameworks

In the Global South, street vendors often (but certainly not always) operate informally, outside established regulatory frameworks, disregarding conventional legal norms (Hagos & Adnan, 2020; Sun et al., 2020; Torky & Heath, 2021). The challenge here is to regulate vending in a way that prevents disorder. However, some cities have taken extreme measures by criminalising, banning, or relocating street vending—albeit with limited success (Torky & Heath, 2021; Woldeamanuel et al., 2022). In cities like Mumbai, Delhi, and Mexico City, collective action has pressured authorities to restore vendors' right to conduct business (McGee & Yeung, 1977). However, in places with weaker labour organisations, such as Dhaka, vendors resort to individual tactics, such as illegally reoccupying trade sites and bribing authorities, thus perpetuating exploitation by corrupt local governments (Lata et al., 2019).

While some regulation is beneficial, excessive and overly rigid rules can deter people, resulting in dreary and unsafe public spaces—as many cities in the Global North have learned the hard way (Carpenter, 2018; Voltolini, 2006). Here street vending has been more tightly regulated to manage pedestrian congestion and maintain public order and hygiene standards (Torky & Heath, 2021). However, Northern cities are starting to recognise the value of this activity, and, to encourage it, are loosening some regulations around public space use (Brisbane City Council, 2023).

3. Methodology

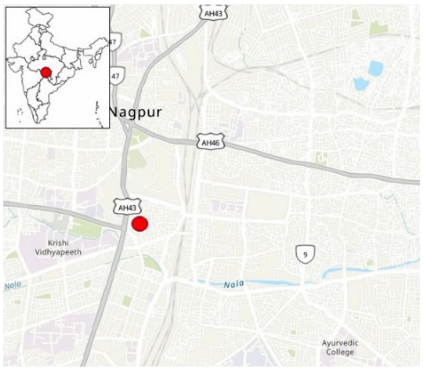
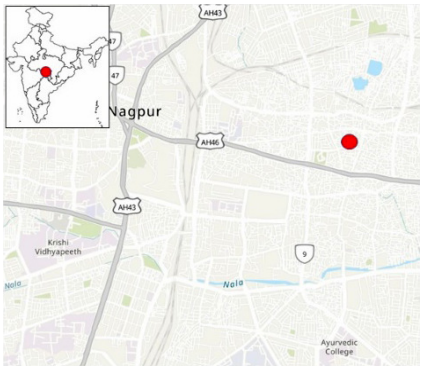
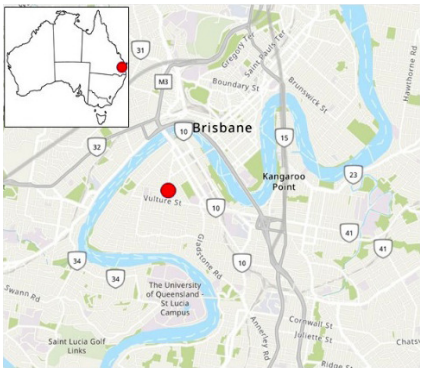
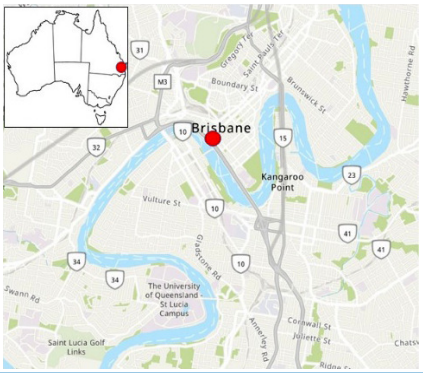
3.1. Case Studies

Australia and India share a common historical background as former British colonies, yet their urban development paths diverge significantly. Since gaining independence, Australia has maintained a strong affinity for Anglo-style planning, which has shaped its urban landscape. The country has traditionally embraced an indoor lifestyle, with social activities primarily taking place within controlled, enclosed environments. Notably, outdoor dining restrictions persisted in Brisbane until the 1980s, despite its mild climate throughout the year. However, with the influx of migrants from diverse backgrounds, there has been a gradual shift in mentality over time. Brisbane, now boasting a population of 2.5 million (Brisbane City Council, 2024), aspires to position itself as "Australia's new world city" (Brisbane City Council, 2019). While many suburban main streets continue to have low urban design quality (Hooi & Pojani, 2020), the City Council is emphasising the creation of vibrant public spaces in the centre (see Parajuli & Pojani, 2018). Spaces here are more conducive to socialising and community events, and some allow street vending for food, crafts, accessories, clothing, and even services such as bodywork or soothsaying (Brisbane City Council, 2023). Street vending is managed through a licensing and permitting system, with most markets located in the central business district and around the inner city.

In contrast, India has preserved its deeply entrenched cultural practices following independence. One of those is a pronounced preference for outdoor living and bustling street markets. Nagpur, situated in the centre of India, has a population of 3 million. The city is renowned for its burgeoning IT industry (Macrotrends, 2023). In addition to white-collar tech employees, the city attracts blue-collar migrants from smaller towns seeking employment opportunities, many of whom engage in small-scale businesses on the streets, contributing to the informal economy. However, a rapid increase in vendors, with approximately 90,000 currently (a fourfold rise over a decade), coupled with limited dedicated vending zones, has led to complaints by residents (Hagos & Adnan, 2020; Nagpur Municipal Corporation, 2023). In response, the Municipal Council has recognised the need to regulate vending activities under the City Development Plan. The aim is to facilitate the registration of vendors utilising public spaces and address illegal encroachments, thereby fostering a more structured and orderly streetscape (Nagpur Municipal Corporation, 2023).

In summary, distinct approaches and preferences regarding street vending are evident in India and Australia. While India has long relied on street markets as a cornerstone of its urban fabric, Australia is only beginning to explore this aspect. Furthermore, in India, street vending is an important source of livelihood that supports the urban poor, whereas in Australia, it primarily catalyses social interaction and urban vibrancy (Brisbane City Council, 2024; Nagpur Municipal Corporation, 2023). Nagpur and Brisbane were selected as contrasting case studies to examine these differences. For the study, four streets were chosen where outdoor vending occurs regularly: two in Nagpur and two in Brisbane (see Table 1). Sitabuldi Market Road (Nagpur) and Suitcase Rummage (Brisbane) share similarities with semi-mobile vendor arrangements, while both Itwari Bazar Road (Nagpur) and Boundary Street (Brisbane) feature fixed structures such as local shops and cafes that utilise sidewalk space for advertising and selling their products.

Table 1. Case studies.

Study area	Location	Description
Sitabuldi Market Road, Nagpur		Sitabuldi is Nagpur's premier street market, having evolved organically over the years. It boasts a mix of semi-mobile and mobile informal vendors, offering a wide array of affordable clothes, accessories, footwear, and more. The street is flanked by shops on both sides, with vendors typically stationed in front of these establishments, adjacent to kerbside parking. Recent developments, including the construction of the World Trade Centre, and ongoing street renovation efforts, have forced vendors to relocate toward the centre of the road.
Itwari Bazar Road, Nagpur		Itwari Bazar Road is one of Nagpur's longstanding activity hubs. This expansive wholesale market comprises numerous parallel shopping lanes catering to diverse merchandise categories. During shopping hours, these lanes cater to pedestrians, with vending structures predominantly fixed in place. The market is renowned for its selection of home décor items, accessories, and cooked food. Parking for private vehicles is centralised on the market's main square during shopping hours. The surroundings blend commercial and residential uses.
Boundary Street, inner-city neighbourhood, Brisbane		Boundary Street functions as the high street of an inner-city suburb called West End. West End's population is wealthier and better educated relative to other suburbs throughout Brisbane (Australian Bureau of Statistics, 2018). Boundary Street is one of the oldest thoroughfares in the city and originally served to separate Indigenous populations from British colonisers (hence the name). Given West End's accessible location and its attractive design, Boundary Street attracts visitors from all over the city rather than just the immediate vicinity.
Suitcase Rummage, central business district, Brisbane		Suitcase Rummage occurs bi-monthly on Sundays, always in the same location. This event transforms an open plaza in Brisbane's central business district into a vibrant marketplace. Local sellers showcase their offerings nestled within suitcases. A diverse selection of goods is usually on offer, ranging from vintage clothes to handcrafted jewellery. Most vendors are community members rather than business owners. Occasionally, there are live music performances. Organised and overseen by the Council, this market is usually well-attended.

Sources: Architizer (2023); Brisbane City Council (2023); Hill (2023); Nagpur Municipal Corporation (2023); Suitcase Rummage (n.d.).

3.2. Data Collection

To gather data, this study employed a passive (non-participant) observation method. This method has been used in urban design research since William Whyte's seminal investigation of human behaviour in urban settings (Whyte, 1980) and is still popular today (see, for example, Milne & Pojani, 2023). However, this study goes a step beyond traditional techniques by privileging multi-sensoriality over abstract metrics, maps, or language (see Pink, 2015, on the notion of sensory ethnography). The purpose is to develop an embodied rather than purely logical understanding of the research sites.

The underlying assumption is that vendors and their customers dynamically alter the urban landscape through visual and tactile displays of clothing and crafts (i.e., sight and touch), food preparation (i.e., smell and taste), music and calls (i.e., sound), and other sensory elements, such as movement. Sensory cues affect how people perceive and interact with public spaces—they either attract or deter people. While the smell of handcrafted soap or essential oils can be appealing, excessive noise, refuse odours, or people brushing against one another may lead to discomfort and avoidance.

This study applied the sensory rhythms method, which was first developed by Palipane (2019), based on Lefebvre's (2013) theory of rhythmanalysis. According to Lefebvre, cities are not fixed; they are constantly changing as people interact with their surroundings: "Everywhere there is interaction between a place, a time, and an expenditure of energy, there is rhythm" (Lefebvre, 2013, p. 15). Humans perceive urban environments with all the senses, and rhythmanalysis helps to understand how the rhythms of everyday life shape urban spaces. Based on Lefebvre's (2013) theory and Lucas' (2009) empirical approach, Palipane (2019) developed a radar notation system of sensory rhythms. This method focuses on capturing all sensory experiences, including sight, sound, touch, movement, taste, and smell on a radar diagram. Each spoke represents a sensory modality, with the intensity rated on a scale from 1 to 6, with 6 being the highest (Figure 1).

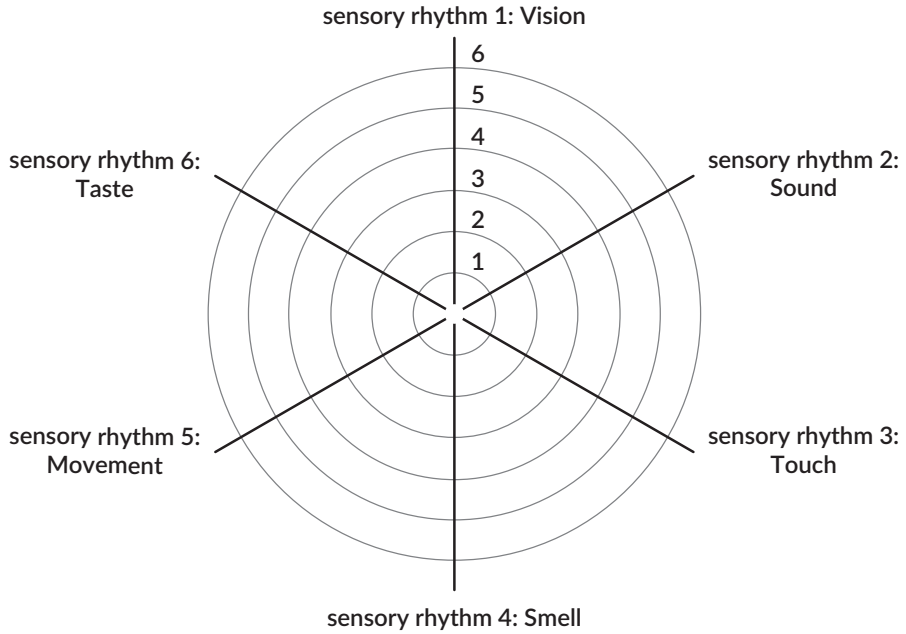


Figure 1. Radar diagram to note sensory rhythms. Each spoke of the radar wheel represents a sensory modality, the intensity of which is rated on a 1–6 Likert scale. Source: Palipane (2019).

This research extends Palipane's (2019) original insights by applying her method to street vending patterns and the interactions between pedestrians and vendors in two different socio-cultural contexts. The authors found that the sensory rhythms method is well suited to the study of street vending because vendors and pedestrians create their rhythms by using the space in different ways. To track the sensory rhythms across each site, the fieldworker traced the spatial journeys on a local map. Hourly notations of rhythms in key locations along the journey were made, observing fluctuations in their intensity over time. These notations were subsequently translated into temporal patterns, and triangulated with other data collected during fieldwork, such as sketches, handwritten notes, food tasting, touching of merchandise, sound recording, photographs, and videos (Figure 2).

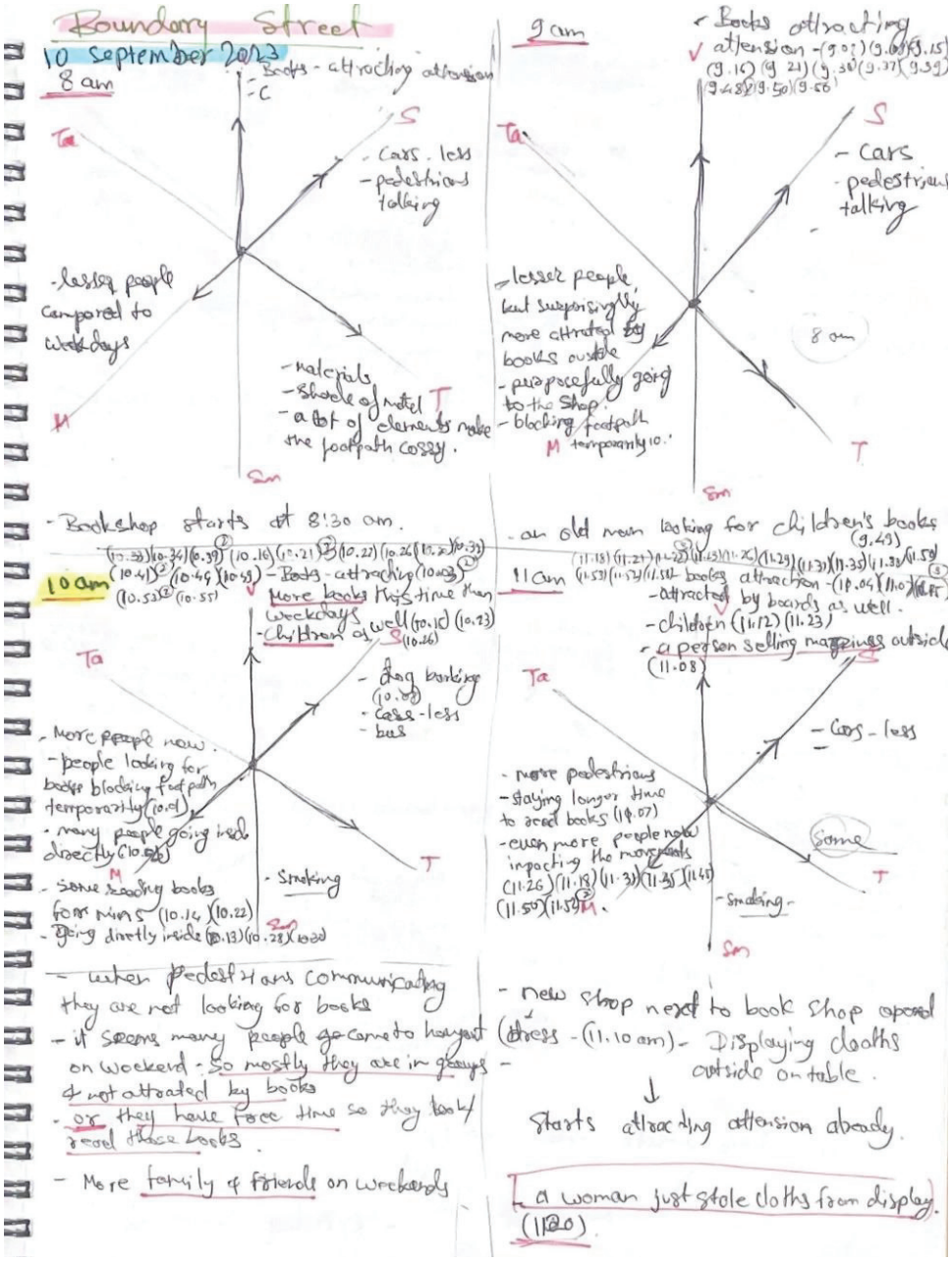


Figure 2. Example of fieldwork journal page with hourly notes. In addition to rating sensory modalities, hourly notes are recorded alongside the radar to explain any fluctuations in intensity.

The fieldwork was conducted in September 2023. In Brisbane, this is the start of the spring and weather conditions are typically warm, dry, and sunny. In Nagpur, September marks the end of the monsoon season, which is characterised by light rain and high humidity. The observations took place for 12 hours (8 am to 8 pm), in 1-hour intervals, on two Wednesdays and two Sundays (except for Suitcase Rummage which was only observed for 5 hours on Sunday). In total, 149 hours of observations were accumulated.

3.3. Data Analysis

Once the fieldwork process was complete, the data were collated into sensory rhythms diagrams for each site (see Figures 3 to 6). The horizontal rows of these diagrams follow the data collection timeline and include:

- Insights: This row depicts written notes and reflections on recorded sounds and videos. These data are meant to complement the rest.
- Body/Space: This row displays photos and drawings of human figures that illustrate the embodied action that helps produce activity and sensory rhythms.
- Sensory Rhythm: This row summarises the data collected through the radar diagrams.
- Timeline: This is universal for all sites.
- Section: This explains the connection between bodies and the built environment.
- Plan: This provides additional information about the density and orientation of bodies in space.
- Spots: This vector indicates the points of interest where the researchers lingered the longest, linking those to the Timeline. The Spots are also noted in the Spatial Trajectory (see below).
- Spatial Trajectory: These maps show the spatial context and illustrate the researchers' trajectory during site visits. Researchers followed the strongest sensory rhythms and focused on areas dominated by vending activities. This journey included stopping at specific points and moving between different locations.

The vertical columns of the sensory rhythms diagrams depict individual Episodes. The data were analysed thematically, by triangulating all the materials gathered through fieldwork. This analytical approach allowed the authors to compare the cases while highlighting their particularities. Four key Episodes were selected (one per site) to discuss in depth in the Findings section.

Figure 3. Sensory rhythms diagram, Sitabuldi Market Road, Nagpur (weekend).

ITWARI MARKET, NAGPUR

Figure 4. Sensory rhythms diagram, Itwari Market, Nagpur (weekday).

BOUNDARY STREET, BRISBANE

Figure 5. Sensory rhythms diagram for Boundary Street, Brisbane (weekday).

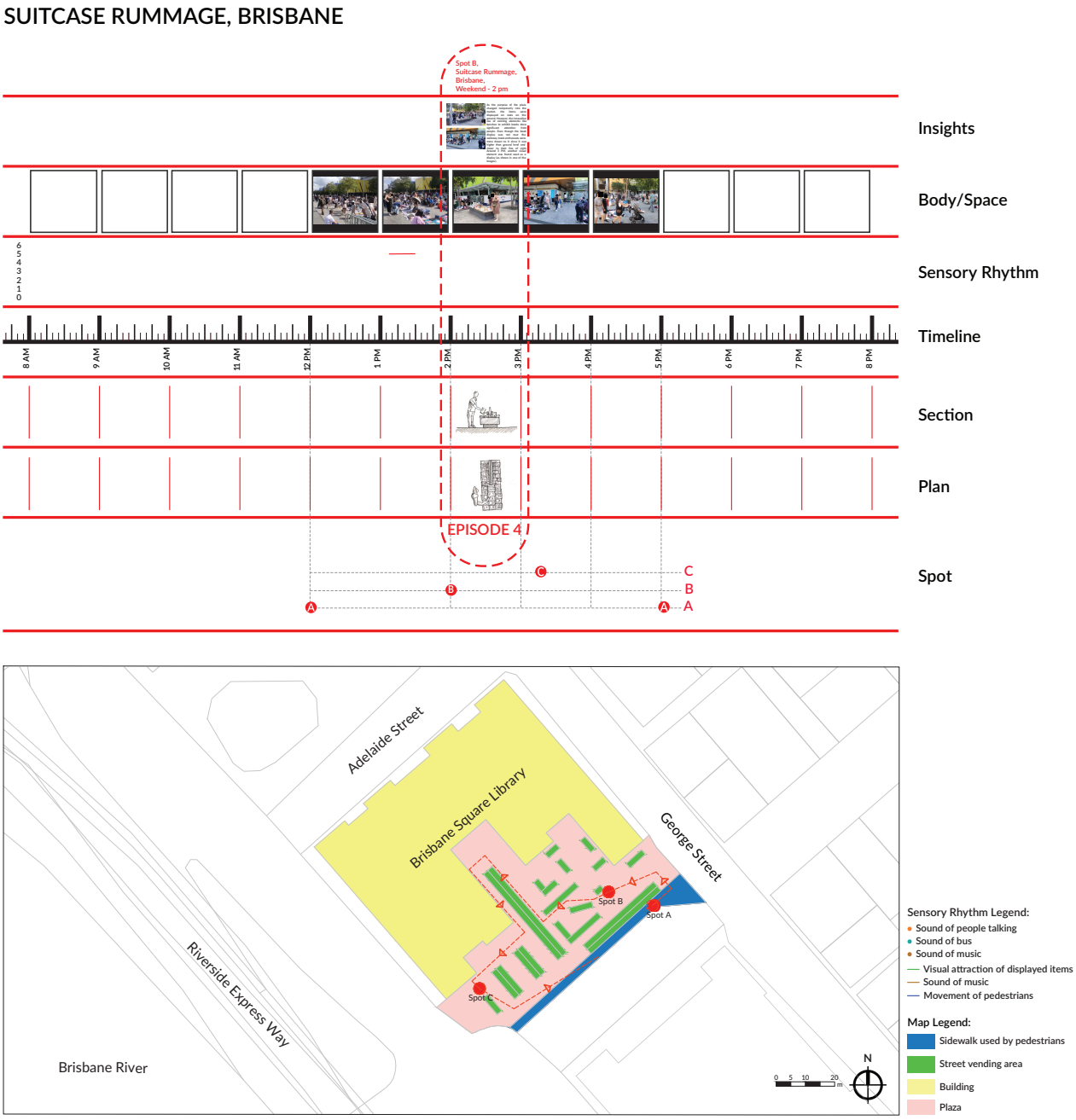


Figure 6. Sensory rhythms diagram, Suitcase Rummage, Brisbane (weekend).

4. Findings

4.1. Episode 1: Sitabuldi Market Road, Nagpur

Figure 7 illustrates the findings of the detailed observation of Spot B at noon. The marketplace was quite dynamic during that time: A video clip in Insights and a photograph in Body/Space show a vendor carrying belts. He approaches passersby while standing on the side of the street to increase the visibility of his goods (Peimani & Kamalipour, 2022b; Voltolini, 2006). There are numerous such vendors, stationary or semi-mobile. The visual data suggest that footpaths are too tight for comfortable pedestrian movement. This

bodily discomfort redirects pedestrians onto the road carriageway. Earlier research similarly suggests that, while street vendors add to the city's liveliness, residents also consider them a nuisance (Lata et al., 2019; Woldeamanuel et al., 2022).

The sensory rhythm shows a soundscape in which mixes loud traffic noises, blaring motorcycle horns, and the murmur of people's conversation in both Marathi and Hindi languages. The vendors' enthusiastic sale pitches break through the ambient noise, punctuating the soundscape. Unlike the traffic noise, this sound is loud but not unpleasant. The Section and Plan reveal vendors' tactics to engage with a larger customer base, e.g., personalised conversations during each encounter. The pedestrians' response is mixed. Many stop to interact with vendors even if they do not purchase anything. The vending locations charted in the Spatial

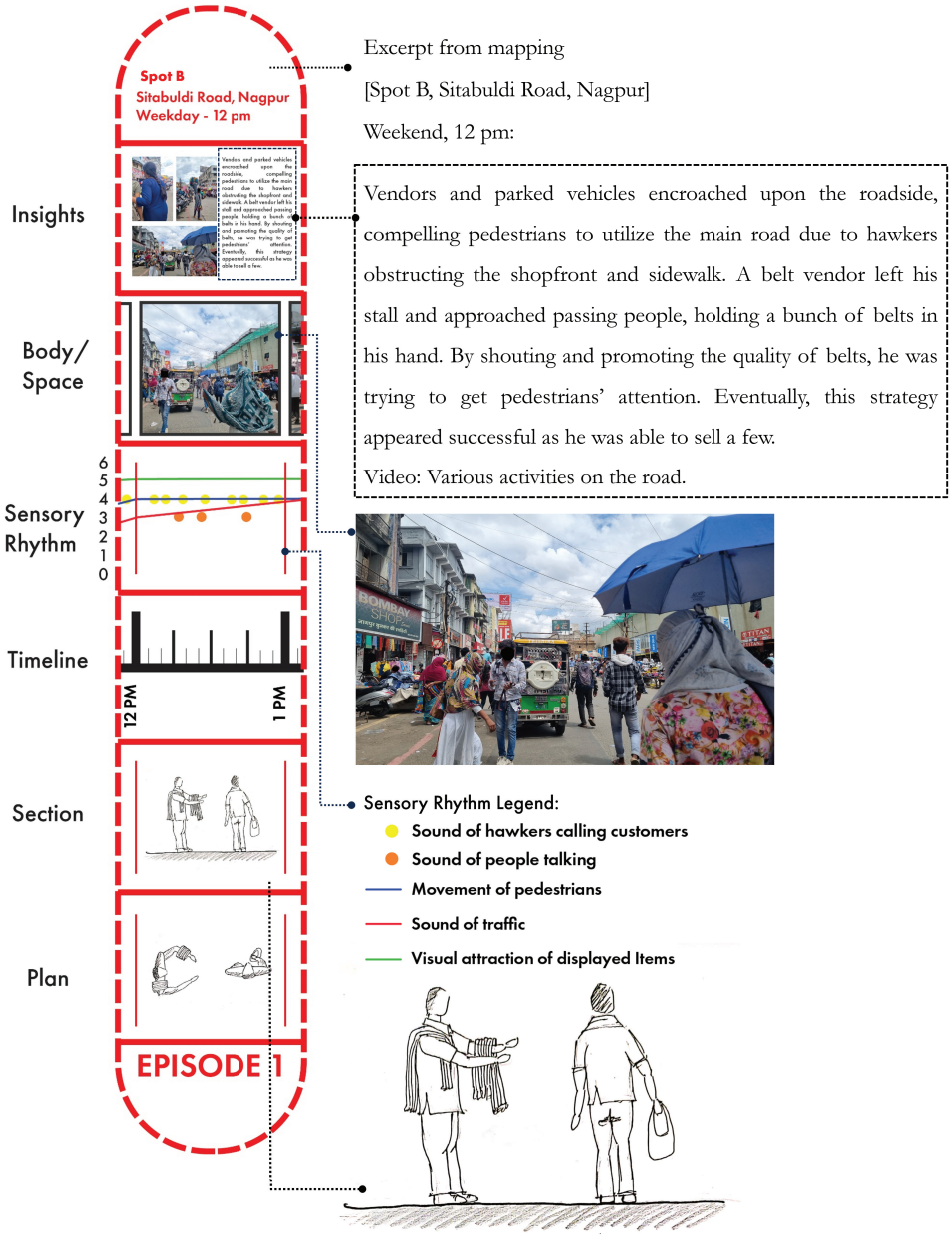


Figure 7. Mapping of Sitabuldi Road, Nagpur (Spot B, noon, weekend, September 2023).

Trajectory (see Figure 3) are populated by older and younger pedestrians of all genders (all adults), whereas vendors are all male, spanning various age groups. No persons with visible disabilities are seen, likely due to limited market accessibility.

4.2. Episode 2: Itwari Market, Nagpur

Figure 8 presents a detailed observation of Spot A at 9 am. The Insights highlight the efficient utilisation of space by shop owners, who stretch their business activity onto the pavements with impermanent objects such as display stands and sunshades. These shop extensions blur the lines between the spaces dedicated to various activities. This is also seen later in the Section. A video clip shows passersby checking out the displays set on the sidewalks while cyclists, motorcyclists, and pedestrians use the same street. A photograph in the

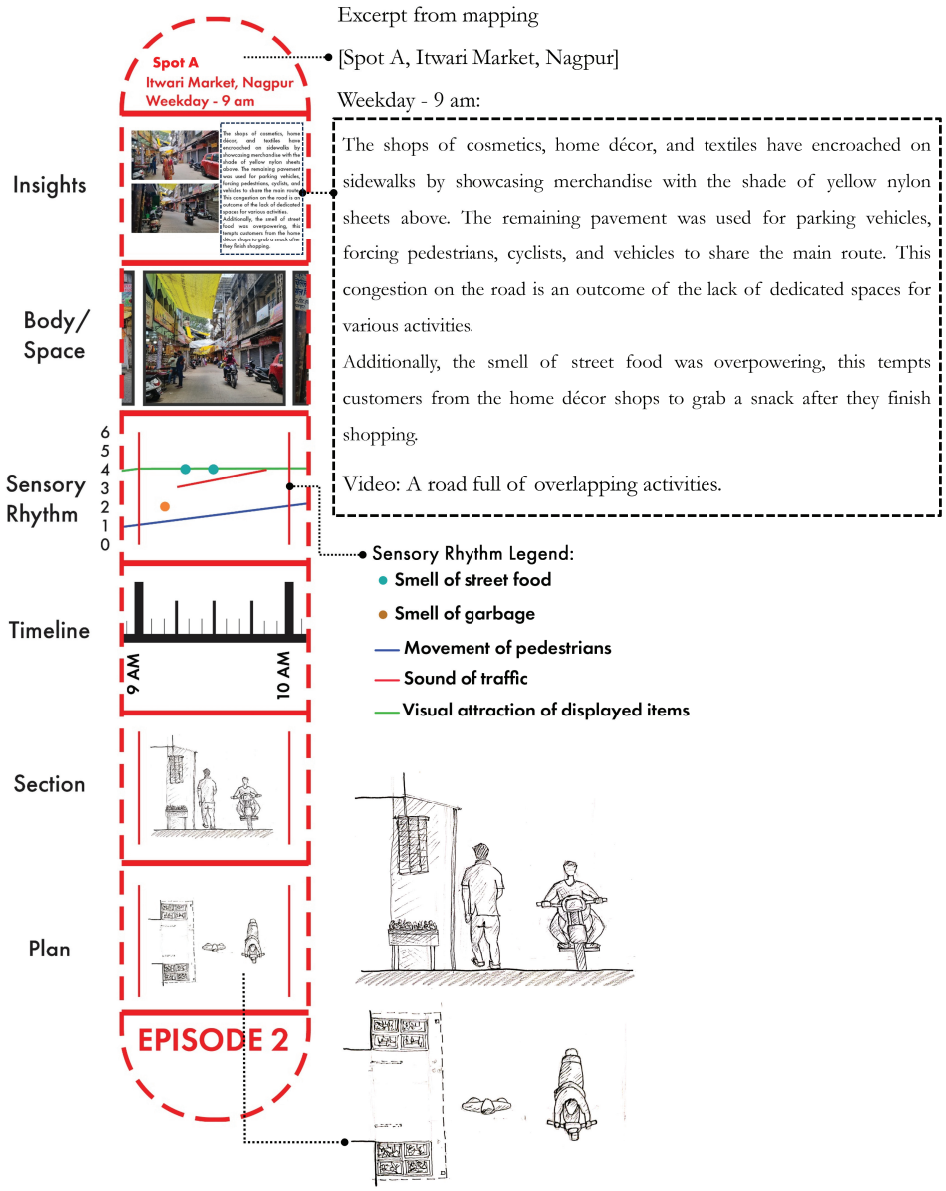


Figure 8. Mapping of Itwari Market, Nagpur (Spot A, 9 am, weekday, September 2023).

Body/Space showcases a somewhat chaotic shared road expanse that accommodates walking, street parking, and riding while vendors approach the sidewalks. This is quite typical in places with a high street vending volume (Acharya & Jagari, 2023; Hagos & Adnan, 2020; Hidayat et al., 2010; Woldeamanuel et al., 2022).

The Sensory Rhythm focuses on the senses of smell and touch. The aroma of street food, which is quite appetising, pervades the market, although food vendors are slightly separated from the main shops. Unfortunately, a noticeable odour of garbage permeates the environment as well, discouraging some people from dining in the area. Regarding touch, the use of yellow nylon sunshades lends a soft feeling to the street. Motorcycle horns are audible, but no one seems bothered by them. The Plan diagram illustrates the density of materials and bodies in the shared space. The day's exhibits are disassembled and brought indoors at night. Visitors and shoppers avoid bringing vehicles onto Itwari Road due to the dense pedestrian crowd. Practically, street vending serves as a motorised traffic calming device. The Spatial Trajectory (see Figure 4) reveals that pedestrians and customers are all adults, comprising all genders. While male vendors dominate, a few female adult vendors are also seen, possibly due to easy access to businesses from upstairs. Again, no people with visible disabilities are observed; like Sitabuldi Market Road, Itwari has limited accessibility.

4.3. Episode 3: Boundary Street, Brisbane

Figure 9 depicts a detailed observation of Spot D at 4 pm. In Insights, a photograph combines textual observations highlighting placemaking and impermanent elements such as a street planter, a bench, and a clothing stand. Body/Space shows a photo of a person walking along a narrow sidewalk space, surrounded by urban design furniture on both sides. The Sensory Rhythm indicates pedestrians' movement and their attraction towards displayed items. The rhythm of movement appears to be relatively slow during this time. Despite obstructions, the clothing display creates an intimate space, appearing to be an extension of the shop. It attracts passersby and reduces traffic noise. A metal shade and colourful signboard offer shelter from the sun, enticing pedestrians to explore.

In Section, individuals are seen engaging closely with the clothing on display. A niche is created where people and the built environment interact closely. Shop owners are known to strategically utilise these tactics to enhance street vibrancy and engage with potential clients (Whyte, 1980). However, occasional congestion hampers pedestrian flow. By 5 pm, shop staff begin to remove the outdoor displays. This increases space on the sidewalk but also reduces vibrancy. Most shops close early in the evening, so the street lacks a permeable, illuminated façade. As evening arrives, the risk of opportunistic theft increases: A woman is spotted stealing displayed clothing. Unhoused people occupy sidewalk spaces, which leads to a feeling of insecurity for some (Carpenter, 2018; Voltolini, 2006). During the day the area is populated by pedestrians of various genders and ages, including children and older adults. The site also accommodates people with disabilities, parents pushing prams, and people riding electric bikes, showcasing inclusivity. The vendors are of various genders as well.

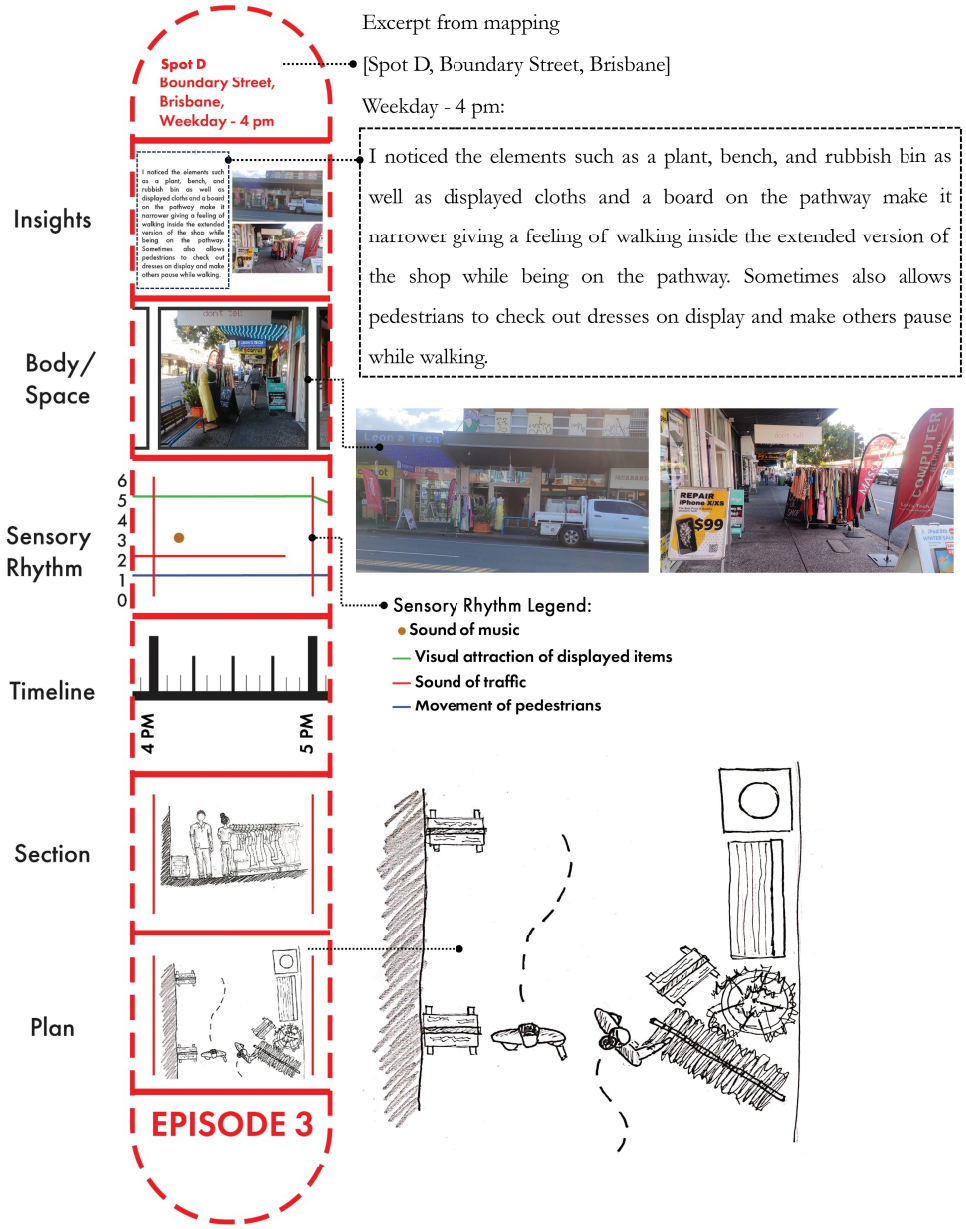


Figure 9. Mapping of Boundary Street, Brisbane (Spot D, 4 pm, weekday, September 2023).

4.4. Episode 4: Suitcase Rummage, Brisbane

Figure 10 shows a detailed observation of Spot B at 2 pm. The Insights highlight the creative use of space during this fortnightly activity. To attract customers, encourage browsing, and capture pedestrian attention even in the more peripheral corners of the market, vendors use clever sit-outs for book displays. This innovative strategy imbues the space with dynamism and purpose. The displays allow for varied usage over time and circumstances. The Sensory Rhythm primarily reflects visual attraction towards book displays, complemented by the sound of conversations in English, Mandarin, and Korean, along with soothing background music. In combination, these pleasant sounds enhance the market's attractiveness. Since no food is served on-site, no distinct smells are captured.

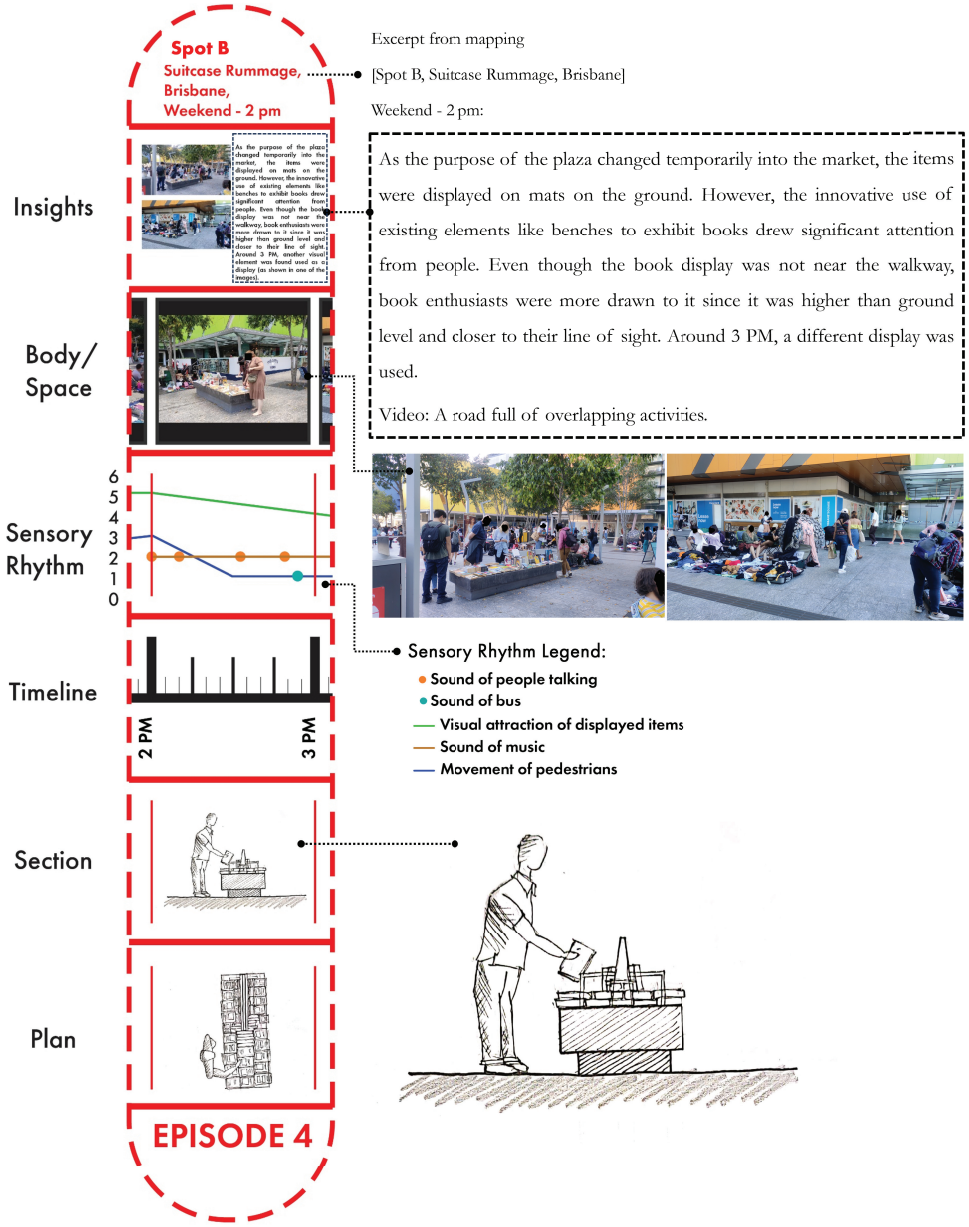


Figure 10. Mapping of Suitcase Rummage, Brisbane (Spot B, 2 pm, weekend, September 2023).

The Section delineates the spatial utilisation of a bench, while the Plan illustrates the density of materials and bodies. Book displays are accessible and readable. The Spatial Trajectory (see Figure 6), which shows the observer's precise location on site, suggests that pedestrians of all ages and genders patronise the market, alongside people with disabilities, adults pushing prams, and people riding electric bikes. The area is quite inclusive. Trendy vendors of all genders add to the vibrant atmosphere. Overall, the vending activities that take place during the Suitcase Rummage contribute to the city's cultural fabric and foster social interactions without harassing passersby (Lakhani, 2021; Torky & Heath, 2021). Because this activity is limited to only two weekends a month, the space appears underutilised and oversized the rest of the time.

5. Discussion

5.1. Comparative Account

This part of the article examines the commonalities and differences in the four sensory rhythms diagrams discussed above. During fieldwork in Brisbane and Nagpur, significant disparities were observed. But in both cases, street vendors influenced pedestrian behaviour through similar cues, including sound, smell, vision, and touch.

In Brisbane, most passersby were drawn to the displays set up by vendors, contributing to the lively atmosphere of the streets. A lively atmosphere, in turn, encouraged passersby to explore, linger, and engage with their surroundings, setting a virtuous cycle in motion. Conversely, in Nagpur, most pedestrians purposefully visited shopping streets to make purchases, often bringing their empty shopping bags. They were observed heading directly to vendors who appeared known to them, rather than walking along the road and browsing. Here, numerous vendors and pedestrians created an impression of extreme congestion. Pedestrians often bumped into one another and had to wait for crowds to thin out before they could access the stalls or stores. Some adjusted their movement patterns or bypassed certain areas altogether due to the high volume of people. A negative aspect was the garbage disposed of in areas too close to the market. This did not deter people from using the space but likely added to their annoyance or posed some health concerns (see Woldeamanuel et al., 2022).

The fieldwork also revealed contrasting pedestrian reactions to the positioning of vendors and the encroachment of the sidewalks by small businesses. In Brisbane's Boundary Street and Suitcase Rummage areas, sidewalk displays occasionally narrowed pedestrian pathways but attracted numerous passersby, thereby enhancing vibrancy. These areas might look drab without the presence of street vending. However, the positive impact of vending activities was limited here by their temporary, highly regulated, and small-scale nature (Voltolini, 2006). The diverse usage of the area indicated a sense of security and inclusivity, but this only lasted during daylight. Accessibility for people with disabilities was generally satisfactory.

In contrast, the pedestrian reactions in Nagpur were more negative. Despite offering convenient access to affordable goods, vendors in Nagpur often caused traffic congestion and reduced pedestrian level of service, resulting in annoyance. This observation is consistent with Woldeamanuel et al.'s (2022) findings in Addis Ababa, which underscore the discomfort experienced by passersby despite the liveliness brought about by vendors. The occupation of sidewalks by vendors not only hindered other street activities and added to foot traffic congestion but also posed challenges for individuals with disabilities (Hidayat et al., 2010). As a result, fewer individuals with walking or vision impairments were present in the Nagpur sites compared to Brisbane, suggesting that the urban environment here is less inclusive. (However, the absence of people with disabilities could also be due to other factors, such as a lower presence in the area or different cultural norms around autonomy.) The absence of female vendors in both Nagpur case studies suggested a gendered environment, potentially limiting safety and further emphasising the need for gender-inclusive urban policies that support equitable participation.

This comparative account suggests that, to enhance its vibrancy, Brisbane needs more locations for street vending activities and more frequent scheduling of activities such as Suitcase Rummage. In contrast, street

vending necessitates better regulation in Nagpur. During the redevelopment of roads, dedicated spaces should be allocated for street vendors (Hagos & Adnan, 2020). Separating some activities such as food and clothes vending might also help alleviate pedestrian congestion and ensure accessibility for all pedestrians.

5.2. Broader Perspective

Empirically, this study corroborates Whyte's (1980) finding that street vending is essential in attracting and retaining people to a public space. In terms of theory, the study supports Lefebvre's notion that people (street vendors, their customers, and passersby in this case) move together in a way that creates a natural rhythm and flow in urban spaces. When strict rules restrict street vending, these natural rhythms are disrupted, and cities are all the poorer as a result (Voltolini, 2006). People indeed experience cities through all their senses; therefore, it is worth researching urban environments through multisensory approaches. A good urban space is enjoyable and balanced in every sense: touch, movement, smell, sound, taste, and sight.

6. Conclusion

This comparative study offers interesting insights. Brisbane, Australia, exemplifying the Global North, illustrates a burgeoning trend toward encouraging street vending, albeit in a highly regulated manner. Here, further initiatives are needed to ensure vibrancy in urban spaces. Conversely, Nagpur, emblematic of the Global South, illustrates India's deeply entrenched and bustling street vending culture. While positive, this also poses challenges such as pedestrian congestion, compromised health and safety, and limited accessibility. Policy interventions should aim to create and sustain dynamic yet comfortable and inclusive urban environments. The following proposals can be adopted in a variety of cities, with necessary adjustments to accommodate specific contexts, street vending cultures, and pedestrian dynamics.

In Global North cities, promoting more street vending activities is recommended, with fewer regulations and less rigid timeframes (Lakhani, 2021; Torky & Heath, 2021). This approach will help maintain vibrancy and ensure safety in urban spaces, especially after business operating hours. While shop displays and café tables might narrow the sidewalks, this trade-off might be acceptable if the result is an increase in street activation and pedestrian volume. This recommendation stems from Jacobs' (1992, as cited in Woldeamanuel et al., 2022) conception of urban sidewalks as hubs of communal exchange rather than mere circulation belts. The installation of noise and visual buffers between sidewalks and carriageways (e.g., tree rows or tall shrubs) is recommended to mitigate the various types of pollution resulting from traffic and to provide a conducive environment for pedestrians to shop and interact with vendors and each other.

In Global South cities, addressing street vending in traffic analyses and establishing dedicated spaces for vendors is paramount (Hagos & Adnan, 2020). Vending zones should be equipped with amenities such as seating areas, waste bins, and restroom facilities, helping to maintain cleanliness and hygiene and enhancing the overall experience for vendors and customers alike. Expanding sidewalk space is also necessary to allow for a more comfortable and accessible environment for both vendors and pedestrians, reducing congestion and ensuring safety (Architizer, 2023). In some places, partial pedestrianisation or banning of private off-street vehicle parking during market hours (with exceptions granted to residents) may be advisable. To make the streets accessible for all, universal design principles should be applied whenever market upgrading works are carried out (Zheng, 2025). Importantly, local planners should actively engage and

collaborate with stakeholders—vendors, shop owners, pedestrians—to better understand and address their needs. To the same end, future research could adopt participatory methods, including interviews and surveys of these stakeholders. The ultimate planning goal is to strike a balance between functionality, vibrancy, and pedestrian accessibility.

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Conflict of Interests

The authors declare no conflict of interests.

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