Walking the City as a Multisensory Experience: Microclimate and Soundscape Effects in Béjaïa

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Cities today face multiple challenges related to unsustainable transport and the excessive reliance on motorized travel. These issues have led to problems at different levels, including air pollution, roadway congestion, and health concerns linked to physical inactivity such as obesity. Walking offers a key solution to address these challenges and is fundamental to creating livable and healthy cities (Mansouri & Attar 2022). However, most walkability studies still focus primarily on physical attributes, such as sidewalk width, permeability, and street connectivity; while often overlooking the importance of pedestrians' sensory perception. Two dimensions are particularly important: microclimate and soundscape (Mansouri & Stefàno 2024, Mansouri et al. 2025a,b).

This research presents two investigations conducted in Béjaïa, Algeria. The first explores the impact of microclimatic conditions on pedestrian perception and comfort; the second examines the influence of the soundscape on the walking experience in the city. Two contrasting study areas were selected: the old town of Béjaïa (the Medina), built before Algerian independence and characterized by historic urban fabric, and the lower city composed of modern and contemporary fabrics. This contribution therefore addresses limitations of studies focused on isolated spaces by explicitly considering transitions between places and the multisensory nature of the walking experience (Mansouri et al. 2025a,b).

Two complementary methodologies were implemented, one for each study, across five zones selected in each urban fabric (two in the old town and three in the lower city). Zones were chosen after a morphological analysis. Within each zone, walking itineraries were defined and focal points established to support subsequent thermal walks and soundwalks, combined with in-situ measurements (microclimatic and acoustic).

Microclimate component (July 2022). At focal points, we measured air temperature (Ta), surface temperature (Ts), wind speed (Va), relative humidity (RH), and sky view factor (SVF), synchronized with accompanied walks, questionnaires (thermal sensation vote ASV, differential dASV, wind sensation vote WSV, and Willingness to Continue - WTC), and mental maps. Measurements followed ISO 7726 and WMO recommendations; sensor height was 1.75 m. SVF was calculated from fisheye images (Canon EOS 2000D) processed in RayMan Pro. Seventy participants were involved (Mansouri et al. 2025a, ISO 1998). Soundscape component (March 2023). The protocol followed ISO 12913 recommendations, combining soundwalks (3-minute listening per point with a perceptual-attribute questionnaire), 7-day sound diaries, mental maps, and LAeq measurements using a type-2 sound level meter. Fifty-eight participants completed the soundwalks and fifty completed the diaries, distributed over the same zones/itineraries. Standard ISO attributes (e.g., pleasant, calm, vibrant) were aggregated into pleasantness and eventfulness for visualization and statistical analysis (Mansouri et al. 2025b, ISO 2014, 2018). Analysis. Data analysis used R for statistics, regressions, and correlations (e.g., Ta/Ts SVF; ASV ↔ WTC; soundscape – visual- walking associations) and NVivo for qualitative analysis of mental maps (Mansouri et al. 2025a,b).

Microclimate and thermal perception. At 14:00, SVF and Ts showed a clear positive relationship (slopes of approximately 8–9 °C per unit SVF depending on space type). Streets and squares exhibited the highest Ts, whereas gardens recorded the lowest. The SVF–Ta link was weaker but remained generally positive. ASV values peaked along certain sections of lower-city itineraries (LCI1, LCI3), and WTC closely tracked ASV (Kendall's $\tau\beta \approx 0.79$). Vegetation and "breathing spaces" (gardens, vegetated stairways) reduced Ts/Ta and also moderated perception: places with high Ta could still be felt as "neither warm nor cool" in densely vegetated settings. Wind (> 1 m/s) improved WTC, with a plateauing effect under hot/humid conditions (Mansouri et al. 2025a).

Transitions and thermal memory. SVF jumps between consecutive points (sheltered → open) were frequently accompanied by an increase in dASV ("warmer" to "much warmer"), highlighting the importance of sequencing itineraries with shade and alternations. Old-town itineraries (OCI1–OCI2)

showed the richest dASV variations, driven by morphological diversity (narrow lanes, stairs, gardens, occasional openings) (Mansouri et al. 2025a).

Perceptual factors beyond physics. A logistic model indicated that vegetation (OR ≈ 1.50), maintenance (OR ≈ 1.40), and views (OR ≈ 1.30) increase the likelihood of a higher WTC, whereas fatigue (OR ≈ 0.70) and insecurity (OR ≈ 0.80) reduce it evidence of interaction between physical and cognitive-affective factors (Mansouri et al. 2025a).

Soundscape and walking. Natural and social sounds increased perceived comfort and the sense of safety, while mechanical noise (traffic, construction) was associated with discomfort and avoidance behaviors. In the morning, there were moderate-to-strong correlations between acoustic comfort and visual ambiance ($\rho = 0.58$, $p = .001$), and between acoustic comfort and walking pleasantness ($\rho = 0.40$, $p = .033$). Coastal itineraries (e.g., the Leonardo-Fibonacci promenade) encouraged more leisure walking, illustrating the combined effect of landscape and valued sound sources (sea, calm human activities) (Mansouri et al. 2025b).

These findings confirm that urban walking is a multisensory experience in which microclimate and soundscape interact. On the thermal side, targeting useful wind (≥ 1 m/s), lowering Ts through shade and higher-albedo materials, and orchestrating breathing spaces along routes are decisive. On the acoustic side, enhancing natural and social sounds and buffering mechanical sources through design (vegetation screens, traffic setback, surface treatments, microtopographies) improves comfort and perceived safety (Mansouri et al. 2025a,b).

Beyond physical magnitudes, affective and cognitive dimensions (views, order, cleanliness, safety, fatigue) strongly modulate the perceptual translation of stimuli. Correlations between acoustic comfort, visual ambiance, and walking—together with the WTC model's odds ratios—underscore the need to integrate engineering and ambience design in pedestrian-route planning. Finally, the role of transitions (dASV) justifies sequencing strategies: regularly inserting "regeneration stations" (canopies, gardens, fountains, seating) to limit the accumulation of thermal and acoustic stress and to foster recovery (Mansouri et al. 2025a,b).

In Béjaïa, the pedestrian experience emerges from the interlocking of morpho-microclimatic and acoustic factors. Three operational takeaways are: (i) design shaded, varied itineraries (controlled SVF, higher-albedo materials, continuous vegetation) to smooth ASV/WTC and sustain the willingness to walk; (ii) curate sound quality (valorize nature and sociability, reduce mechanical noise) to enhance safety and richness of experience; and (iii) sequence routes with regularly spaced breathing spaces. These recommendations can inform heritage protection and upgrading (PPSMVSS) and be transferred to other North-African cities fac-

ing similar climatic and acoustic constraints (Mansouri & Stefàno 2024, Mansouri et al. 2025a,b).

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