'Imageable' Numbers: Theory-Based Urban Design for Immersive Psychometrics Research

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PURPOSE

We introduce a design process that rests at the intersection of theory-based environmental design, 3D gaming environments (VEs), and spatial cognition measurement. This VE-based approach utilizes gaming engines for designers to build a virtual world that adheres to prescriptions of urban design 'best practices', and then embed empirical structures to test the validity of those practices using spatial cognitive measures in a precisely controlled context. The design process follows several iterative steps:

1. Identify key research questions and hypotheses
2. Identify critical measures
3. Determine environmental and scale controls,
4. Build VE schematic (districts, edges, nodes)
5. Develop road network (paths)
6. Implement landmark locations and assets
7. Implement buildings and vegetation
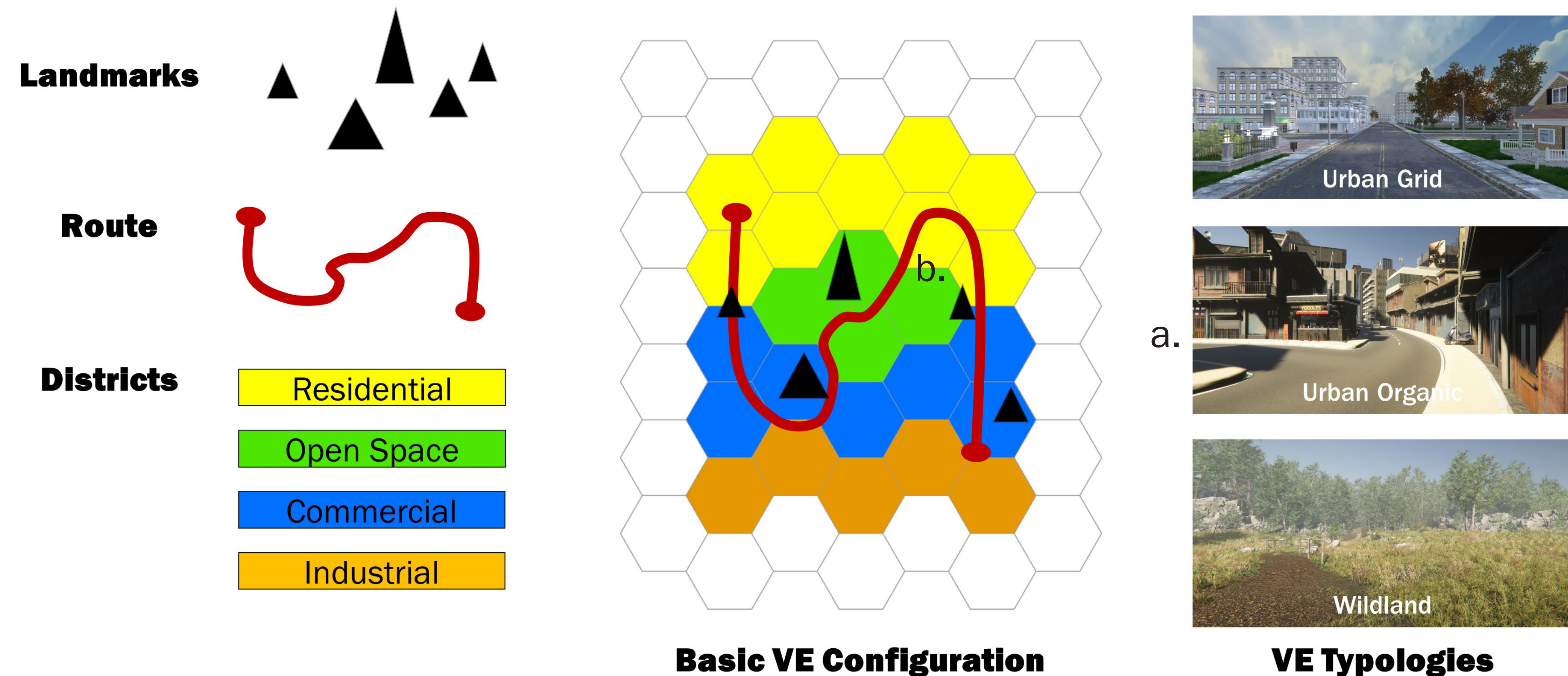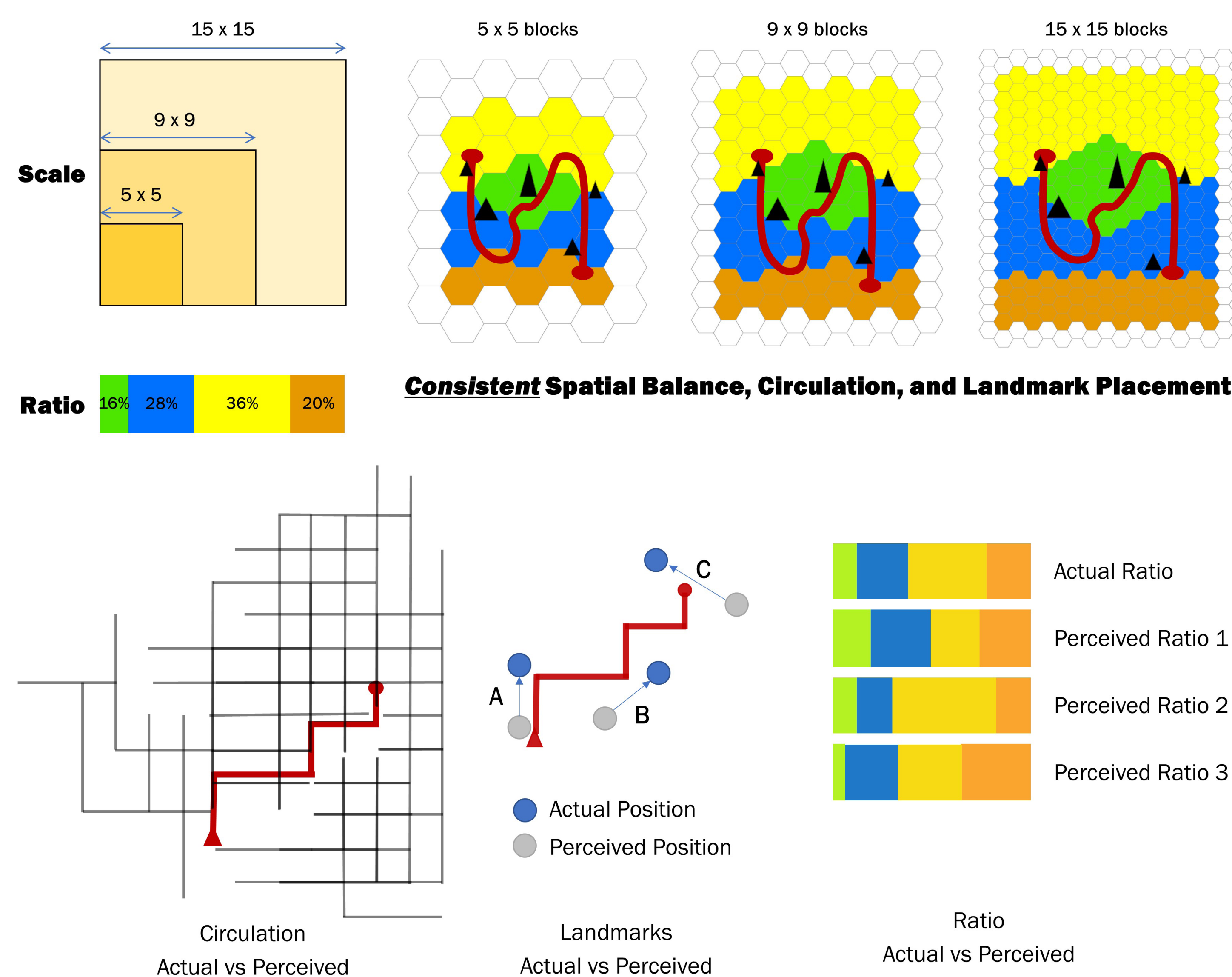8. Integrate user experience

Figure 1

Landmarks

Route

Districts
- Residential
- Open Space
- Commercial
- Industrial

Basic VE Configuration

Urban Grid

Urban Organic

Wildland

VE Typologies

Figure 2

Scale — 15 x 15 / 9 x 9 / 5 x 5

Ratio — 16% / 28% / 36% / 20%

5 x 5 blocks · 9 x 9 blocks · 15 x 15 blocks

Consistent Spatial Balance, Circulation, and Landmark Placement

- Actual Position
- Perceived Position

Actual Ratio
Perceived Ratio 1
Perceived Ratio 2
Perceived Ratio 3

Circulation
Actual vs Perceived

Landmarks
Actual vs Perceived

Ratio
Actual vs Perceived

BASE THEORIES AND METRICS

- Dense urban environment simulating 'organic city' (Figure 1a.)

- Road network transferrable across scales and experiences (Figure 2-Scale)

- Merged edges and nodes to be thresholds between districts (Figure 1b.)

- Districts maintain spatial balance, ratios, overall shape, and circulation (paths) between different scales and environment types (Figure 2)

- Bidimensional regression for landmarks (Figure 2-Landmarks)

- Minimum bounding geometry for district locations (Figure 2-Ratio)

- Shape indices to determine district shape

EXPECTED OUTCOMES

- Advance spatial cognition measures

- Ability to assess how a participant recalls and infers district boundaries lays the foundation for a new spatial memory construct.

- Boundaries of districts can be inferred based on a limited experience of place offering an ability to measure a general accuracy of memory and inference

- Forthcoming cognition studies will provide empirical commentary on the significance of Lynchian design theory as well as further understanding of the nature of human cognition in complex, novel environments

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