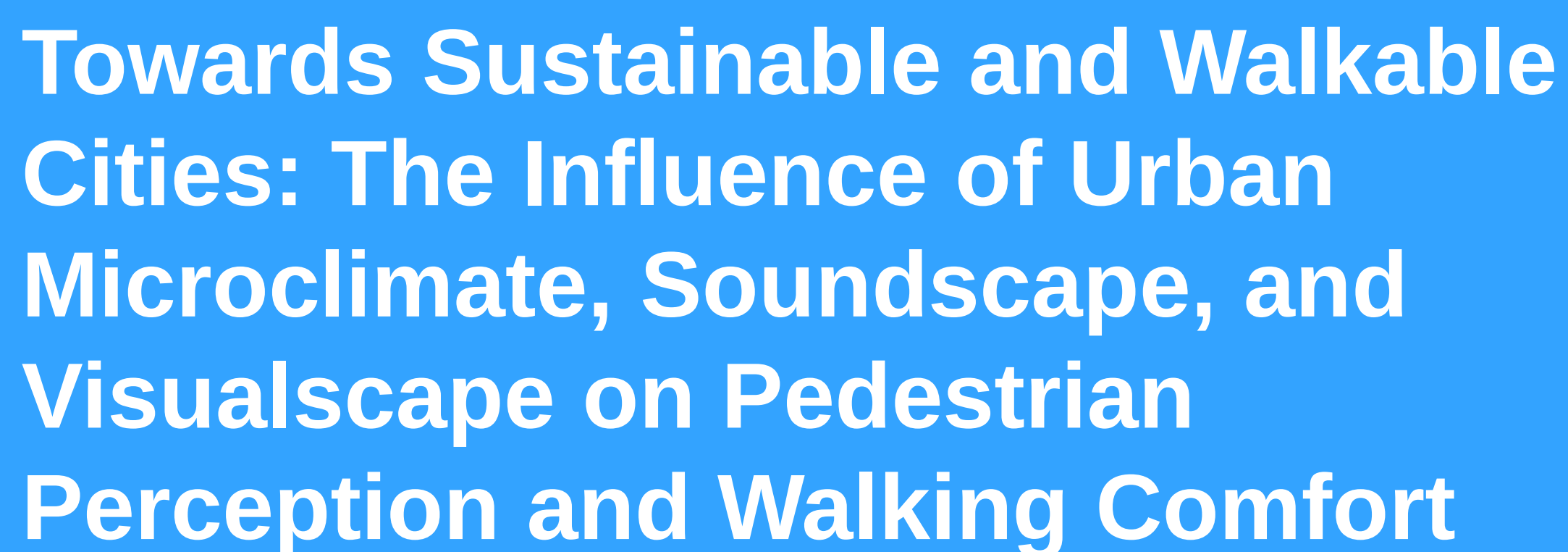




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This dissertation investigates how the multisensory attributes of urban environments, namely visual composition, acoustic context, and microclimatic conditions, shape pedestrian perception and walking comfort. Combining environmental observation, perceptual assessment, and semantic segmentation of street-level imagery, it identifies mechanisms linking sensory quality to experiential outcomes and advances a design-oriented framework for cooler, quieter, and more visually comfortable public spaces that support walking.

Pedestrian Perception, Walking Comfort, Visual Quality,
Soundscape, Urban Microclimate, Urban Morphology

In the face of heatwaves, urban noise, and climate-neutrality goals, improving walking comfort has become a key lever for sustainable mobility and urban health. Yet walkability approaches still assess urban microclimate, soundscape, and visualscape separately. As a particularly exposed Mediterranean city, Béjaïa provides a relevant testbed for connecting environmental measurements with pedestrian perceptions, identifying key comfort factors, and informing the design of resilient, inclusive, and pedestrian-friendly public spaces.

Advance an integrated approach that links visual, acoustic, and microclimatic qualities of urban public spaces to pedestrian perception and walking comfort, using mixed methods, to derive mechanisms, thresholds, and transferable design principles.

Urban planners, public-space managers, policymakers, mobility practitioners, municipalities, and researchers advancing active mobility, climate-resilient public spaces, pedestrian comfort, and healthier cities.

How, and to what extent, do urban microclimate, soundscape, and visualscape shape pedestrian perception and walking comfort in diverse urban public spaces?

- Integrated multisensory framework for pedestrian perception and walking comfort, unifying visualscape, soundscape, and microclimatic qualities at the scale of urban public spaces.
- Integrated coupling of environmental measurements, perceptual judgments, and DeepLabV3+-derived visual indicators, using mixed methods and explainable models to reveal mechanisms and thresholds.
- Empirical grounding in a Maghrebi, Global South context that is largely underexplored, yielding transferable yet context-sensitive design principles.

Study area: five zones in two contrasting parts of Béjaïa: Old City OC1 (pre-Ottoman/Ottoman) and OC2 (colonial); Lower City LC1 (planned), LC2 (industrial mixed), LC3 (informal).

Microclimate: accompanied walks with synchronized measurements (Ta, RH, Va, Ts) and brief questionnaires; SVF from hemispherical photos processed in RayMan; compliant with ISO 7726 and WMO guidance.

Soundscape: ISO 12913-2 soundwalks with listening stops and attribute scales; concurrent LAeq measurements per ISO 1996-2; complemented by sound journals and mental maps.

Visualscape: visual audits and street-level imagery; semantic segmentation using DeepLabV3+ to quantify streetscape elements and characterize the visual environment influencing pedestrians' perception and walking comfort.

Prescriptive framework: translating sensory exposures and perceptual appraisals into design guidelines that support pedestrian perception and walking comfort.

Influence of Non-Physical vs. Physical Factors on WTC
Odds ratios (95 % CI) from ordinal logistic regression

Category	Factor	Odds-ratio (95 % CI)
Non-physical	Vegetation	~1.5 (1.0, 2.0)
	Maintenance	~1.3 (0.8, 1.8)
	Views	~1.4 (0.9, 1.9)
	Safety	~0.8 (0.5, 1.1)
Physical	Fatigue	~0.7 (0.4, 1.0)
	Va (m/s)	~1.2 (0.7, 1.7)
	Ta (°C)	~0.9 (0.6, 1.2)

Comparison of Walking Thermal Comfort (WTC) at 2pm Across Itineraries
Old City (OC) Lower City (LC)

Itinerary	WTC Score (approx.)
OC1	3.5
OC2	3.2
LC1	4.2
LC2	4.5
LC3	4.8

WTC (Walking Thermal Comfort) scale: (1) Very uncomfortable due to cold to (5) Very uncomfortable due to heat.

Word Clouds:
 OC1: abandoned, rain, cold, wind, silence, heritage, etc.
 OC2: traditional, warm, wind, comfort, calm, safety, noise, etc.
 LC1: shops, footpaths, garden, noise, etc.
 LC2: building, ventilation, footpaths, noise, etc.
 LC3: engines, footpaths, noise, traffic, etc.

OC1 — ISO 12913 Soundscape Scatter Plot

ISO Eventful vs. ISO Pleasant

Legend: 9 am (blue dots), 8 pm (red dots)

Labels: (chaotic), (vibrant), (monotonous), (calm)

Spearman Correlations between SC, VA, and WC at 9 am and 8 pm (p-value and 95% CI)

	Morning (9 am)			Evening (8 pm)		
	SC	VA	WC	SC	VA	WC
WC	0.40* [0.05, 0.67]	0.68*** [0.45, 0.84]	1.00	0.29 [-0.07, 0.62]	0.50** [0.20, 0.78]	1.00
VA	0.58** [0.27, 0.80]	1.00	0.68*** [0.45, 0.84]	0.57** [0.33, 0.74]	1.00	0.50** [0.20, 0.78]
SC	1.00	0.58** [0.27, 0.80]	0.40* [0.05, 0.67]	1.00	0.57** [0.33, 0.74]	0.29 [-0.07, 0.62]

Significance: *p < 0.05 **p < 0.01 ***p < 0.001 (95% CI in brackets)

Visual, acoustic, and microclimatic qualities structure pedestrian perception and walking comfort. Thermal comfort emerges from both physical and non-physical factors. Acoustic comfort cannot be reduced to decibels, but to meaning, context, and multisensory interplay. Visual composition modulates thermal and acoustic perception, shaping the overall walking experience.

Mansouri, Y., Matallah, M. E., Attar, A., Mahar, W. A., & Attia, S. (2025). An Investigation of Microclimatic Influences on Pedestrian Perception and Walking Experience in Contrasting Urban Fabrics: The Case of the Old Town and the Lower City of Béjaïa, Algeria. *Urban Science*, 9(7), 243. <https://doi.org/10.3390/urbansci9070243>

Mansouri, Y., & Stefàno, D. (2024). The perception of Mediterranean cities through walking. The Landscape of Béjaïa in Algeria and Loulé in Portugal. In A. Gospodini, *Proceedings of the International Conference on Changing Cities VI: Spatial, Design, Landscape, Heritage & Socio-Economic dimensions*. <https://hdl.handle.net/2268/322233>