The 15th World Congress & Exhibition on Design & Health

Microclimate Exposure and Public Space Use in Smart Cities

Environmental perception and adaptive activity adjustment in an urban public space

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Shenzhen context

Shenzhen: high-density, hot-humid, park-intensive, and digitally connected

These urban conditions make Shenzhen a relevant setting for climate-adaptive public-space research.



Houhai CBD / China Resources Tower · Nanshan District

Urban scale

18.25 million

Permanent residents in 2025; 99.79% lived in urban areas.

Climate pressure

23.5 °C

2025 annual mean temperature; 60 hot days, the highest annual total on record.

Public-space network

1,350 parks

4,018.9 km of greenways; park-service-radius coverage exceeded 91.2%.

Smart-city capacity

1,178 indicators

City operation monitoring indicators on the municipal CIM platform; 300 smart applications.

Data: Shenzhen Statistics Bureau; Shenzhen Meteorological Bureau; Shenzhen Ecology & Environment Bureau; Shenzhen Development and Reform Commission.

Source: EyeShenzhen (2025), photo courtesy of MixC. https://www.eyeshenzhen.com/content/2025-09/30/content_31706373.htm

Research background

Why Shenzhen’s urban characteristics create a design research problem

Strong public-space provision and digital capacity coexist with substantial outdoor climate exposure.

Climate exposure + urban green space



Shenzhen Central Park · Futian District

Source:https://www.sz.gov.cn/en_szgov/travel/natural/content/post_1354238.html

Everyday public-space use



Shenzhen Talent Park · Houhai, Nanshan District

Source: https://www.eyeshenzhen.com/content/2024-03/21/content_30816832.htm

Smart-city capacity

1,178 monitoring indicators

300 smart applications

Citywide CIM platform and integrated urban environmental monitoring create strong data capacity.

Source: Shenzhen Development and Reform Commission (2025). https://fgw.sz.gov.cn/fzgggz/jjxs/content/post_12078615.html

Design gap

Urban data are available ≠ local conditions are legible

→

Research focus: Can microclimate information support adaptive public-space use by making current conditions easier to interpret?

Research Focus

Two questions within one public-space setting

The study distinguishes aggregate use from user-level adaptation.

Observed public-space use

Are changes in hourly occupancy associated with microclimate conditions?

This captures the aggregate intensity of space use under different environmental conditions.

≠

Adaptive activity adjustment

Which perceptual and behavioural factors are associated with changes in stay duration, timing, activity intensity, or location?

This captures adaptation while users remain engaged with the space.

Design relevance: presence versus absence is not the only form of climate-responsive behaviour.

Field Setting

One public space with mixed landscape and activity conditions

Shenzhen University Town, Xili, Nanshan District, Shenzhen, China · 19-22 October 2024 · 09:00–21:00



≈ 6,000 m²

Lake · lawn · paths · plaza · seating · pavilion

4 survey days

Two weekdays and two weekend days

Field evidence

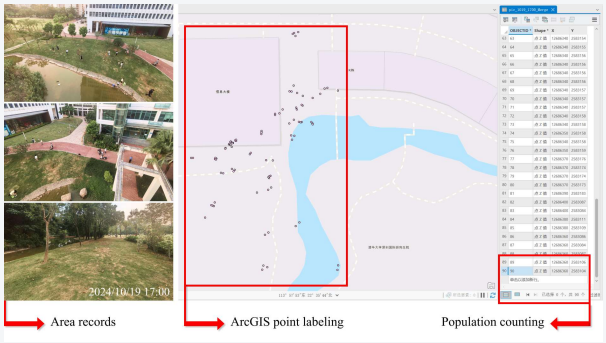
52 hourly activity observations · 257 valid surveys

Location reference: EyeShenzhen, "Shenzhen University Town." https://www.eyeshenzhen.com/content/2023-05/12/content_30197672.htm

Evidence Collection

Three synchronized evidence streams





Questionnaire

257 valid responses

Environmental perception
Behavioural constructs
Adaptive activity adjustment

Monitor the environment

Local microclimate monitoring at pedestrian level.

Observe public-space use

Hourly photographic records and people-count annotation.

Understand user response

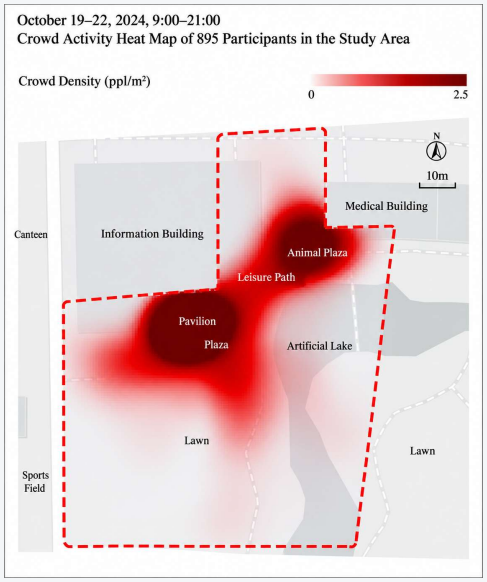
On-site survey under the same environmental context.

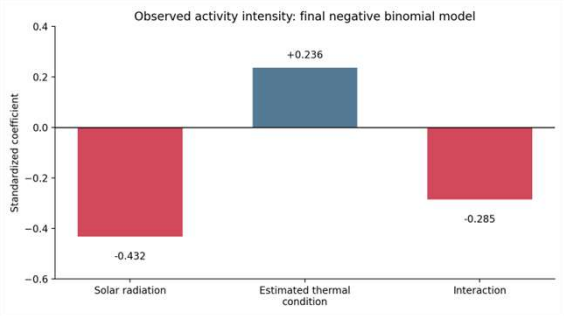
The three streams are complementary: physical exposure, aggregate use, and perception-based response.

Finding 1

Stronger solar exposure was associated with lower observed activity intensity

The aggregate-use analysis points to solar exposure as the clearest behavioural signal in the field dataset.





Design reading

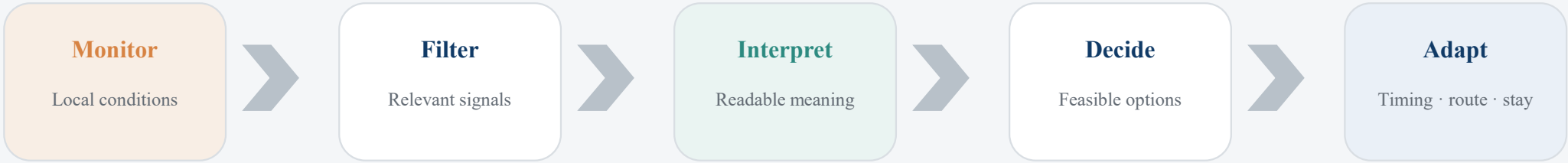
- Shade and solar exposure matter for public-space usability.
- Spatial options can support people in managing exposure.
- The design implication is more important here than the full regression specification.

Field interpretation remains exploratory because the count model is based on 52 hourly observations.

Information as Design Cue

Microclimate information can connect environmental monitoring with adaptive choice

The survey interface made current conditions explicit without automatically prescribing behaviour.



Research proposition

The value of microclimate information lies less in displaying raw data and more in making environmental conditions legible enough to support practical adjustment in public space.

Relevant adjustment options include changing stay duration, activity intensity, timing, or location while remaining in the public space.

Finding 2

Adaptive adjustment was linked to environmental legibility and perceived control



Design interpretation

Environmental information becomes more relevant when users can understand the condition, perceive a feasible response, and form an intention to adjust. This is a control-centred rather than purely information-centred pattern.

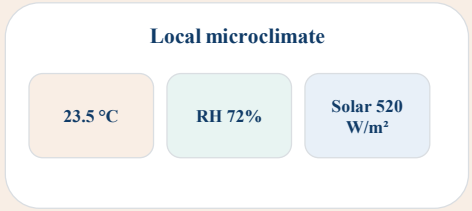
Design Translation

What the research can become as a public-space service

The empirical study informed a downstream prototype; the prototype is presented as design translation, not validation evidence.

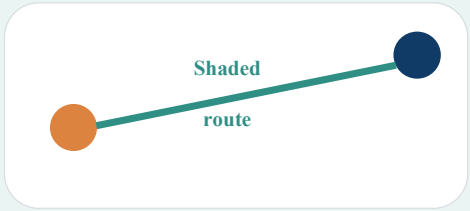
Microclimate details

Translate local environmental conditions into a readable public-facing summary.



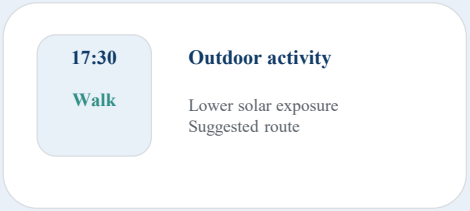
Route guidance

Connect environmental information with movement, destination choice, and spatial navigation.



Activity information

Link programme timing, location, and outdoor activities with the current environmental context.



Illustrative service sketches derived from the study; the operational prototype is shown on the next slide.

Prototype Demonstration

User-facing microclimate information service



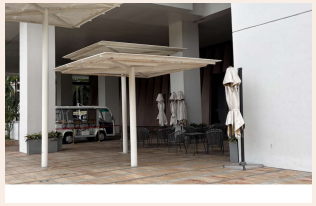
Design + Health Implications

Three implications for climate-responsive public-space design

The emphasis shifts from technical measurement to the quality of everyday environmental decision support.

1 Design for exposure choice

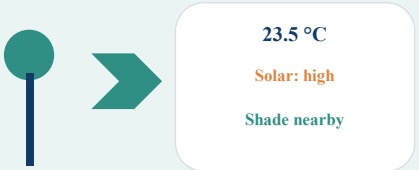
Provide shade, spatial alternatives, and routes that allow users to manage solar and thermal exposure without leaving the public space.



Shaded pavilion at the study site

2 Design for legibility

Translate environmental data into readable signals that non-expert users can understand quickly at the moment of use.



Environmental monitoring translated into readable meaning

3 Design for perceived control

Connect information with feasible actions: where to move, when to stay, and which activities remain appropriate under current conditions.



Multiple spatial choices within the study site

The study concerns climate-responsive activity and decision support.

Study-site photographs by the research team, Shenzhen University Town, October 2024.

Conclusion

Smart City design becomes meaningful when environmental data support adaptive public-space use

The study connects environmental monitoring, observed use, environmental perception, and a downstream design prototype.

Exposure

Microclimate conditions were associated with public-space use, with solar exposure standing out as the clearest behavioural signal.

Adaptation

People can remain in public space while adjusting duration, timing, location, and activity intensity.

Design support

Microclimate information may support adaptation when it improves environmental legibility and perceived control.



Source: A scene of OCT Wetland (2024), photo from GD Today. https://www.eyeshenzhen.com/content/2024-03/21/content_30816832.htm

Acknowledgements

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Thank you

Questions & Discussion

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Five parks interconnected-Lianhua Hill Park, Bijia Hill Park, Shenzhen Central Park, Meilin Mountain Park, and Yinhu Mountain Park

Source: EyeShenzhen (2024), photo from GD Today. https://www.eyeshenzhen.com/content/2024-03/21/content_30816832.htm