Multisensory Outdoor Environmental Study for Enhancing Urban Population Resilience to Climate Change

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ABSTRACT

Climate adaptation requires a fundamental shift from single-domain thermal interventions to integrated multisensory approaches that reflect the actual complexity of human-environment interactions. While indoor laboratory studies have provided valuable insights into multisensory integration, their controlled conditions often lack the ecological validity needed for outdoor urban applications, where dynamic environmental fluctuations, circadian rhythms, safety perception, and contextual factors fundamentally shape human responses. This workshop introduces a research framework advancing urban resilience through multiscale integration—from materials and inter-building microclimates to neighborhood and city-regional configurations—multidomain environmental assessment across thermal, acoustic, air quality, and visual conditions, and multisensory human-centered solutions validated in authentic urban environments. The framework establishes how environmental stimuli activate both material responses and human physiological adaptation across scales. Photoluminescent compounds demonstrate domain-specific activation patterns under varied lighting spectra, while synchronized physiological-environmental monitoring reveals that multidomain models substantially outperform single-domain approaches in predicting human stress. Integrated monitoring strategies combining fixed stations, mobile and wearable sensing, and crowdsourced data capture spatiotemporal environmental variations and authentic human perceptions. Critically, individuals exhibit heterogeneous resilience to identical conditions, operationalized through quantifiable adaptation metrics that challenge demographic vulnerability assumptions. Temporal investigations further reveal that safety perception and circadian rhythms produce distinct urban chronotypes—contexts where specific environmental domains dominate response patterns and interventions achieve maximum effectiveness. These insights converge in the Multisensory Urban Climate Zones framework, extending traditional morphology-based classification by overlaying dynamic anthropogenic indicators with static urban form. The framework identifies adaptation zones through spatial analysis of domain-specific sensitivities and temporal dynamics, demonstrating that human activity patterns—more adaptable than fixed urban form—offer practical intervention pathways validated through actual physiological responses rather than theoretical assumptions. By bridging individual sensing to neighbourhood-scale resilience planning across the full spectrum of environmental exposures, this approach provides actionable intelligence for climate-responsive urban design that enhances population wellbeing in our changing climate.

KEYWORDS

multisensory urban design, climate adaptation, multidomain environmental assessment, human resilience, urban climate zones