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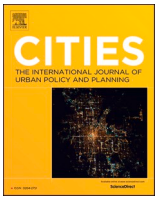

Self-built infrastructure interventions to (un)walkable streets: Pedestrian accessibility, safety and enjoyment in a neighbourhood in Accra

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ABSTRACT

This paper investigates the role of self-built infrastructure interventions in shaping pedestrian perceptions. The paper expands on the Oviedo et al. (2021) framework for critically understanding walking in Sub Saharan Africa, proposing an analytical approach to examine the spatial relationship between self-built interventions to the walking environment and the perceptions of diverse pedestrians. Using Accra New Town, a neighbourhood in Accra, Ghana, as case study, the paper examines whether recognising self-built public space amenities in a context of fragmented, limited, and unequal infrastructure provision may contribute to cities' long-term objectives for sustainable development. Acknowledging self-built modifications could guide policies attuned to localized needs, reinforcing long-term equitable infrastructural development. Through geolocated structured interviews, spatial analysis and photographic records, our findings show the widespread presence of self-built infrastructure that adapts public spaces to navigate the existing risks and limitations of the built environment. Some of these interventions address the need for basic pedestrian infrastructure, such as speed bumps or streetlights, whereas others are temporary adaptations to cover drainages or create shade. Our analysis suggests that such environmental interventions are significantly related to the safety dimensions of the walking experience while the connection to enjoyment and accessibility requires further research. These findings emphasize that pedestrians' most pressing challenge is safety and underscore the potential of recognising self-built interventions for more inclusive urban strategies. Although the spatial correlation of the interventions to enjoyment and accessibility was inconclusive, pedestrians' comfort and motivations for walking show the need to understand these dimensions for integrated planning approaches for walkability.

1. Introduction

Urban mobility is most often portrayed in the collective imaginary in terms of vehicles and roads, with automobility being the focus. Although walking is a primary mode of mobility for many urban inhabitants worldwide, pedestrians have historically been overlooked in urban mobility planning (Okyere et al., 2023; Rivas & Serebrisky, 2021). Across the world, urban transport planning and policies have been underpinned by the aim to make mobility faster to reduce cost and contribute to capital accumulation (Hanson, 2003; Hodge, 1990). In African cities, research shows that local urban design has prioritised automobility, with little attention given to other forms of active transport such as walking (Behrens, 2005; Pendakur, 2005). The focus on automobility in urban transport planning in many African countries such as Ghana is related to local political and economic structures that sustain it (Boateng, 2021).

In Ghana, automobility has been highly debated and discussed, particularly regarding safety and congestion. However, the steady increase in numbers of private cars on the road since the 1990s driven by the elite and the middle-class have pulled most investment toward car-centred functional structures (Hart, 2016). These have left a gap in available facilities for safe, accessible and enjoyable walking across the city to which different bottom-up initiatives have responded. This gap is being address by residents of cities building modifications, some

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addressing the need for basic pedestrian infrastructure, others facing everyday challenges such as covering drainages or creating shade.

This paper examines how self-built material interventions to the walking environment influence residents' accessibility, safety, and enjoyment when walking to economic and leisure activities. Applying an adaptation of the framework of walking in unwalkable cities proposed by Oviedo et al. (2021) we explore the walking experiences of diverse pedestrians in the three dimensions of walking, accessibility, safety, and enjoyment. The aim is to identify the association of material interventions built by residents to the experience of pedestrians. The paper recognises the position of walking is the most sustainable mode of mobility, and its potential as a catalyst to achieve multiple SDG targets (Brand et al., 2021; Hérick De Sá et al., 2017) and its contributions to road safety (Boateng, 2021), good health (Zapata-Diomedi et al., 2017) and wellbeing (Calvert et al., 2019; Ziegler & Schwanen, 2011). However, to harness the potential of walking being the main transport mode of urban residents in the world it is necessary to overhaul the built environments that have been predominantly shaped by the priority of automobility.

This research builds on the growing body of empirical evidence highlighting the neglect of pedestrians in urban areas where walking, despite being the primary mode of transport, is often rendered a burden and a necessity due to inadequate mobility infrastructure (Behrens, 2005; Massingue & Oviedo, 2021; Oviedo et al., 2021). To advance understanding of these "unwalkable" cities, this study examines the relationship between walking as a daily mobility strategy and the material interventions and practices developed by residents in response to the lack of governmental investment in public space and transport infrastructure. Using the neighbourhood of New Town in Accra, Ghana's capital city, the paper focuses on the interplay between these adaptations of the urban landscape and walking as the dominant mobility practice of most residents. In Ghana, sidewalks are unequally distributed and poorly integrated into areas with high pedestrian traffic (Abane et al., 2019), pedestrian road accidents constitute almost half of the road fatalities (Obeng-Atuah et al., 2017).

Our analysis is underscored by the recognition that intersectional social identities entail differential mobility practices, experiences, and perceptions (Doherty, 2021; Hanson, 2010; Lecompte & Juan Pablo, 2017; Levy, 2013; Loukaitou-Sideris, 2016; Mella Lira, 2019; Salon & Gulyani, 2010). Oviedo et al.'s (2021) study about walking conditions, practices and experiences in a deprived settlement in Freetown (Sierra Leone) called Moyiba, highlighted the role of collective and individual infrastructure interventions in enabling pedestrians to navigate the walking environment. Inhabitants intervened in their neighbourhood's empty or abandoned areas to build football fields (accessibility), bring light to footpaths (safety and security), and provide shade (enjoyment). The selection of Accra New Town as a case study is aimed to bring forward the implications of the non-governmental production and adaptation of infrastructure in a consolidated neighbourhood close to the city centre in contrast to the previous more peripheral case study of Moyiba.

In the following sections, we introduce the literature on walking conditions, experiences and practices in unwalkable cities, informal interventions, and infrastructure production in urban mobility. Following, we present the methodology and context of the case study. The research results and discussion are structured around the relation between the interventions to the walking environment and the three dimensions of walking: accessibility, safety, and enjoyment and how these experiences and practices change for pedestrians with diverse social identities based on age, gender, and economic conditions.

2. Everyday walking environments, practices, experiences, and infrastructure interventions: a review of the literature

A recent literature review shows abundant literature linking walking in cities and planning in the field of walkability, focusing on the attributes that influence decisions to walk and the quality of walking (Tight, 2022). These studies are focused on incentivising physical activity and shape travel choice, however, the evidence about the material conditions that improve the quality of walking have fallen short to inform transformative planning and infrastructure interventions in contexts where the majority already walk to access most places but do so enduring high-risk conditions. In these contexts, walking for transport represents a low but growing percentage of transportation studies (Sagaris et al., 2022), as transportation is usually thought of as an activity mediated by a vehicle and not just our bodies. In Africa, the literature has been focused on road safety responding to the high number of road traffic deaths. Despite low motorisation rates, the continent has the highest road traffic deaths in the world. In Ghana, fatalities due to road accidents have been growing in the last two decades, reaching a 15 % increase from 2008 to 2019 (Dotse, 2019). Accordingly, research about walking as active travel in these cities is skewed toward road safety concerns (Amoako et al., 2014; Obeng-Atuah et al., 2017; Obeng-Odoom, 2010; Oyeyemi et al., 2012). The findings about the political economy, design and infrastructural conditions that contribute to road accidents and fear need to be expanded for an integrated view of infrastructure development for walking as a mode of transport.

To contribute to a more comprehensive understanding of possibilities for infrastructure interventions that improve the walking conditions of diverse individuals, that recognises the role of residents in shaping public spaces, we build also on scholarship highlighting the ingenuity and improvisations of everyday urbanism (Okyere & Kita, 2016; McFarlane & Silver, 2017; Simone, 2010). Concerning other urban infrastructures, the literature about urban informality (Bhan, 2019; Marx and Kelling, 2019), incremental infrastructure (Silver, 2014), people as infrastructure (Simone, 2004) and socio-technical dispositifs (Jaglin, 2015) has shifted the entry point of planning to the actors, tools, technologies, organisations and dynamics that adapt and shape the urban environment filling the gaps and adapting, scaling and reshaping the infrastructure and services produce by the state. Knowledge about individual, collective and community infrastructure interventions to shape the walking environment is scant, except for Oviedo et al.'s (2021) findings about the work of the inhabitants of a hill settlement in Freetown to adapt and improve the infrastructure for walking and Loor and Evans (2021) analysis of vulnerabilities and value of footpaths in a peripheral settlement in Quito.

In this section, we focus on these two strands of literature, the one that has advanced the understanding of walking as an active - often captive - transport mode and studies about the infrastructural interventions that adapt and reshape the built environment that pedestrians use.

2.1. Walking as a mobility strategy: accessibility, safety, and enjoyment

Recent research in cities where walking is a key mode of urban mobility, particularly for low-income households (Behrens, 2005; Bryceson et al., 2003), has shifted focus from influencing travel behaviour to addressing equity (Dada et al., 2019; Oviedo et al., 2021) and policy engagement (Okyere et al., 2023). However, there is limited evidence on how unequal and exclusionary built environments affect walking experiences (Tight, 2022) or how these conditions reflect and reinforce structural and spatial inequalities (Pendakur, 2005; Venter, 2011). Research on the built environment's impact on walking has largely focused on attributes such as land use diversity, traffic conditions, and intersection density, with limited attention to how these features interact with specific demographic factors like age (Oviedo et al., 2021; Sagaris et al., 2022).

In Sub-Saharan African cities, safety, convenience, and functionality emerge as central concerns. Mfinanga (2014) underscores that crosswalk attributes preferred by pedestrians in Dar es Salaam prioritize safety features such as level crossings, traffic police, or speed humps for

speed control. Functional improvements like medians and shaded pathways are valued, particularly on higher-class roads. Safety is emphasized by older adults, women, and those on utilitarian trips, while younger and male pedestrians on recreational trips prioritize comfort and convenience. Similarly, Malambo et al. (2017) highlight the importance of well-designed sidewalks, shaded areas, low traffic volumes, and crime-free environments. Women's safety concerns, particularly regarding crime and poor lighting, significantly impact their willingness to walk, while lower-income groups often rely on walking despite unsafe conditions.

Haregu et al. (2016), studying informal settlements in Nairobi, reveal that inadequate infrastructure—such as poor drainage, lack of lighting, and congested pathways—makes walking physically taxing and unsafe, disproportionately affecting women, children, and the elderly. In Ilesa, Nigeria, Olojede et al. (2017) identify barriers such as the absence of pedestrian facilities, road busyness, and unfavorable terrain, with walking often seen as time-consuming compared to motorized travel. Anciaes et al. (2017) further emphasize disparities, showing that wealthier neighborhoods provide better pedestrian access to jobs and services, underscoring the inequities of walking as a transport mode in urban environments.

The evidence highlights an exclusionary built environments for walking, where inadequate pedestrian infrastructure reinforces inequalities constraining walking to an unsafe, uncomfortable necessity for most urban residents, particularly those in low-income settlements. While these studies identify key elements of the built environment that influence safety, accessibility, and functionality, underscoring the persistent gaps in walking infrastructure provision. In response to these challenges, residents in precarious walking environments often resort to self-built material interventions to adapt public spaces, addressing immediate needs for safety, functionality and enjoyment. The following section introduces what has been studied about these local adaptations that reshape walking environments and define public spaces in view of absent or unfit public infrastructure.

2.2. *Material interventions to the walking environment*

In cities where infrastructure disruption is the norm rather than the exception, the material conditions necessary to perform daily activities are produced, shaped and adapted by individuals, groups, communities or government agencies using personal finances or pooling financial and technical resources together to address immediate needs (Marx & Kelling, 2019; Satterthwaite et al., 2020). Xiao and Adebayo (2020) explore the interaction of commercial actors' interventions in North Lagos in an area where a major transport hub and a vibrant market coexist. The appropriation of the hard infrastructure and the improvised/temporal adaptations represent different capital investment capacities of each commercial actor and create inequalities in the interaction with the material infrastructures and flows of visitors to the market. Focusing on the governance structures of Old Fadama in Accra, Ghana, Stacey and Lund (2016) investigate the role of community-based organisations in mobilising materials and the necessary labour and technical capacities of "numerous small-scale, jack-of-all-trades building contractors" (p. 603) living in the neighbourhood. The authors show how the non-statutory governance structure in this neighbourhood has produced the 'public' space infrastructure such as pathways, bridges and street lighting.

Specifically dealing with urban mobility infrastructures, Loor and Evans (2021) explore the interventions of the inhabitants of a peripheral neighbourhood in Quito to be connected to other areas of the city. The authors argue that rather than being independent material configurations, these constructions are integrated adaptations of the infrastructure developed by the state. Some of these adaptations enable pedestrians to access their destinations in shorter, cheaper, and sometimes more safe trips than the available alternatives. The construction of footpaths builds on ancient local traditions of collective building, changes incrementally and can also vanish shaped by processes in the central city of infrastructural development, urbanisation, reduction of unbuilt spaces and more dense use of land. The temporality and disappearance of the footpaths indicates the incapacity of the inhabitants to safeguard them.

Vahidi & Yan (2016) argue that footpaths organically formed in informal settlements represent a primordial form of pedestrian intervention in the built environment. This organic infrastructure arises through a bottom-up process driven by individual and collective behaviours. The formation of these paths reflects pedestrians' immediate needs for accessibility and convenience, influenced by socio-economic and environmental factors. The study frames these trails as desire lines, as a manifestation of fundamental human interaction with space, forming the backbone of access within settlements in the absence of formal interventions. Following desire lines for urban design is claimed to function as guides to optimise transport systems (Bahbouh et al., 2017), accordingly understanding the interventions of diverse actors to the built environment in relation to pedestrian experiences and practices, could inform policies and planning aimed at configuring a sustainable urban mobility system where active transport modes are at the centre of accessibility.

3. Conceptual framework

To explore walking as a mobility practice, we build on the framework developed by Oviedo et al. (2021) to understand walking as a mode of transport in unwalkable cities. These cities are defined as urban areas where motorization is low but rapidly growing, walking is the primary means of mobility, and pedestrians—predominantly low- and middle-income inhabitants—face precarious and dangerous walking environments. Oviedo et al.'s (2021) framework is based on two pillars.

The first pillar leverages rich evidence about the determinants of walking through observed, reported and perceived subjective impressions of the walking environment. Observed elements refer to measurable characteristics of places that are documented by an external observer or through systematic assessments. Reported experienced attributes reflect pedestrians account of their practices such as their walking path or destinations. Perceived attributes reflect tangible, objective characteristics of the walking environment that individuals describe based on personal experience. These attributes capture individual experiences and interpretations of the walking environment, shaped by psychological, cultural, and personal factors, which may not directly correspond to physical realities.

The second pillar differentiates questions about walking in unwalkable cities from those in places where active transport modes require incentives. This distinction emphasizes two key implications: the equity dimension (Anciaes et al., 2017; Foley et al., 2022; Oviedo et al., 2021; Sagaris et al., 2022) and the sustainable urban mobility opportunity to prevent rising motorization (Oviedo et al., 2022). Walking in unwalkable cities is often a necessity, reflecting systemic inequalities. Unlike urban contexts where walking is incentivized for health and environmental benefits, studies in unwalkable cities must address walking as an essential mode of mobility for low-income populations and takes place under precarious and high-risk conditions, including poor infrastructure, exposure to traffic hazards, and inadequate safety measures, which disproportionately affect women, children, and the elderly.

Accordingly, the framework proposed by Oviedo et al. (2021), and expanded in this study responds to the need to understand walkability beyond urban areas where active travel is incentivized, motorization rates are high, and mobility infrastructure is well-established. Based on an extensive literature review, Oviedo et al. (2021) grouped conditions influencing pedestrians' practices and experiences into three dimensions: accessibility, safety, and pleasurability (Fig. 1). While the structural and behavioural dynamics differ significantly, insights about the relationship between specific built environment characteristics and diverse pedestrian practices, perceptions, and experiences provide a

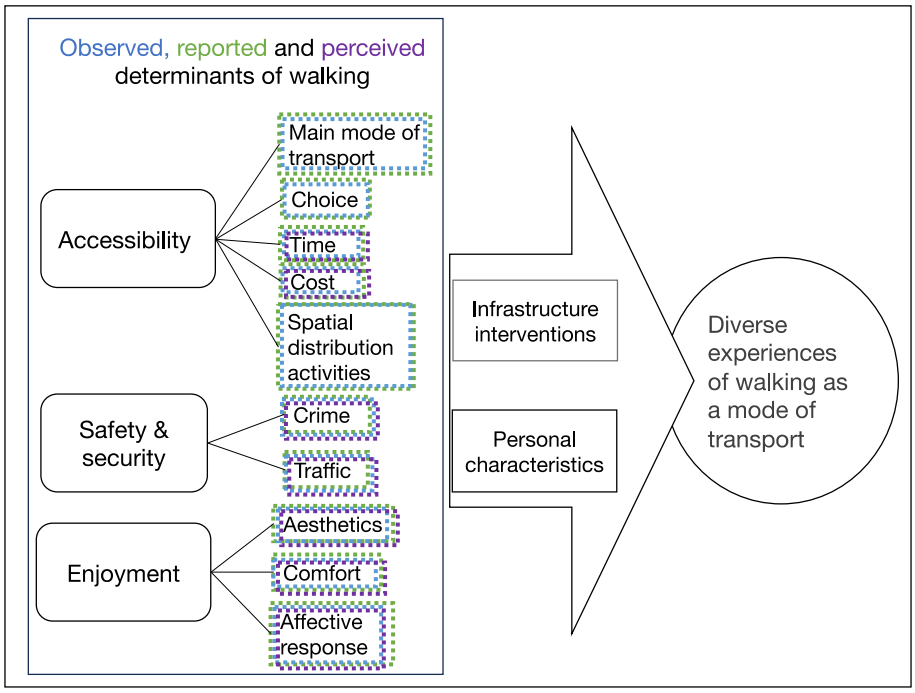


Fig. 1. Walking unwalkable cities framework: walking as a mode of transport experience.

useful foundation for analysing walking in unwalkable cities.

To address contexts where spatial information may be scarce, the framework analysed the three dimensions of walking using a continuum of variables, ranging from observed (independent of subjective perspectives) to reported (based on individual accounts) and perceived (shaped by personal interpretations). This continuum helps generate actionable insights about the material and design characteristics of the built environment while accounting for the relevance of individual perceptions. For example, proven determinants of accessibility, such as proximity to economic, health, or consumption activities, exist at the material end of the continuum. In contrast, motivations for walking as a primary mode of transport and associated feelings, such as fear of traffic or enjoyment, are at the subjective end.

This study expands and adapts the framework based on a pilot study in Moyiba, Freetown (Oviedo et al., 2021). The objective-subjective continuum is reframed into three categories for each dimension: observed, reported, and perceived. For instance, within the safety dimension, traffic lights and speed ramps are observed elements, pedestrians can report their experience of accidents of crime, and perceptions of road safety are captured as subjective impressions. This layered approach enables a holistic understanding of walking experiences in unwalkable cities.

In the current version of the framework the accessibility dimension continues to represent elements of the built environment (e.g., distribution of spatial activities) and walking behaviour (e.g., primary mode of transport) related to reaching a destination. Historically, transport literature has focused on motorized modes to analyse accessibility. Building on this theoretical foundation, Oviedo et al. (2021) emphasized connectivity and the location of activities as key influences on pedestrian accessibility. This study proposes three components: time distance (time required to reach activities), spatial distance (distribution of activities and residences), and individuals' motivation for walking. The latter incorporates travel behaviour theories, recognising structural conditions (e.g., availability of transport modes) and individual mobility strategies shaped by preferences, limitations, and cultural values.

Security is explicitly included in the safety dimension as research about pedestrian perceptions shows that risks other than those related to traffic are a key element of the walking practices and experience in unwalkable cities (Arellana et al., 2021). In analyses of crime prevention through environmental design as well as in studies of perception of safety, sufficient street lighting is identified as the main contributor (Park & Garcia, 2019) and poor visibility as the main cause of anxiety (Painter, 1996). With regards to the pleasurability dimension, the pilot study highlighted the limitation of defining as pleasant (or not) the varied affective responses that pedestrians can experience in response to various stimuli during their walk. Therefore, we defined this dimension as enjoyment to represent the conditions that have been identified in the literature to be key stimuli in walking experiences such as noise, pollution, condition of the road (Ma et al., 2021) greenery (Rahm et al., 2021) and the array of feelings that can be experienced, including if the walk elicited an aesthetic experience.

Furthermore, the pilot study about walking in unwalkable cities highlighted an additional feature to understand walking as a mode of transport in contexts of fragmented infrastructure where this form of mobility is the main mode of accessibility. The infrastructural interventions to the walking environment are developed by decentralised agents such as pedestrians, community members, business or residence owners, and street vendors. Some of these interventions are more permanent, requiring technical knowledge and economic resources, while others are temporary. Regardless of their nature, all these interventions influence walking practices and experiences. Accordingly, we introduce a new element to explore the relationship between walking, the built environment, and related practices, particularly in contexts where infrastructure is shaped, adapted, and disrupted by a multiplicity of agents.

4. Context: Accra New Town

Accra New Town is located in the Ayawaso North Municipality in the Greater Accra Region (GAR) of Ghana (Fig. 2). In the 2021 population and housing census, GAR had a population of 5,455,692 of which 2,679,063 were males and 2,776,629 were females. It also has a population density of 1681.3 persons per sq. Km and an average household size of 3.2 (Ghana Statistical Service [GSS], 2021). GAR is the economic hub of Ghana and contributes to about 25 % of the country's GDP (Government of Ghana and World Bank Group, 2017). GAR is the most

Fig. 2. Map of the study context.
(Source: Author's own elaboration using data from Mapbox and Open Street Map)

populous, urbanized, and one of the sixteen administrative regions in Ghana, while the Ayawaso North Municipality forms parts of the 29 local governing units in the region (GSS, 2021). The local governing units which are designated Metropolitan, Municipality, or District depending on a defined population have specified departments responsible for carrying out various development projects to meet the varying needs of local people. For instance, the Department of Urban Roads in the various local governing units is responsible for the provision and maintenance of motorable roads. Accra Newtown was selected from the Ayawaso North municipality as a case study. Walking is an active mode of transport in this urban community, especially for short trips to the markets, school, clinics, religious centres and workplaces. The walking environment is perilous due to the competition for space between walkers, vendors, pedestrians, and drivers (Okyere et al., 2024).

Accra Newtown is a dense, mature community having access to a variety of commercial opportunities as well as vital social facilities, including healthcare and education (UN-Habitat, 2011). Accra Newtown is about 3.3 km away from the central business district of Accra. The community had 58,488 residents as of the 2010 population and housing census (GSS, 2014). The entire municipality is about 2.2 km^2, making it the smallest local governing unit in the country (Ayawaso North Municipal Assembly (ANMA), 2021). Even though there are several people from different ethnic groups in the community, most of them belong to ethnic groups from the northern part of Ghana (ANMA, 2021). Most of the working population (71.8 %) are involved in informal commercial activities. The main route between Accra's Newtown and Circle is a significant road where a variety of economic activities are concentrated, including manufacturing, retail, and the processing of food and wood. Accra Newtown is severely congested with subpar access routes, a high population density, and a high level of informality (ANMA, 2021).

5. Methodology

5.1. Research design

Recent studies about urban infrastructure (Jaglin, 2015; Lawhon et al., 2018; McFarlane et al., 2017; McFarlane & Rutherford, 2008) highlight the need to understand the everyday practices, social relations and improvised, makeshift, incremental material interventions that work to enable urban daily routines in the context of inadequate and unequally distributed essential services like sanitation and mobility. In this research we focus on the visible material adaptations of public space and their relationship with the experiences of pedestrians with diverse sociodemographic and economic characteristics. This relationship is explored in New Town through the three dimensions proposed in the framework: accessibility, safety, and enjoyment using a mix of observed, reported and perceived variables. We apply a mixed method approach in three stages of primary data collection: i) documenting the walking environment: mapping of key characteristics of the built walking environment in New Town, ii) understanding pedestrian experiences and perceptions: an extended version of the geolocated questionnaire developed in the pilot study in Moyiba, Freetown (Oviedo et al., 2021) about walking in unwalkable cities iii) photo-documentation of the interventions and the configuration of the walking environment. In the first two phases of the study, we used an online map-based participatory mapping tool (Maptionnaire). The photo-documentation was developed with a smart phone to geolocate each of the pictures. During the three stages of field work, the research team had debriefing sessions which led to the inclusion of visual analysis and to expand some dimensions of the questionnaire. The data analysis process was iterative, returning to the mapping of the built environment characteristics with the photographs taken by the research team and using the images as guidance to analyse the questionnaire and design the spatial analysis. Deploying this mix of methods, we accessed different aspects of the relation between self-built infrastructure and pedestrians' experiences.

5.2. Data collection procedures: mapping the walking environment, walking experiences and perceptions of individuals with diverse sociodemographic and economic characteristics

The first phase of the data collection exercise involved the objective mapping of the walking environment and conditions. Before the commencement of this exercise, a reconnaissance visits were made to the community to meet the community leaders, and to officially introduce the research team to the community. During these visits, the purpose of the study was explained to the community leaders, and upon their understanding of the research objectives, a walking tour of the major walking routes in the community was conducted. During the tour, an inventory of the walking routes and conditions were made. In the end three graduate research assistant were recruited and trained to assists in the structured observations and mapping of the road and walking conditions. At the end of the objective mapping exercise, the walking

conditions were mapped for a randomly selected 104 varying road segments (i.e. arterials, locals, cul-de-sac, footpaths, sidewalks, and bridges) around 100 m long, around the main Accra New Town road. The graduate research assistants further conducted a general check of the roads on dimensions such as type, surface, traffic volume, and noise from traffic. The conditions of the walking environment mapped by the research team are distributed along the three dimensions (i.e. accessibility, safety and security and enjoyment) of the conceptual framework adapted from Oviedo et al. (2021). Table 1 provide the details of the road conditions, and the conditions of the walking environments.

The second phase of the data collection exercise involved 98 georeferenced structured interviews with pedestrians in the community using the street intercept sampling method. A street intercept interview is a face-to-face interview with a randomly selected person who is approached on a street or in an open space to get a first-hand information on an issue (Ojo et al., 2022). The purpose of the structured interviews was to understand pedestrian experiences and perception of the walking environment. The structured interview questionnaire was comprised of three parts. The first part identified socioeconomic and demographic characteristics of the respondents: age group, sex, religion, education, occupation and civil status, access to essential services, housing condition and income. After identifying the individual characteristics of the participant and the block where they live, the second part of the structured interview questionnaire was focused on elucidating why, when and for how long they have walked, the emotive experiences they encounter while walking and the perceptions of the walking environment in Accra New Town.

Table 1
Road characterisation and conditions of the walking environment.

Conditions	Variables	Obs.
Type	Arterial	10
	Local	17
	Cul-de-sac (semi-private)	15
	Footpath	62
	Sidewalks	69
	Bridge	4
Surface	Asphalt-concrete	28
	Dirt	34
	Gravel	0
	Mixed concrete/dirt	39
	Mixed dirt/gravel	4
Traffic volume	Low (1–10 vehicles)	57
	Medium (11–20 vehicles)	9
	High (21+)	6
Noise from traffic	Not noticeable	42
	Noticeable	37
	Very noticeable	6
Accessibility	Economic activity:	
	Banks	7
	Commercial activity	85
	Market centre	4
	Street vending	32
	Small services business (artisanal, household enterprise)	102
	Major social facilities:	44
	Bus stop	5
	Water station	0
	Schools	16
	Places of worship	16
	Recreation and leisure	9
Safety & security	Pedestrian crossings	2
	Speed ramps	14
	Obstacles, risks	46
	Uncovered drainage	26
	Public light	42
	Low (1 to 3)	40
	Medium (4–6)	2
	High (6 or more)	2
Enjoyment	Trees	8
	Rest stops	2
	Trash on the street	7

Due to the nature of the sampling procedure, only pedestrians who were willing to share their views on the research questions were interviewed. Respondents were also assured of the anonymity and confidentiality of their responses. There were no allocations for the selection of a specific sample size along the various walking routes due to the difficulty in estimating the total populations of pedestrians along these walking routes. A convenient sample technique was therefore used to select the 98 pedestrians along the various streets and walking routes. Sample questions that were asked during the interviews were: i) How do you always or often feel when you are walking? ii) Is walking the main way you get around the city? and iii) Are you comfortable walking within the community? Finally, photographs of the sampled streets and walking routes during the day and night were taken to further understand the interventions mapped and the conditions for walking. Table 2

Table 2
Questionnaire interviews and classification of responses.

Questions and classification of responses	Answers
Is walking the main way you get around the city?	98
Almost always true	24
Usually true	27
Occasionally true	29
Usually not true	16
Almost never true	6
Please show in the map your walking path to work or leisure activities	98
You walk to get to places because:	
Accessibility - There is no other form of travel	20
Cost - Public transport is too expensive	25
Time - Walking is the most efficient way to get to places	39
Choice - You prefer to walk	41
How do you always or often feel when you are walking?	98
Positive feelings: happy, elated, pleasant	50
Negative feelings: frightened	27
Angry	27
Disgusted	35
Are you comfortable walking within the community?	
Comfortable	43
Not comfortable traffic related issues	39
Not comfortable walking environment issues (e.g. rubbish, space available, no proper walkways)	10
Not comfortable crime related issues	1
Referring to those emotions that you feel often or always when walking, could you explain more?	
Reference to traffic	13
Reference to crime	6
Reference to enjoyment	14
Neutral (okay)	14
Reference to the walking environment not being good	10
Will you say (general view of the respondents) you are comfortable walking within the community	
Traffic Inconvenience	23
Crime	6
Enjoyment	18
Inconvenient walking conditions not referring to traffic or crime	26
Neutral (okay)	20
Do you pay attention to your surroundings when you are walking and why?	
Yes, for road safety	73
Yes, for fear of theft	19
Yes, to enjoy the landscape	1
No	3
When you change route, why do you do it	
Safety traffic and crime	17
Shorter, more convenient route	40
Could you show the streets or paths you would usually avoid when walking?	100
From the areas you usually walk, could you show which paths/ streets you perceive as negative?	45
Destinations of walking trips	
Sports	51
School	61
Worship	71
Rest stops	45

shows pedestrian subjective assessments of the walking routes in the community.

Fig. 3 presents the profile of the respondents that completed the geolocated structured questionnaires. The respondents consisted of 65 % women, and the remaining were men. Half of the respondents were between the ages of 26 and 45 years old with 18 % in the 18–25 age bracket and 19 % in the 46–55 bracket. For close to half of the participants had secondary education as their highest level of education (49 %), 70 % indicated that they can read and write. A third of the respondents (30 %) were working in the services sector, followed by trade (25 %) and most of the sample has access to piped water (75 %) and electricity (87 %). Half is renting, and a quarter own the house where they live. A third of the sample declared to 'always' have more than enough income to cover basic needs (bills, food, and transportation) and 14 % said to never have had insufficient income for the basic needs.

5.3. Data analysis: spatial association of interventions and walking dimensions

We tested the spatial association between the self-built interventions mapped and the components of the three dimensions of walking in the framework. The test combines 1 to k sets of layers per theoretical dimension (TD) of the walking experience (see Table 3), where k is the maximum number of layers per TD. We tested the spatial association between the set of interventions ($n = 51$) and 1023, 511and 63 possible combinations of layers for the accessibility, safety and enjoyment dimensions, respectively. The spatial association statistics (Good, 2005) is based on a measure of proximity between the intervention layer and the set of combined layers from a specific TD. If the set of interventions and the TD follow a process of joint-distribution, and so they are close to each other, the distance between them will be close to zero (Haining, 1990).

We estimated the quadratic Euclidean distance between each of the elements of the intervention and TD (see Fig. 4) to tests the null hypothesis (h_0): no relationship between the distribution of interventions and the TD, assuming that the assignment of intervention or TD is perfectly random, conditional on the fact that each of them has a set number of occurrences. There are C (number of interventions + number of TD, number of interventions) distinct such assignments. For each assignment there is a value for the distance between any configuration of the intervention layer and the TD yielding a distribution of C numbers. There is evidence of spatial association when the value of the distance between any configuration of the intervention layer and the TD layer is smaller than most of the numbers in the distribution. To infer if the data deviates from spatial randomness we simulated the full distribution of C

Table 3
Elements of the theoretical dimensions to analyse walking.

Accessibility	Safety	Enjoyment
Place of worship	Drainage	Congestion
Economic activities	Obstacles	Out of breath
Leisure & recreation	Path to avoid	Rest stops
Schools	Negative path	Smell
Sanitation	Public light	Trash
Sports	Speed ramp	Trees
Rest stops		

allowing for 10,000 assignments of the number of interventions + number of TD into fixed number of interventions and fixed number of TD.

6. Findings: walking conditions, experiences, practices, and interventions

6.1. Characterisation of the walking conditions

The characterisation of the walking conditions in the sampled area of Accra New Town points to the precarious walking conditions and the pervasive development of infrastructure interventions to navigate the existing risks and limitations of the built environment. Out of 63 audited foot paths, none was paved, the majority being a mix of concrete and dirt (38) and dirt (20) (Fig. 5). Despite being narrow, unpaved streets, half of the audited footpaths had some level of traffic, from 1 to 10 vehicles and a quarter presented noticeable noise from traffic. Accordingly, dust, pollution, and traffic were consistently part of pedestrians' responses when asked about their experience walking around New Town. The sample of arterial roads (New Town Rd.) mapped have drainage, sidewalks, and streetlights. However, the drainage has long uncovered stretches, most of the sidewalk (60 out of 69) is blocked by cars or other activities like vendors or signs, and while one side of the road has at least one streetlight every 100 m, the other side has just a few streetlights spread around every 500 m with extended dark stretches during the night with the light coming from business on that side of the road (Fig. 7). Accordingly, respondents refer to the lack of space as a source of discomfort and coverage of drainages was the most recurrent self-built intervention reported by the pedestrians interviewed. Local roads are primarily of asphalt-concrete (13), and the surface of a quarter is dirt. Traffic levels on these roads are from 1 to 10 cars in the majority (12) and medium in a third of the sample, and in two-thirds the noise from traffic is noticeable.

In the sampled area we mapped 52 infrastructure interventions

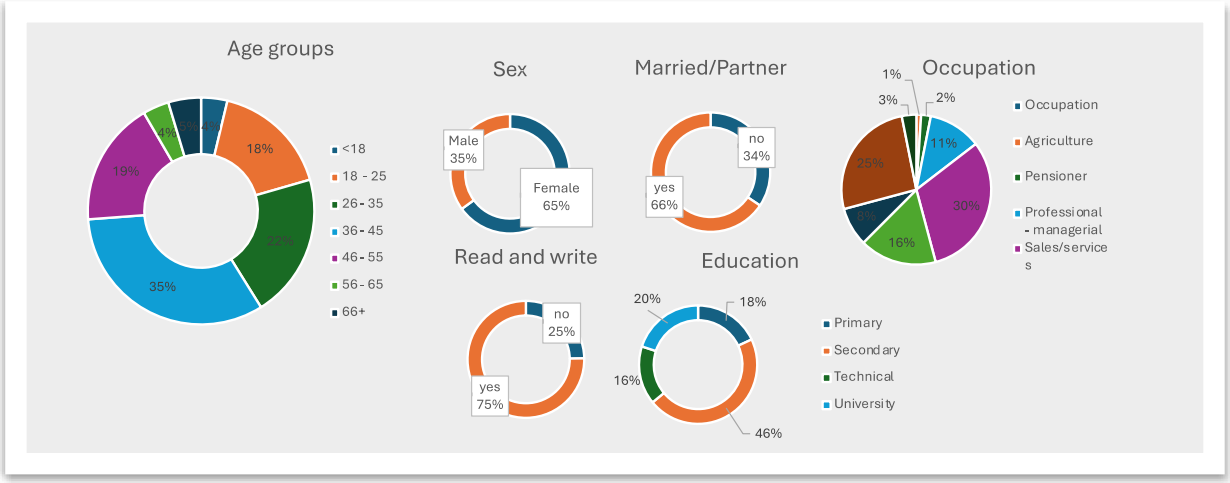


Fig. 3. Demographics and socioeconomic characteristics.

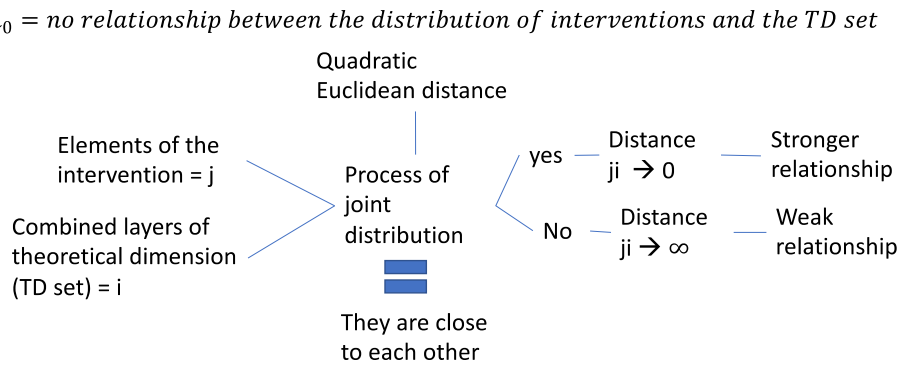


Fig. 4. Test of spatial association.

(Fig. 6) the majority of which have the purpose of covering uncovered drainages. There are also some examples of urban furniture, speed bumps, streetlights, and awnings to cover from rain and create shade. During the documentation of the infrastructure intervention, we also encountered constructions of private use, such as kiosks, commercial stalls, drying rags and porches in areas outside the private dwellings.

6.2. Pedestrian accessibility

This subsection examines how the location of social facilities, economic activities, and road conditions influence accessibility in the area. It highlights how the built environment impacts pedestrians' movement patterns and their reliance on walking as the main form of mobility.

The findings reveal that economic activities and social facilities are concentrated along arterial and local roads, with commercial and food-related activities being the most visible (Fig. 7). The main social facilities mapped in the area were schools and worship buildings (churches and mosques). The most visible economic activity was commercial (banks, printing houses, etc.) and food businesses and vendors of diverse goods on the street. For most respondents (80 %), walking is the primary mode of transportation, often due to its efficiency (39 respondents) or simply because they prefer to walk (41 respondents); less so for its affordability (25 respondents) and not having other alternatives (20 respondents). However, about half of the participants stated they would stop walking if alternative modes of transport were available. The other half, would walk even if they had other options, referring to distance as a key determinant of choosing to walk if they had other options. Proximity, convenience and ease of access due to familiarity with the route are key themes of respondents' motivations to decide their walking routes.

6.3. Safety and security of the walking environment

In the sample area, the built environment conditions for safety, security are minimal (Fig. 8). There is no traffic light or marked pedestrian crossing in the area, only the arterial road has at least one streetlight per block, most of the mapped drainage is uncovered, and all the roads mapped have at least one obstacle, risk or impediment marked. From the perspective of pedestrians, the paths to avoid are widespread with some concentration on the arterial road (a fifth of the reported paths to avoid are on New Town Rd. and an additional 14 % are on Oku St.). Motivations related to safety and security are predominantly related to crime rather than road safety with reference to changing conditions depending on the time of day and linking their avoidance of path to the lack of light at night and presence of crime.

6.4. Pedestrian enjoyment features

The enjoyment dimension shows the perception of pedestrians of congestion happening almost exclusively in New Town road, the main arterial road analysed (Fig. 9). Although there are trees visible from the streets, those that are part of the public space of the sampled roads are scant. The perception of comfort walking around New Town is split, with 46 people saying they are generally comfortable walking around the neighbourhood and 48 manifesting dissatisfactions in general, and specifically with the lack of space and the noise. Mentions of poor conditions of the roads were related by the respondents with the enjoyment of their walk, with comments about too narrow paths, lack of space due to cars, inconvenience created by motorist, unpleasant smells, and sight from gutters, dust, and trash. Other recurrent explanations to avoid or not use specific streets is the proximity to daily activities and distance from residence. The location of rest stops and out of breath spots reported by the respondents is predominant in the area where the market is (46 %) with 15 % participants getting out of breath in the area north from the market, 13 % close to the arterial road and the rest dispersed West of New Town rd. When asked about places to rest or stop participants referred to two types of stops: a halt in the path to recover physically and stopovers to socialise. In reference to being out of breath, bad smells (8 %), gutters (17 %) and hills (8 %) were the recurrent explanation.

The spatial association between the layers of each conceptual dimension and the spatial distribution of intervention show that there is a weak association between the layers describing the accessibility and enjoyment dimension (Table 4). The elements describing the safety and security dimension are significantly associated with the spatial distribution of interventions. For the layer of accessibility and the enjoyment dimensions, the lowest *p*-values range between 0.1 and 0.2 for combinations of the Recreation, Sanitation, and social facilities layers in the accessibility dimension (4 combinations) and Congestion, Rest Stops, Trash, and Tress for the Enjoyment dimension (8 combinations). There is not enough evidence to reject the null hypothesis of no relationship between the distribution of interventions and the TD of accessibility for most of the elements. The only combination that is strong enough for a 90 % confidence level (0.1 p-value) is sanitation and social facilities (0.109) followed by social facilities on its own (0.123). In enjoyment, there are no combinations with confidence level above 86 %, being congestion and trees (0.141), and congestion, rest stops and trees those the two combinations with the lowest p-values (0.148). For the case of Safety and Security dimension 100 combinations, involving the presence of obstacles, speed ramps and drainage were found significant for the test of spatial association with p-values smaller than 0.2. Thirty-five combinations show a 99 % significance with obstacles, drainage and speed ramps. The same elements are in the twenty-eight combinations with p-value 0.02 and the 30 combinations with p-values between 0.07 and 0.1. For the other elements included in the safety and security theoretical dimension, there is not enough evidence or to conclude that there is a spatial association between path to avoid, negative path and public light and the interventions mapped.

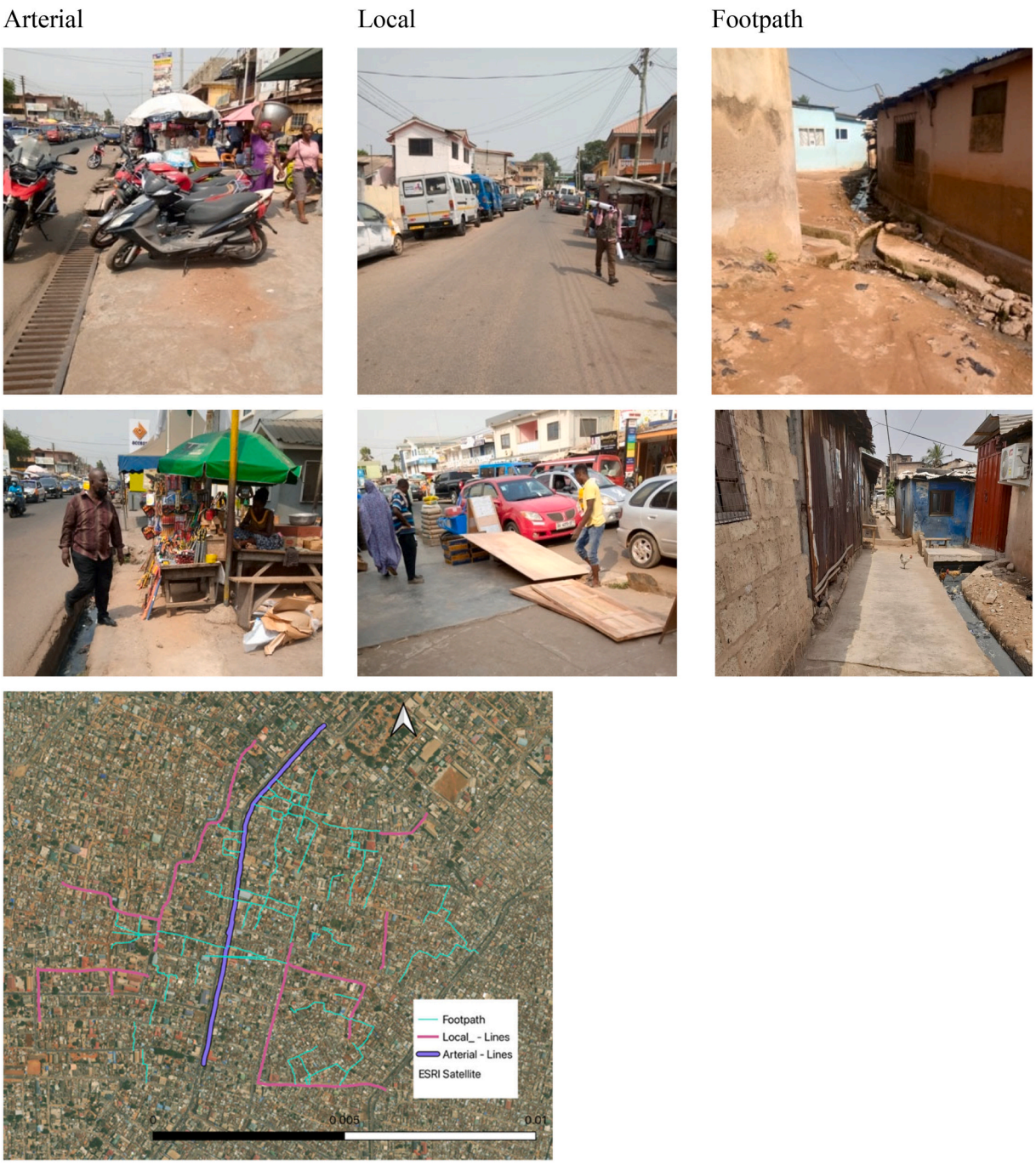


Fig. 5. Audited roads.

7. Discussion

Interrogating the walking practices, experiences, and perceptions of pedestrians in cities where much of the population relies on walking to access their main activities involves addressing questions of equity, policy engagement, and planning. This focus sheds light on the systemic challenges faced by these pedestrians. Similar to other basic urban needs in post-colonial, fragmented infrastructure contexts, the needs of pedestrian accessibility, safety and enjoyment are determined by a built environment and networks of infrastructure in precarious conditions. In response, self-built interventions are developed by individuals and communities attempting to navigate around and address the constraints imposed to them by an unequal and car-oriented urban environment.

In this research, we explored the relationship between self-built interventions in public spaces and the walking conditions in a consolidated neighbourhood of Accra. This study specifically considers pedestrians' perceptions and experiences to understand these dynamics more comprehensively. The spatial association between mapped interventions and the observed and reported elements of walking conditions related to the safety and security dimension of the framework presented in Section 3 was statistically significant. This finding highlights the critical link between self-built interventions and pedestrians' perceptions of safety. However, for the dimensions of enjoyment and accessibility, no significant spatial association was found with the mapped interventions. New Town illustrates the dynamics of self-built transformations in a consolidated neighbourhood near the CBD. Its central location enables individuals and communities to access diverse and less localized destinations for everyday activities, contributing to the dimension of

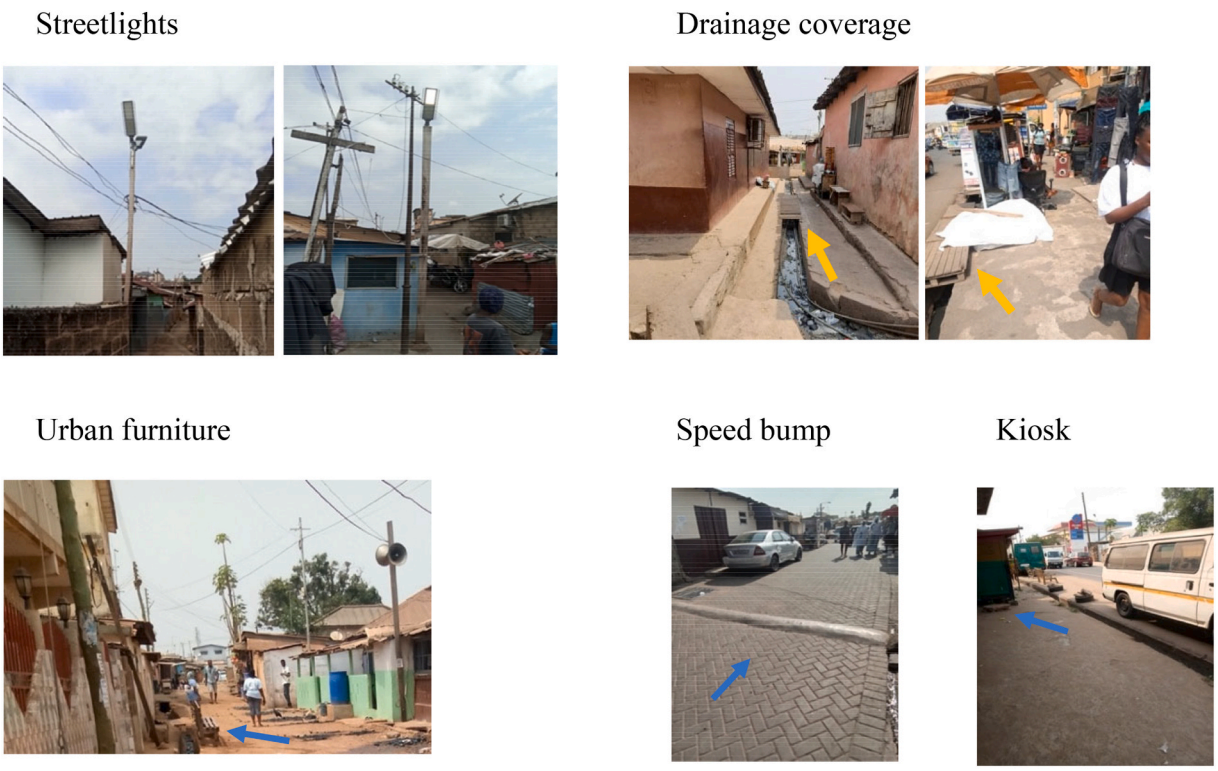


Fig. 6. Infrastructure interventions.

accessibility, even though these activities are not directly connected to self-built adaptations. Unlike Moyiba (Oviedo et al., 2021), a more peripheral and less consolidated neighbourhood where self-built interventions included larger, permanent facilities (e.g., a football field), interventions in New Town tend to be more temporary and smaller in scale. Consequently, their influence on pedestrians' accessibility to destinations is lower. The lack of a statistically significant association between interventions and the accessibility dimension also reflects the dispersed nature of self-built adaptations in the neighbourhood, which are not necessarily located near key economic, leisure, worship, study, or sports activities.

By contrast, the evidence shows a connection between the safety and security dimension and the spatial distribution of the interventions that underscores the reciprocal relationship between pedestrian's experiences and perceptions and the self-built adaptations of public space. On the one hand, the spatial distribution of obstacles reflects a negative relationship between interventions and pedestrians' perception of safety and security. More than a quarter of the obstacles mapped (28 %) are makeshift stalls, and the rationale of pedestrians to dislike and/or avoid a path referred predominantly to fear of crime rather than to traffic. Fear of crime in public spaces is associated with the obstruction of the line of sight, with blind spots or shadows perceived as places where criminal activities could take place (Park & García, 2019). This connection underscores the role of self-built interventions in shaping perceptions of

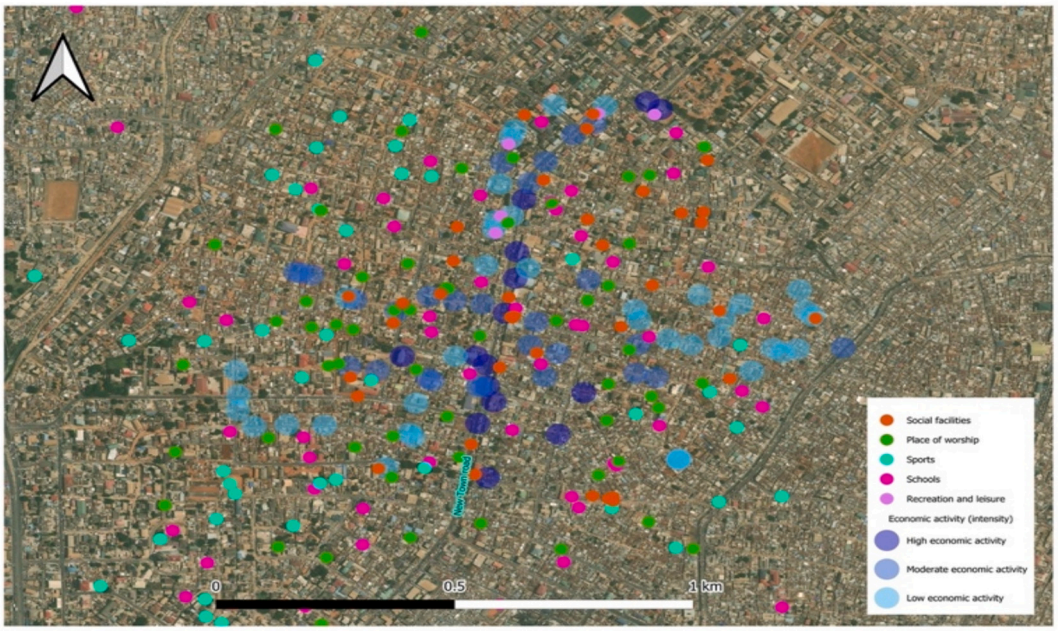


Fig. 7. The walking environment in New Town: Accessibility.

safety, as structures like kiosks or temporary stalls may contribute to such obstructions, thereby heightening fears among pedestrians. Thus, we can infer that constructions such as kiosks are associated with obstacles that heighten perceptions of insecurity. This, however, does not suggest street vendors are responsible for the negative experience of pedestrians. Such a finding elicits reflections about the need to include these actors into the development of public spaces and integrate isolated efforts for adaptation to prevent them becoming an obstacle or a source of negative perceptions for pedestrians. The contributions of street vending as a source of livelihoods for those with few employment opportunities is a further argument in favour of developing strategies for the coproduction of the built environment, particularly in cities where informal markets are an essential part of the economy (Hagos et al., 2020) and a source of affordable goods and services for residents (Wongtada, 2014). Street vendors have also been found to be important to the vitality of urban areas (Sun et al., 2020) and to make streets safer and reduce crime (Meneses Reyes, 2013).

The comparison of these functions of kiosks and other interventions to the cars parked in the few sidewalks identified in New Town and the absence of differentiated spaces for walking cues in another direction to address obstacles and lack of pedestrian space. Attard et al. (2023) findings in three case studies (Bogotá, Freetown and Valetta) point in this same direction showing the tendency in urban planning to prioritize cars creating an unequal distribution of space between modes of transport.

On the other hand, speed bumps and drainages are key features of the built environment that improve pedestrian safety from traffic. Speed is the main cause of collisions between cars and pedestrians leading to a high proportion of injuries and fatalities (Hussain et al., 2019). Regarding drainages, interviewees' opinions about self-built drainage coverage (the most recurrent self-built intervention reported by the pedestrians interviewed) had a positive view of such interventions as a way to reduce infectious diseases, bad smells and helping to avoid falling into gutters. The lack of statistically significant association between public lights can be interpreted as a relation between better infrastructural conditions (i.e. presence of public lights) and less self-built adaptations. Furthermore, no combinations between paths to avoid and negative paths and the location of interventions is a sign that there is not necessarily an association between interventions and areas perceived as unsafe or that the pedestrians perceive as negative. This contributes to the understanding of street vendors not as an obstacle to be removed but as a stakeholder to be considered in the development of more equitable walking environments (Yatmo, 2008).

The high *p*-value for enjoyment limits the interpretation of the spatial association between this theoretical layer and the interventions. A high p-value suggests that the relationship observed may be due to chance, making it difficult to draw conclusive connections between enjoyment and the mapped interventions. However, the association with trees, congestion, waste and rest stops can be understood as in terms of the location of self-built interventions and areas of the public space where there is concentration of activity. First, trees have been proven to be positive elements for pedestrians; higher densities of trees are linked to higher quantities of pedestrians (Sarkar et al., 2015) and more comfort and aesthetic enjoyment (Langenheim et al., 2020). Second, trash can accumulate with passer byers and more commercial activity and congestion (Seco Pon & Becherucci, 2012). This association introduces an element of the built environment that was not considered during the framing of the research: trash bins. Finally, respondents reported motivations to have a rest stop also suggest that the location of interventions is linked to commercial, active areas as the reason given for stopping is to do groceries or buying something (66 %), followed by visiting friends or family and few to get shade and rest.

Pedestrian's responses to the question 'what have you done to improve your walking experience' reflect the use of own resources (power and finance) rather than behavioural changes. This not only highlights the relevance of material interventions. It also connects to findings in literature about informal infrastructure where individuals pool together resources to address urgent needs or those with some extra capital start the process of improvement of the areas adjacent to their properties (Bhan, 2019; Jaglin, 2015; McFarlane & Silver, 2017; Silver, 2014). This finding requires further exploration addressing the process of development of the interventions, the actors involved, and the resources employed.

8. Conclusions

This paper contributes novel empirical evidence about walking in contexts of fragmented infrastructure and low motorisations rates. The process of sampling streets to describe built environment determinants of walking, combined with geolocated interviews of pedestrians,

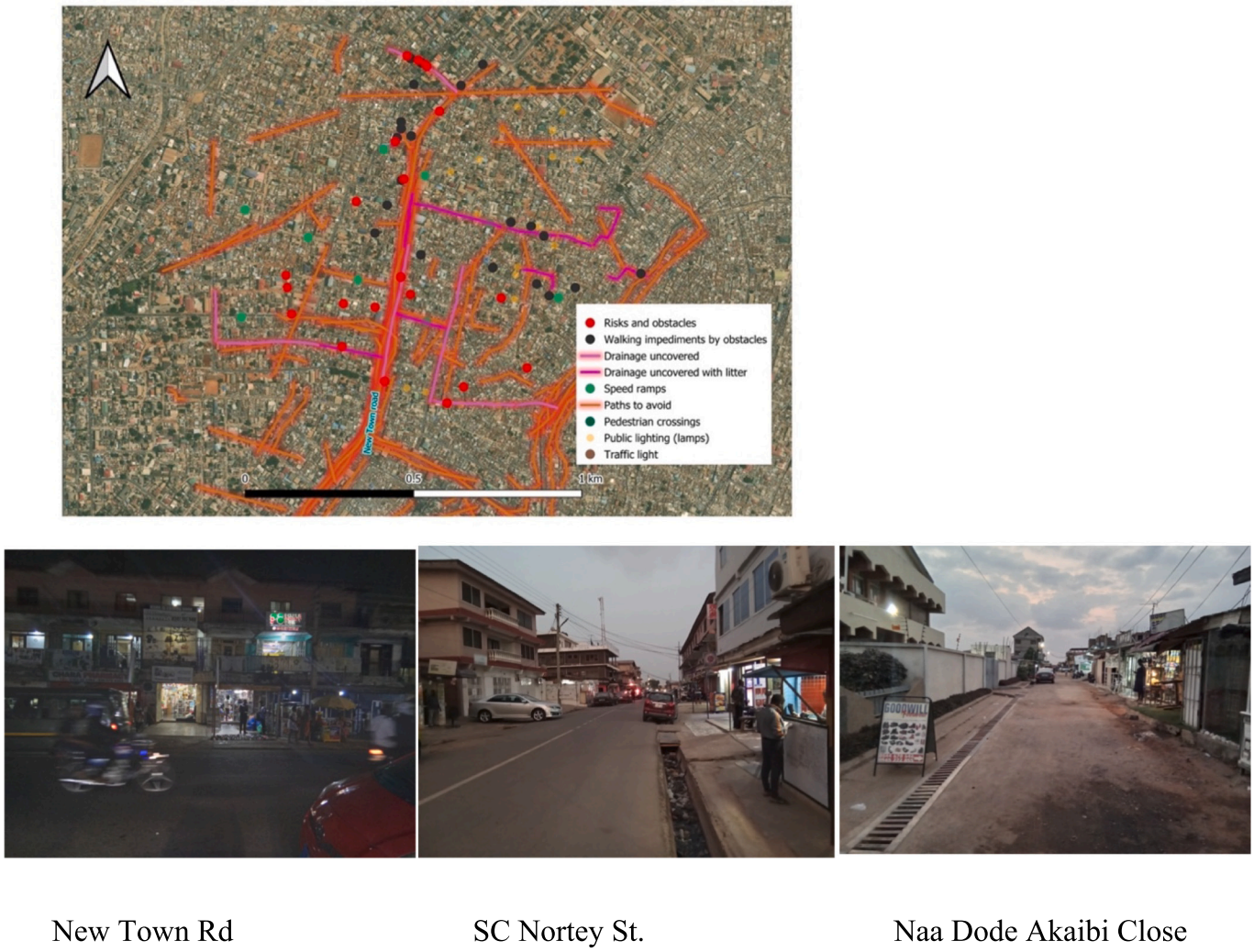


Fig. 8. The walking environment in New Town: Safety & Security.

advances our understanding of the current conditions for pedestrians. This approach sheds light on their experiences and perceptions in the walking environment. Following, Attard et al. (2023) findings, the predominant lack of space in comparison with roads for cars and use of sidewalks for parking underscores the disparate environment that most pedestrians must navigate in the walking environment. The analysis of self-built interventions to public spaces as a transformative factor of the built environment determinants of walking addresses a research gap in both the walkability and informal infrastructure literature. The research brings a recognition of the participation of residents in creating the material conditions necessary to perform their daily activities into studies about public space and walking. Analysing how such adaptations relate to the everyday experience and perception of public space users brings forward insights that push the envelope in research about the dynamics of self-built infrastructures and of pedestrians, counterbalancing the biases and gaps left by an international body of evidence dominated by scholarship from the global north. The combination of a geolocated structured interview, photo-documentation and spatial statistical analysis supports the need for mixed-methods approaches to explore patterns of location and association between self-built interventions to the public space and dimensions of walking. In depth evidence is a must in this process of recognising the work that residents do and identify their possible downsides. Such recognition has been argued to be a key part of planning in contexts where a substantial part of the material conditions necessary to perform daily activities are produced, shaped, and adapted by residents using personal finances or pooling financial and technical resources together to address immediate needs (Bhan, 2019; Jaglin, 2015; Lawhon et al., 2018).

The findings of the study offer two main imperatives for scholarship and practice on walking experiences in SSA and other global south cities. First, city authorities and professionals at the municipal levels such as road engineers and planners should give agency to the creative ingenuities of residents in the planning and provision of walkable infrastructure. Supporting community-led walkability interventions in the built environment results in the co-production of knowledge and strategies between residents and authorities in addressing common challenges in the urban environment. Second, walkable infrastructure such as pedestrian walkways, traffic lights, road markings (e.g. zebra crossings), and demarcated bus stops are urgently needed to ensure pedestrian safety and reduce the frequent congestion and contestation for space between pedestrians, drivers and street vendors.

The results of the research are limited by the information available about each of the interventions identified. A particularly interesting conflict that is recurrent in the research about walking in urban SSA and other low-motorisation urban areas in the world is between pedestrians and street vendors. The finding that self-built interventions in Accra New Town are significantly related to obstacles is an issue that requires further research in connection to said conflict of use of public space. This

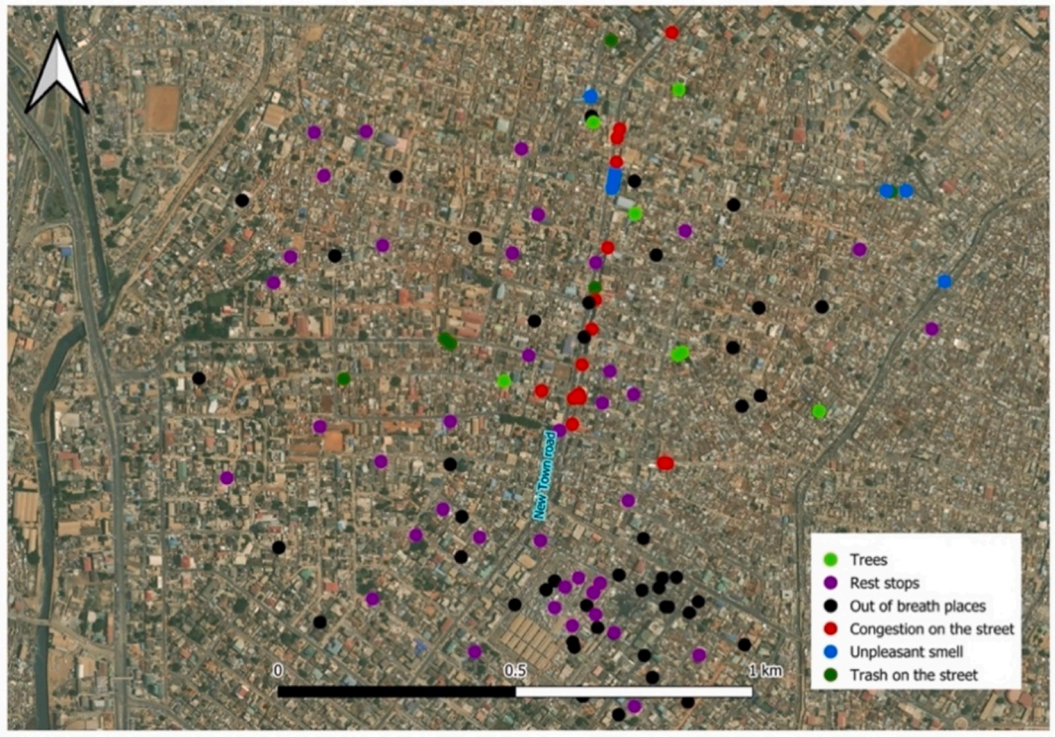
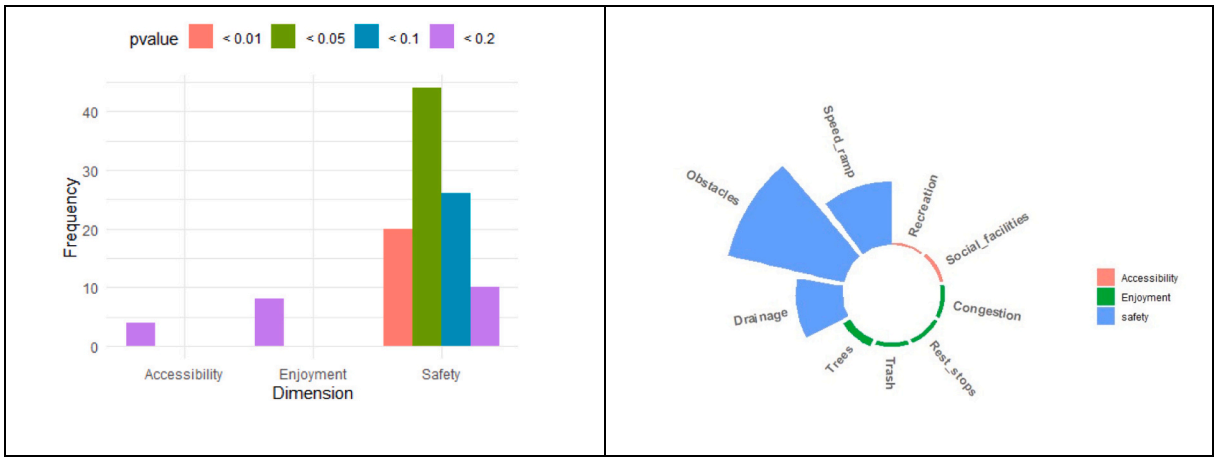


Fig. 9. The walking environment in New Town: Enjoyment.

Table 4
Results from the spatial association test between interventions and components of each dimension of walking.



is particularly important as the focus on street vendors invading the streets is obscuring the disproportionate amount of space that is occupied by cars and it is not questioned. It also speaks to the need for future research to capture the diverse perspectives regarding the use of street spaces, particularly between pedestrians, drivers, and vendors.

The exploration of the relationship between self-built interventions and the three dimensions of walking –accessibility, safety and enjoyment– points to additional priorities for future research. The contestations over public space by different actors require further understanding from the perspective of the distribution of space in terms of property rights and how perceptions influence where people feel more (or less) comfortable, safe, secure walking. Furthermore, other mobile actors of the road, such as vehicles of human traction require attention to understand the use of the walking environment and their relationships with pedestrians. As more observed variables become available, the relationship between perceived, experienced and observed conditions of the walking environment and walking practices and emotive reaction can be interrogated further to evaluate the difference between what people perceive and experience and the material conditions of the walking environment. An example is the contrast between perceptions of road safety versus the occurrence of accidents, injuries, and fatalities. Bearing in mind the limitations of security for data collection, further considerations about the changes and characteristics of walking dimension at day and during the night are necessary.

Similarly, in contexts of fragmented infrastructure and segregated urbanisation further research is necessary to understand the nature of the adaptations to the built environment in different areas of the city. In the case of New Town most of the self-built interventions addressed

drainage coverage, traffic calming and street lighting. In more peripheral, less consolidated neighborhoods the reflection of pedestrians' needs in the material transformations of the walking environment might point to other priorities.

CRediT authorship contribution statement

MariaJosé Nieto-Combariza: Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Formal analysis, Conceptualization. **Vanessa Galeano-Duque:** Writing – original draft, Methodology, Formal analysis, Data curation. **Stephen Leonard Mensah:** Writing – review & editing, Methodology, Investigation, Formal analysis. **Louis Kusi Frimpong:** Writing – review & editing, Supervision, Project administration, Investigation, Formal analysis. **Seth Asare Okyere:** Writing – review & editing, Validation, Supervision, Methodology, Conceptualization. **Daniel Oviedo:** Writing – review & editing, Validation, Supervision, Methodology, Funding acquisition, Conceptualization.

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This research received ethical approval from the Development Planning Unit's Research Ethics Board under project ID DPUSTAFF 2024-004. We confirm that all participants in this research were provided with appropriate informed consent forms, as explained in the methods section.

Declaration of competing interest

No relationships to disclose.

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Data availability

Data will be made available on request.

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