HKU Musketeers Foundation Institute of Data Science
香港大學同心基金數據科學研究院

Local Living Dynamics: 15-Minutes City

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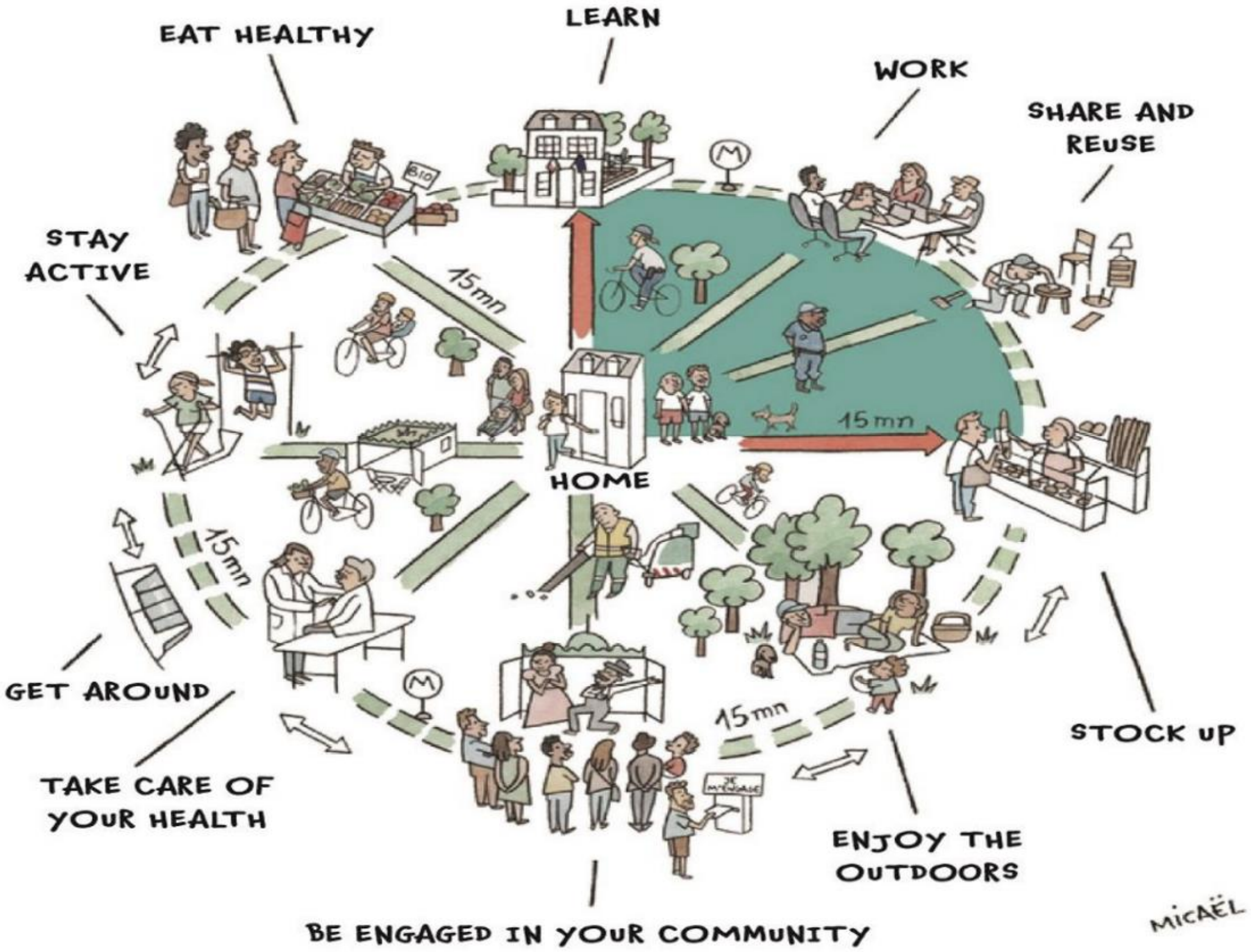
THE CONCEPT OF 15-MINUTES CITY

A city model aimed at reducing transport emissions and enhancing community life by ensuring that essential services are within a 15-minute walk from home.



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CASE STUDY

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Article

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The 15-minute city quantified using human mobility data

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PURPOSE OF THE STUDY

Investigating how urban design, access to amenities, and human mobility data contribute to the realization of the 15-minute city.

DATA SOURCE

Mobile device GPS data from SafeGraph by more than 40 million mobile phone users

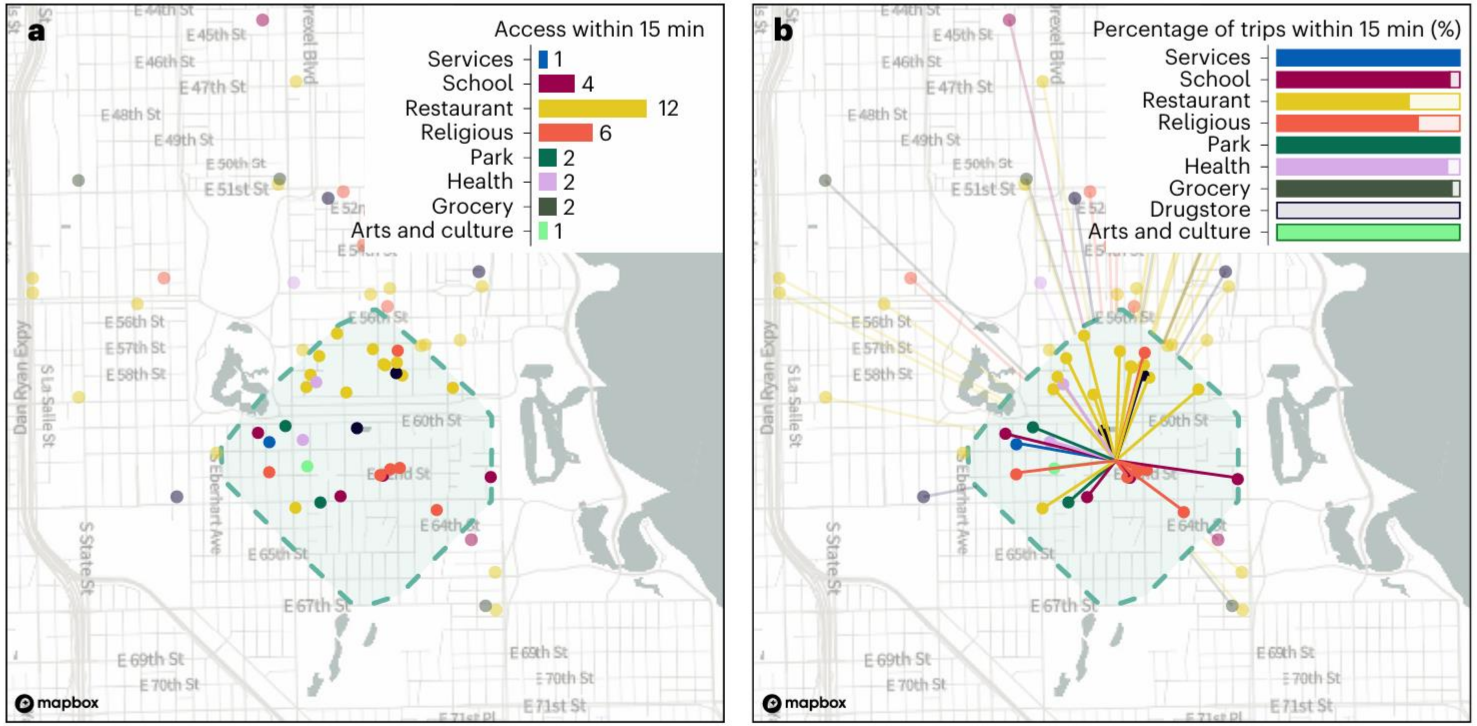

Fig. 1 | Example of measuring access and usage within a 15-minute walk with SafeGraph data. a, POIs within and outside of the 15-minute walkshed from the centroid of the neighbourhood and count of POIs within the 15-minute walkshed by type of POI in the upper-right corner. **b**, Trips to amenities within and outside the 15-minute walkshed and share of trips within the 15-minute walkshed by type of POI in the upper-right corner. Basemap reproduced from Mapbox under CC BY 3.0.

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MEASUREMENT & PRINCIPLE

Urban areas naturally evolve toward spatially optimized configurations that minimize travel distances while maximizing access to essential services.

$$\text{usage}_A = \frac{\sum_{\{a \in A\}} \text{usage}_a \times \text{population}_a}{\text{population}_A},$$

$$\text{access}_a = \sum_{\{c \in \text{categories}\}} \text{access percentile}_{a,c} \times \text{weight}_c, \text{where}$$

$$\sum_{\{c \in \text{categories}\}} \text{weight}_c = 1$$

$$\text{access}_A = \frac{\sum_{\{a \in A\}} \text{access}_a \times \text{population}_a}{\text{population}_A}.$$

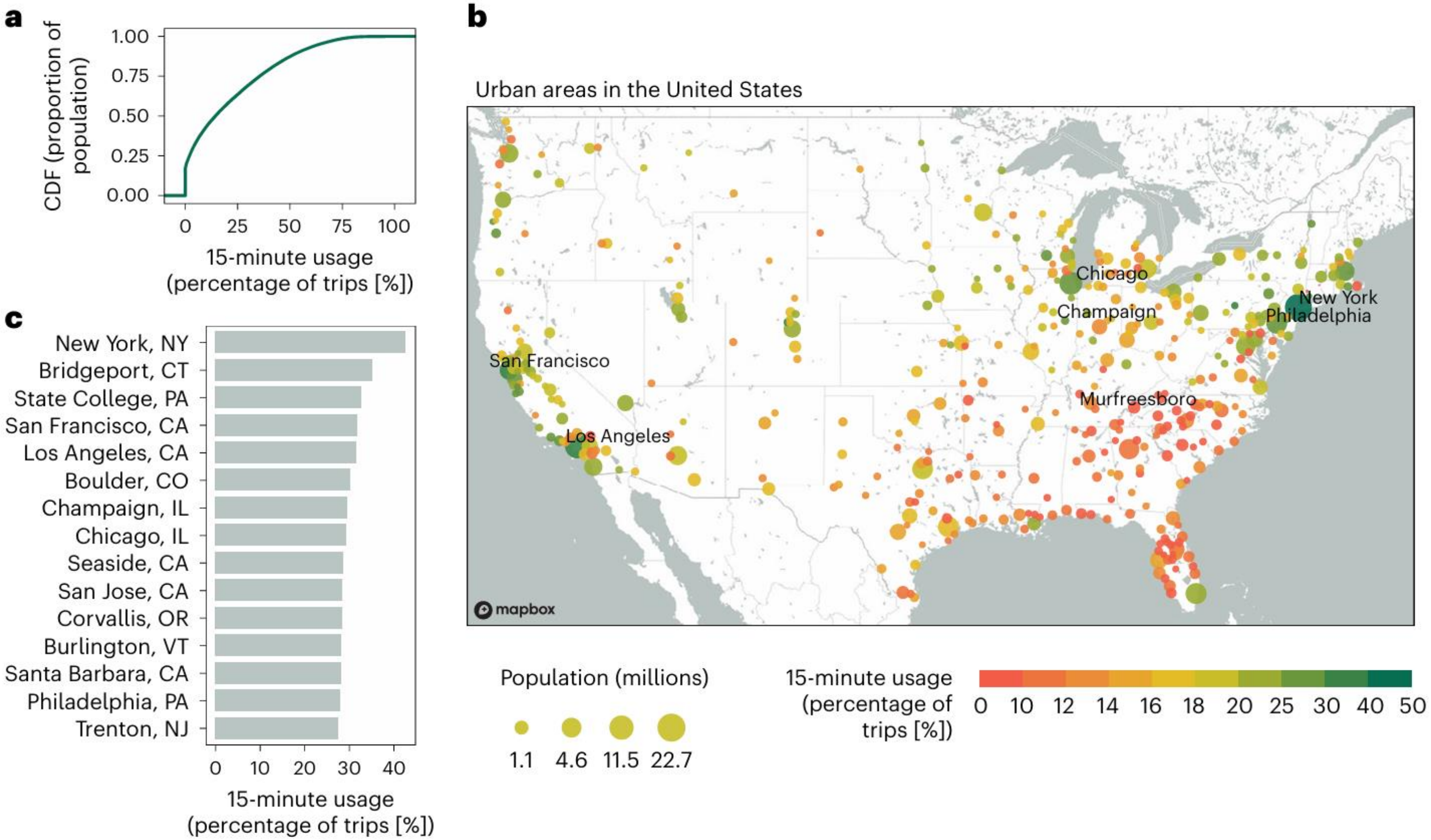

Fig. 2 | Local trips in the United States. a, The cumulative distribution of 15-minute usage for US neighbourhoods. CDF, cumulative distribution function. **b**, 15-minute usage for all urban areas in the United States. Basemap reproduced from Mapbox under CC BY 3.0. **c**, 15-minute usage for those urban areas that have the highest proportions of local trips.

where A represents an urban area and $\{a \in A\}$ represent the block groups contained within it.

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FINDINGS

- Only 14% of daily trips are local for the median US resident, with regional disparities.
- Low-income residents might be more receptive to local living policies and interventions.

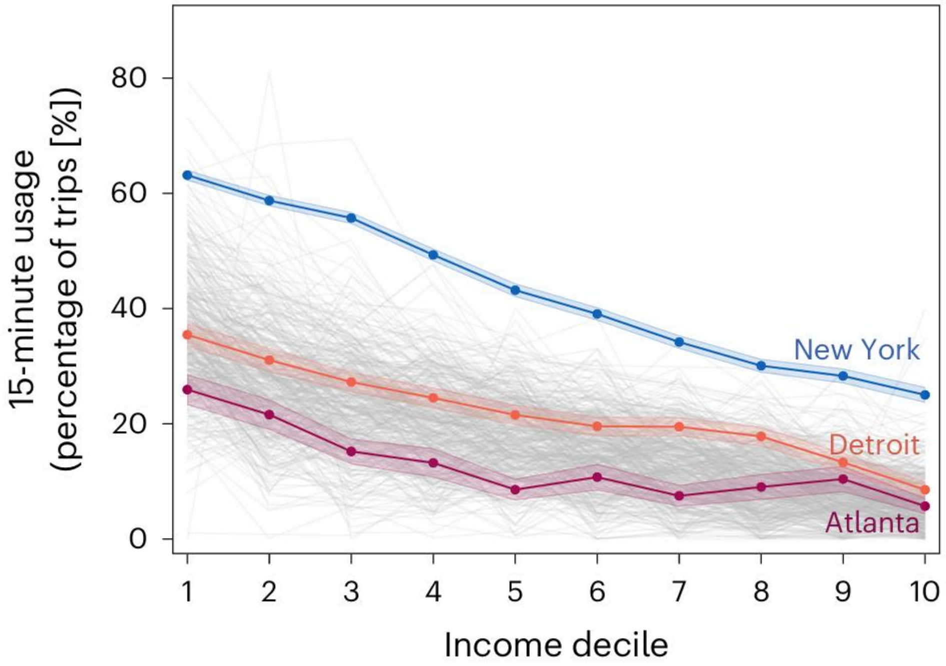

Fig. 3 | Local trips by income levels. 15-minute usage by neighbourhood income deciles for all urban areas, including New York (*n* = 13,908 block groups), Detroit (*n* = 3,359 block groups) and Atlanta (*n* = 2,338 block groups). The error bands represent 95% confidence intervals.

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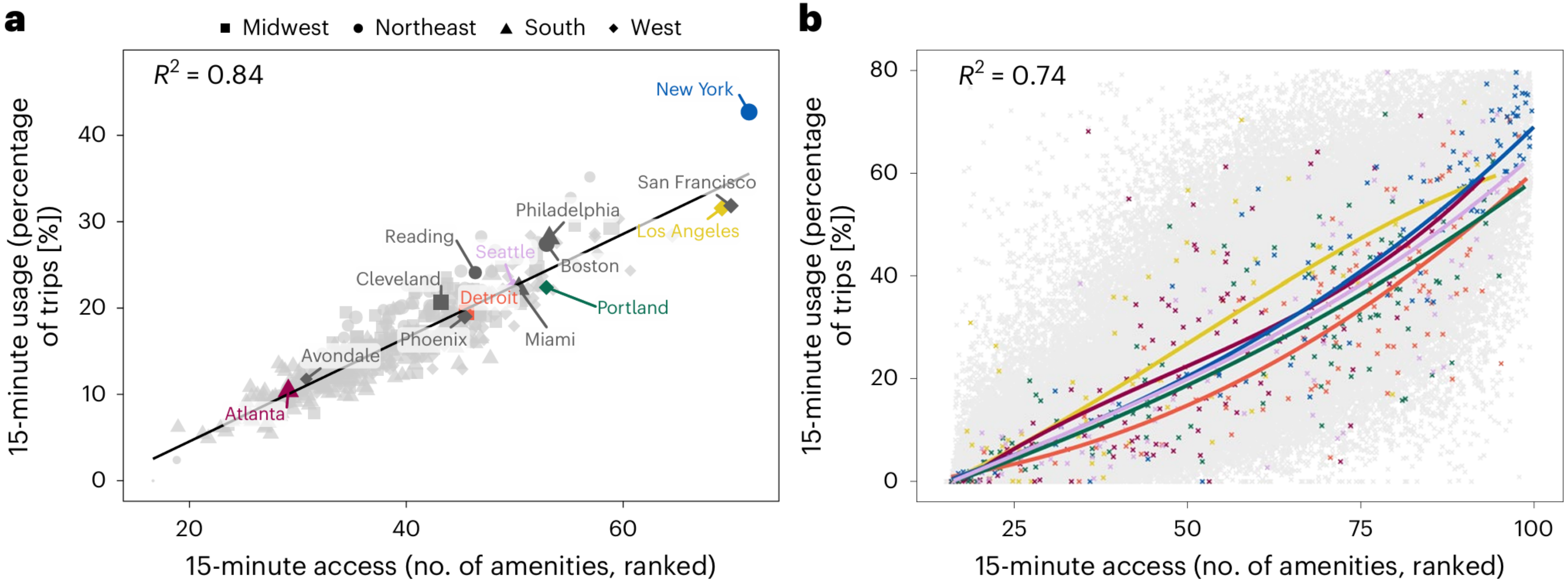

Fig. 4 | Access and local trips. a, The relationship between 15-minute usage and access at the urban area level. **b**, The relationship between 15-minute usage and access across neighbourhoods within urban areas. Block groups in six representative urban areas are emphasized using colours that correspond to the cities indicated in **a**. Each of the six urban areas in **b** also features a fitted non-parametric spline regression, denoted by the same colour as the city. The R^2 value in **a** is derived from a regression analysis of 15-minute usage on 15-minute access at the urban area level (n = 420 urban areas). The R^2 value in **b** is derived from a regression analysis at the census block group level (n = 150,159 block groups), incorporating urban area fixed effects.

- Local living is determined by access to local amenities.
- Local trip patterns strongly influenced by amenities nearby.

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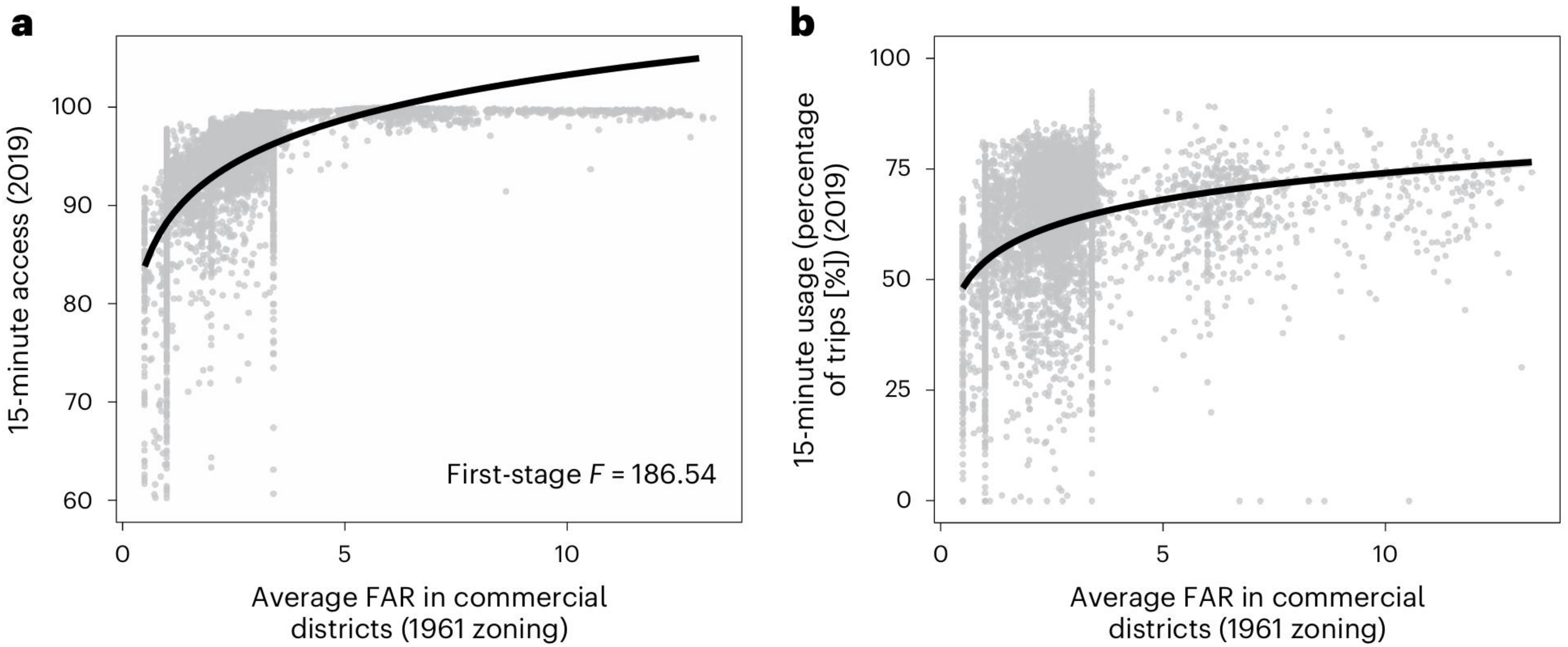

Fig. 5 | First-stage and reduced-form relationships between historical zoning regulations and current access to local services and 15-minute usage for New York neighbourhoods. a, The first-stage relation between historical zoning and current access. **b**, The reduced-form relation between historical zoning and current 15-minute usage. Each dot represents a census block group in New York City (n = 5,582 block groups), and each black line corresponds to a log-linear regression model of the form $y_i = \log(x) + \epsilon_i$, where ϵ is a noise term. Supplementary Table 9 summarizes the regression results from these specifications.

- Local zoning regulations shape the level of access to nearby amenities and more flexible local zoning could be a natural policy lever for those advocates interested in increasing local trips.

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$$\text{experienced integration}_{k_i,L} = \frac{\sum_{k_j} p_{k_j,L} \times s_{k_i \to k_j}}{\sum_{k_j} p_{k_j,L}},$$

$$s_{k_i \to k_j} = |r_i - r_j|$$

$$\text{experienced integration}_j = \frac{\sum_{L \in \text{POIs}} \text{experienced segregation}_{k_j,L} \times p_{j,L}}{\sum_{L \in \text{POIs}} p_{j,L}},$$

$$\text{experienced segregation}_j = 1 - \text{experienced integration}_j$$

where $p_{k_j,L}$ is the number of people of income k_j who visit L and r_j is the income rank of individuals of income k_j.

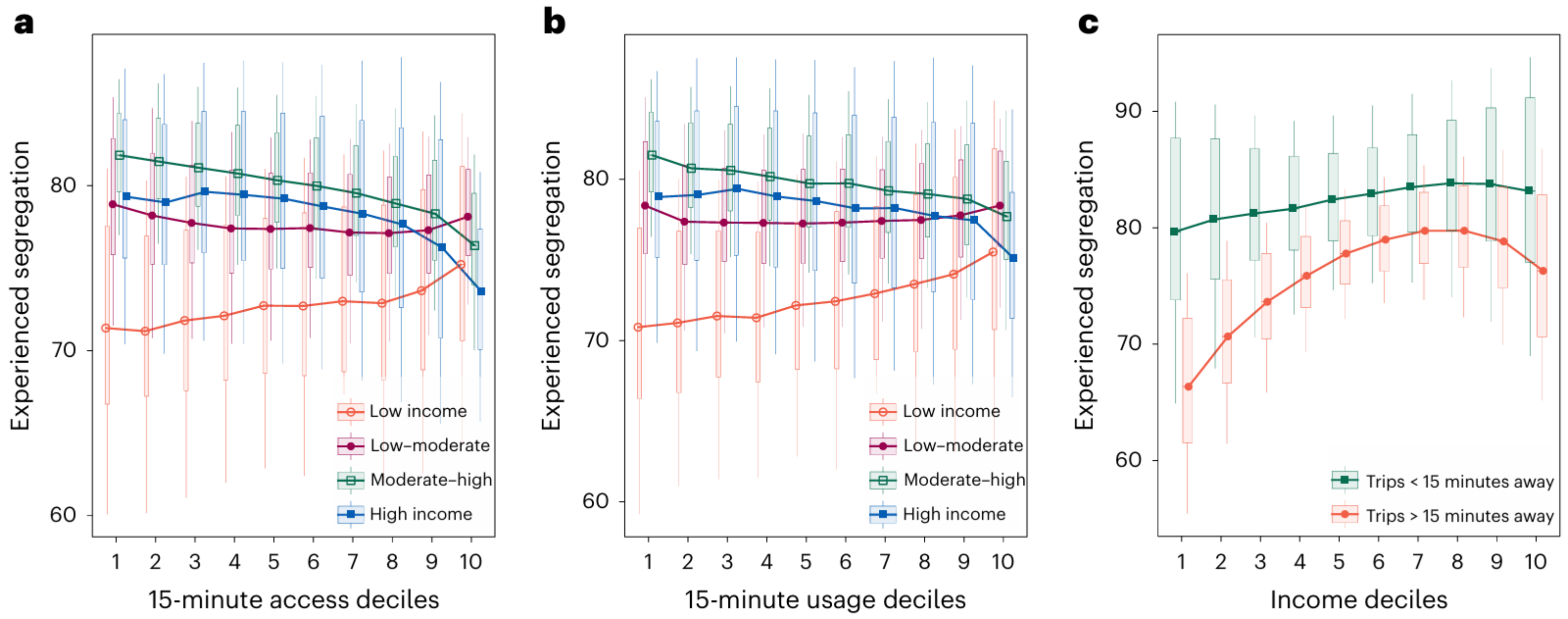

Fig. 6 | Local trip behaviour and experienced segregation. a, Experienced segregation against 15-minute access for neighbourhoods in different income quartiles. **b**, Experienced segregation against 15-minute usage for neighbourhoods in different income quartiles. **c**, Experienced segregation during short (<15 minutes) and long trips (>15 minutes) for residents of neighbourhoods in different income deciles. The box plots show the means and the 10th, 25th, 75th and 90th percentiles. In **a**,**b**, n = 41,998, 37,676, 34,299 and 31,890 census block groups for income quartiles 1, 2, 3 and 4, respectively. For **c**, trips taken less than 15 minutes from home, n = 124,656 block groups. For **c**, trips taken further than 15 minutes from home, n = 145,855 block groups. (Note that residents of 21,119 census block groups take no trips within 15 minutes in our dataset).

- **Positive Impact:** Increased local accessibility contributes to better health, sustainability, and community life.
- **Negative Impact:** Without careful policy, the 15-minute city model may intensify social isolation in census groups.

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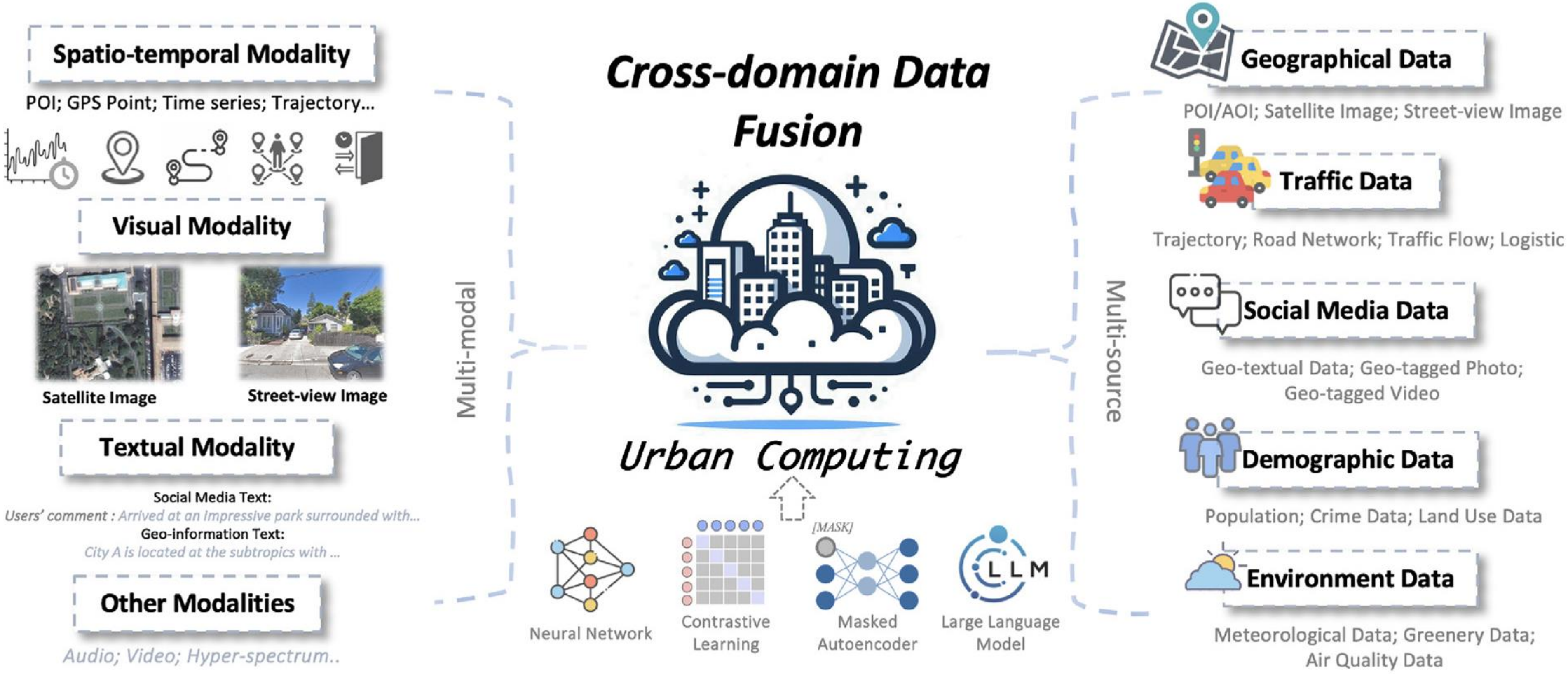
DATA INTEGRATION



Deep learning-based models can integrate multiple types of data sources (e.g., traffic, geographic, demographic, and social media) to optimize urban mobility.

Retrieved from: Zou, X., Yan, Y., Hao, X., Hu, Y., Wen, H., Liu, E., ... & Liang, Y. (2025). Deep learning for cross-domain data fusion in urban computing: Taxonomy, advances, and outlook. Information Fusion, 113, 102606.

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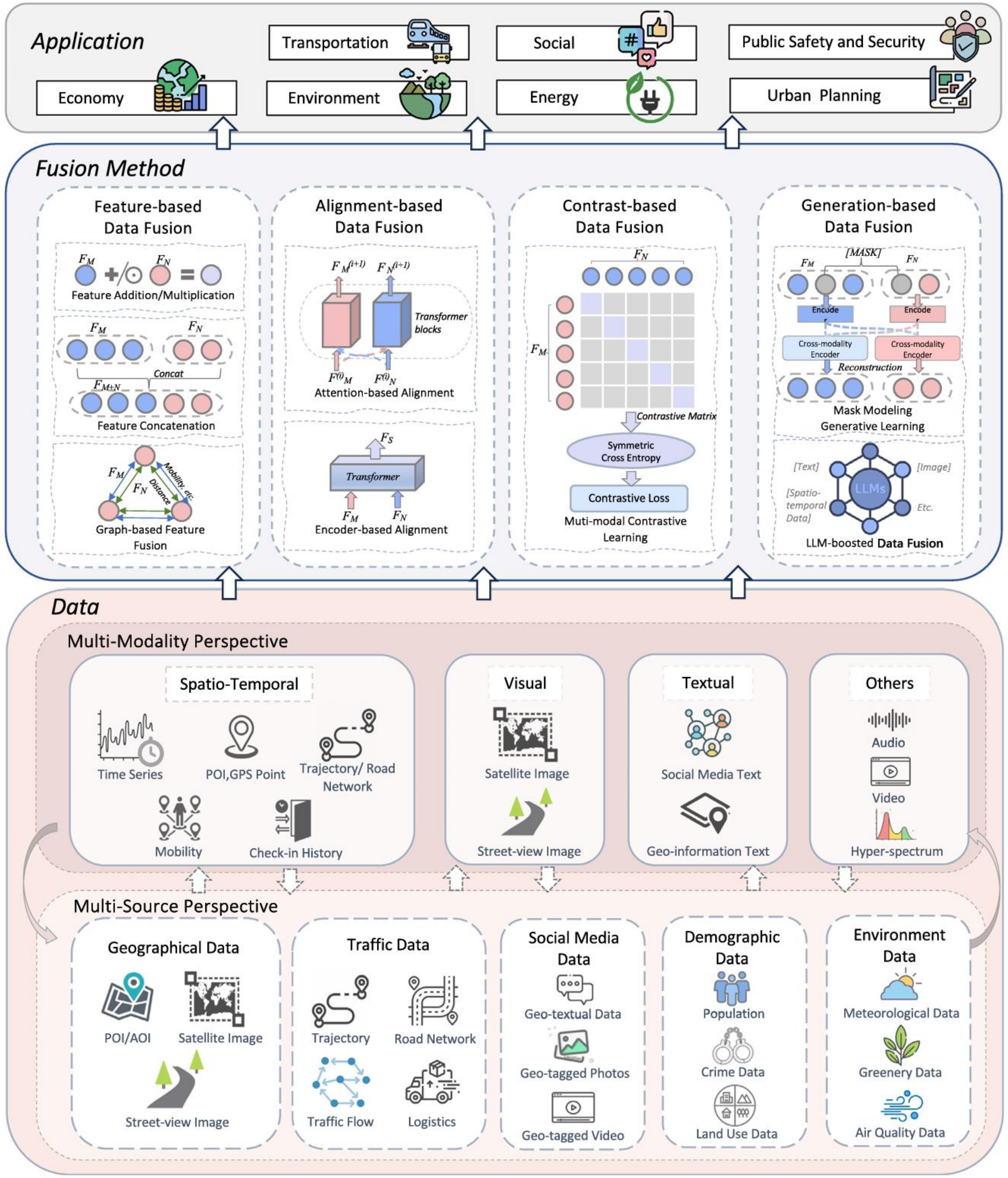
DEEP LEARNING METHODOLOGIES:

- **Feature-based Fusion:** Combining different data features (e.g., traffic flow and POIs) to create comprehensive urban mobility profiles.
- **Alignment-based Fusion:** Aligning data across modalities, such as aligning visual data from street-view images with social media text to understand mobility behavior.
- **Contrast-based Fusion:** Enhancing feature discriminability to identify underutilized amenities or high-demand areas.
- **Generation-based Fusion:** Encompassing mask modeling, diffusion, and LLM-enhanced techniques, for simulating diverse scenarios.



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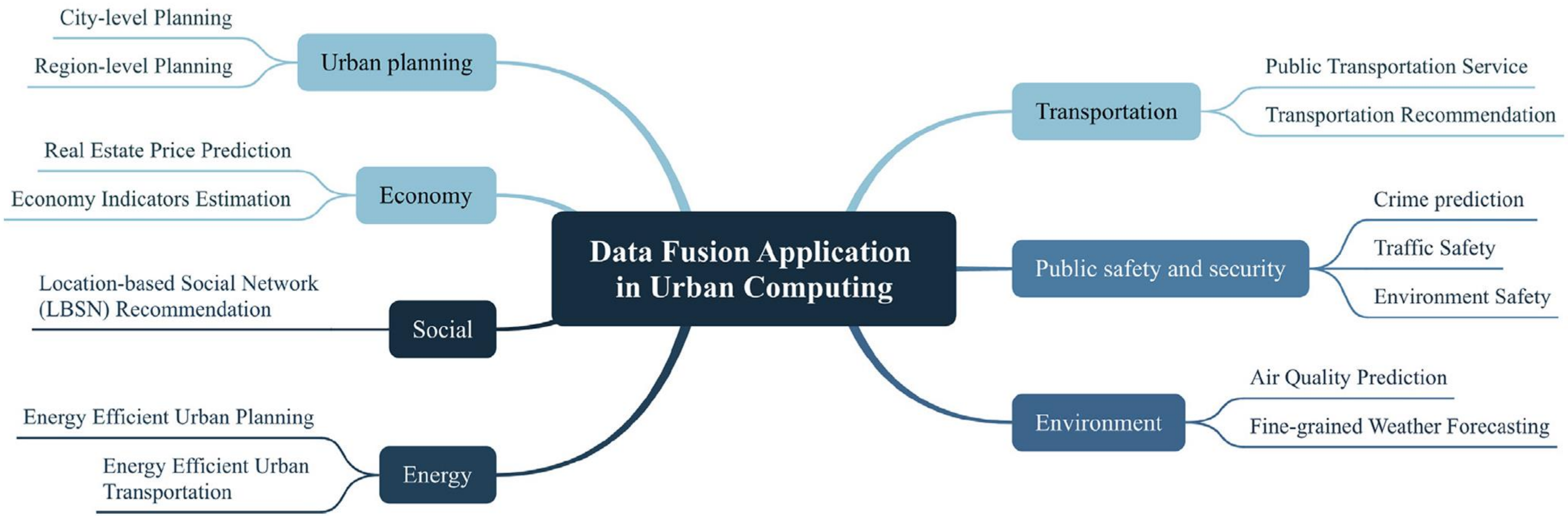
TECHNOLOGICAL INSIGHTS: FUTURE INNOVATIONS



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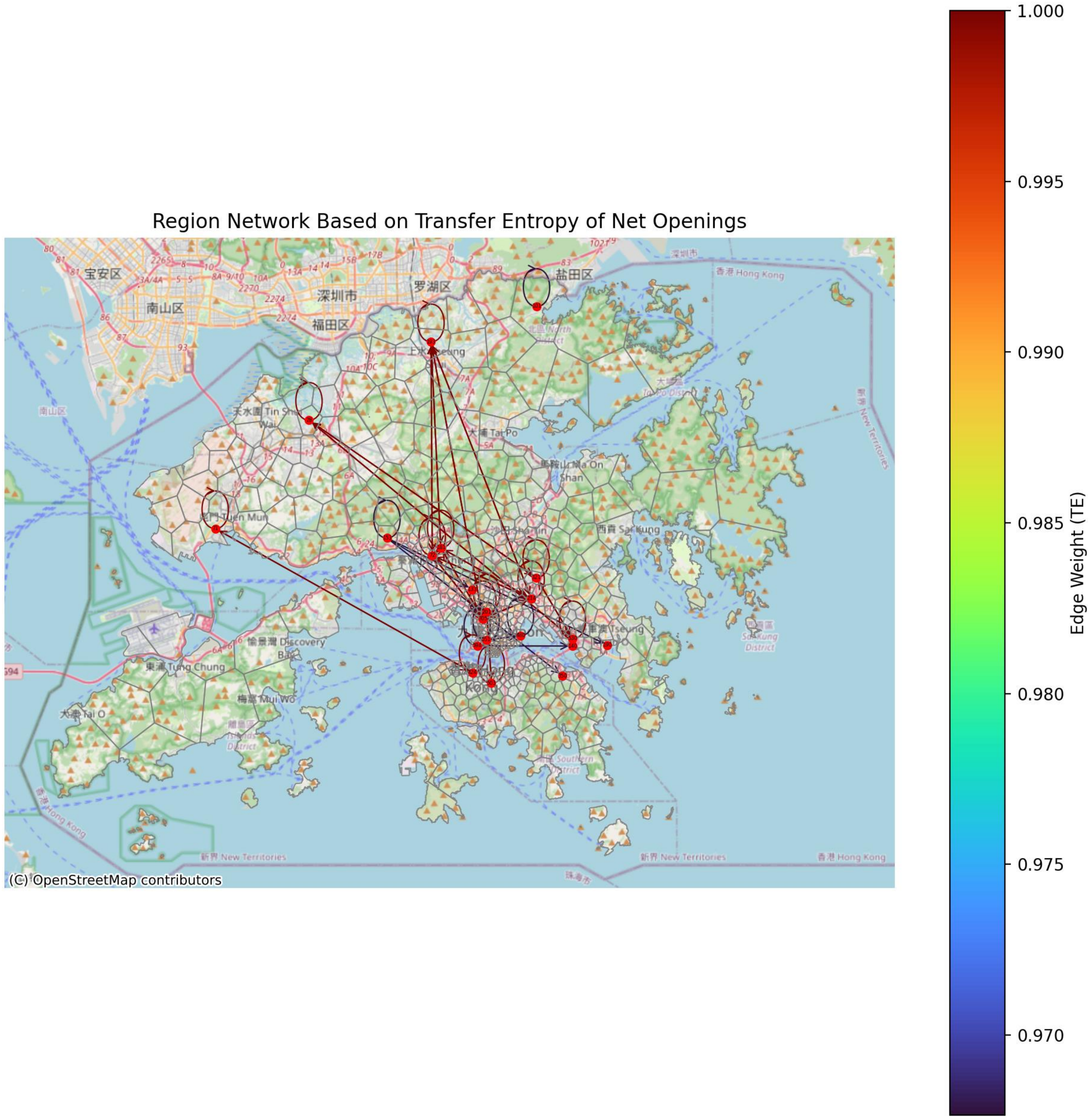
SPILLOVER EFFECTS AND REGIONAL DEPENDENCIES

Businesses in these key areas act as anchors for economic activity across the region.

CROSS-BOUNDARY ECONOMIC INFLUENCE

Business activity in Hong Kong and its boundary regions is tightly linked with cross-border commerce and economic shifts.



TAKEAWAYS

Need for Careful integration of mobility data, policy, and technology to ensure that Local Living becomes a Viable and Beneficial Reality for All urban residents.

Thank You