

Integrating Human Perception into Transportation Planning: A GIS-Based Emotional Mapping and Spatial Cognition Analysis of Meherpur District, Bangladesh

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Abstract

Transportation planning traditionally relies on quantitative measures such as traffic volumes, travel demand, and network performance. Although these approaches provide essential technical insights, they often fail to capture how people perceive and experience urban space. This study explores the role of human perception in transportation planning through emotional mapping and spatial cognition analysis in Meherpur District, Bangladesh. A total of 313 newspaper-reported incidents from 2019–2024 were georeferenced and classified into seven emotional categories: anger, happiness, love, sadness, disgust, fear, and surprise. Sixteen participants interpreted the spatial distribution of these emotion points and developed perception-based spatial patterns. The resulting maps were digitized and analyzed using GIS overlay techniques to identify collective perception structures. The findings reveal the emergence of common cognitive nodes, perception corridors, and high-consensus spatial zones despite individual differences in interpretation. Comparison with the proposed Circular Road alignment demonstrates a notable correspondence between collective perception patterns and planned transportation infrastructure. The study highlights the potential of integrating emotional geography and spatial cognition into transportation planning to support more human-centered and socially responsive decision-making.

Keywords

Emotional Mapping, Spatial Cognition, Human Perception, Gestalt Theory, Structuralism.

1. Introduction

Transportation planning traditionally relies on quantitative indicators such as Origin–Destination (O-D) patterns, traffic volume analysis, capacity assessments, and Volume-to-Capacity (V/C) ratios [12]. These scientific and engineering-based approaches provide essential information for developing transportation proposals and infrastructure projects. However, while such methods effectively measure physical movement and network performance, they often overlook how people cognitively perceive and emotionally experience urban space [9].

Human perception plays an important role in shaping how individuals understand, interpret, and navigate their surroundings [15]. Locations associated with particular experiences, emotions, and social meanings often become significant elements within the collective mental image of a city. Despite this importance, perception-based information is rarely incorporated into transportation planning and infrastructure evaluation [1].

To address this limitation, the present study adopts a human-centered approach to spatial analysis within Meherpur District. Newspaper-reported incidents and their corresponding geographic locations were used as the primary dataset [4]. Each incident location was assigned a dominant emotional response category—anger, happiness, love, sadness, disgust, fear, or surprise—based on participant perceptions [14]. Through the integration of emotional mapping, perception-based analysis, and spatial overlay techniques, the study aims to identify collective perception patterns and assess their implications for transportation planning [7].

A total of 313 newspaper reports published between 2019 and 2024 were collected and analyzed [17]. The dataset comprises reports from local, regional, and national newspapers, ensuring comprehensive spatial and temporal coverage of the study area. The mapped points represent the locations where the reported incidents occurred. Sources include Pratidiner Sangbad, Meherpur News, Naya Diganta, Gangni News 24, Greater Khulna News, The Daily Ittefaq, Janakantha, Jugantor, Kaler Kantho, Prothom Alo, Samakal, Meherpur Pratidin, Jaijaidin, Jago News 24, Doinik Noapara, Bangladesh Pratidin, Bonik Barta, BSS News, Channel 24, and Dainik Mathabhanga, among others.

The primary objective of this analysis is to explore how residents collectively organize and interpret urban space and to evaluate whether these perception patterns correspond with the proposed Circular Road alignment within Meherpur District.

2. Research Objective

The primary objective of this study is to examine collective human perception patterns within Meherpur District using emotion-based spatial analysis and to evaluate their relevance for transportation planning.

Specific objectives include:

- Developing an emotional geography database from newspaper-reported incidents.
- Identifying how individuals cognitively organize emotionally significant locations.
- Detecting common perception structures through spatial overlay analysis.
- Measuring levels of perceptual consensus among participants.
- Examining the relationship between collective perception patterns and the proposed Circular Road alignment.
- Demonstrating the applicability of perception-based approaches in transportation planning.

3. Conceptual and Theoretical Framework

3.1 Human Perception and Spatial Cognition

Spatial cognition refers to the process through which individuals perceive, interpret, and mentally organize geographic space. Rather than understanding cities through administrative boundaries or planning zones, people often rely on landmarks, memorable events, emotional experiences, and familiar routes to construct mental images of their surroundings. These cognitive representations significantly influence everyday movement and spatial decision-making.

3.2 Gestalt Theory

Gestalt Theory provides the primary theoretical foundation for this study. According to Gestalt principles, individuals naturally organize dispersed visual elements into meaningful wholes. Concepts such as proximity, continuity, closure, and connectedness explain how scattered spatial features become integrated into coherent patterns. When participants observed emotion points distributed across Meherpur, they instinctively grouped them into recognizable structures and networks.

3.3 Structuralism Theory

Structuralism complements Gestalt Theory by suggesting that human understanding is shaped by underlying cognitive structures. Repeated spatial patterns emerging from different participants indicate the existence of shared frameworks through which residents collectively interpret urban space. The recurrence of similar

perception structures therefore reflects common cognitive processes rather than random individual interpretations.

4. Methodology

This study adopted a multi-stage methodological framework integrating emotional mapping, cognitive perception analysis, participant-based visual interpretation, and GIS-based spatial analysis. The objective was to identify collective perception patterns within Meherpur District and examine their relevance to transportation planning. The methodology consisted of four sequential stages.

4.1 Data Collection and Emotional Mapping

A total of 313 newspaper-reported incidents published between 2019 and 2024 were collected from national, regional, and local newspapers. Each incident was georeferenced based on the location reported in the news article and incorporated into the GIS database for Meherpur District.

To develop the emotional geography database, each incident was reviewed in relation to the overall context and emotional meaning of the reported event. Seven emotional categories were considered: anger, happiness, love, sadness, disgust, fear, and surprise. A single dominant emotion was assigned to each incident to ensure consistency in the spatial analysis.

Incidents involving conflict, frustration, or public dissatisfaction were classified as anger, while positive or joyful events were classified as happiness. Events reflecting affection, care, or emotional attachment were categorized as love. Incidents involving loss, grief, or suffering were classified as sadness. Events associated with unpleasant, harmful, or socially disturbing conditions were categorized as disgust. Incidents involving danger, threats, insecurity, or risk were classified as fear, whereas unexpected, unusual, or sudden events were categorized as surprise.

The classification was based on the overall context of each news report rather than on individual words or headlines. When an incident appeared to involve more than one emotion, the category that best represented the primary emotional meaning of the event was selected. The same criteria were applied throughout the coding process for all 313 incidents to maintain consistency in the database and subsequent spatial analysis.

Although the classification followed predefined criteria, some degree of researcher judgment was unavoidable because newspaper reports do not always express emotions explicitly. This contextual interpretation may introduce a degree of subjectivity into the classification and is therefore recognized as a limitation of the study.

Table 1. Classification basis for emotional categories

Emotional category	Classification basis
Anger	Conflict, frustration, dissatisfaction, protest, or public anger
Happiness	Joyful, positive, celebratory, or successful events
Love	Affection, care, emotional attachment, or close relationships
Sadness	Loss, grief, suffering, death, or distress
Disgust	Unpleasant, harmful, dirty, disturbing, or socially unacceptable conditions
Fear	Danger, threat, insecurity, accident risk, or unsafe situations
Surprise	Unexpected, unusual, sudden, or unforeseen events

Source: Author's classification framework, adapted from Ekman (1992) and Plutchik (1980), with Love incorporated as an additional contextual category.

The classified incidents were visualized in a GIS environment using a color-coded mapping system. The resulting emotional map represented the spatial distribution of emotionally significant locations and served as the primary input for the perception analysis.

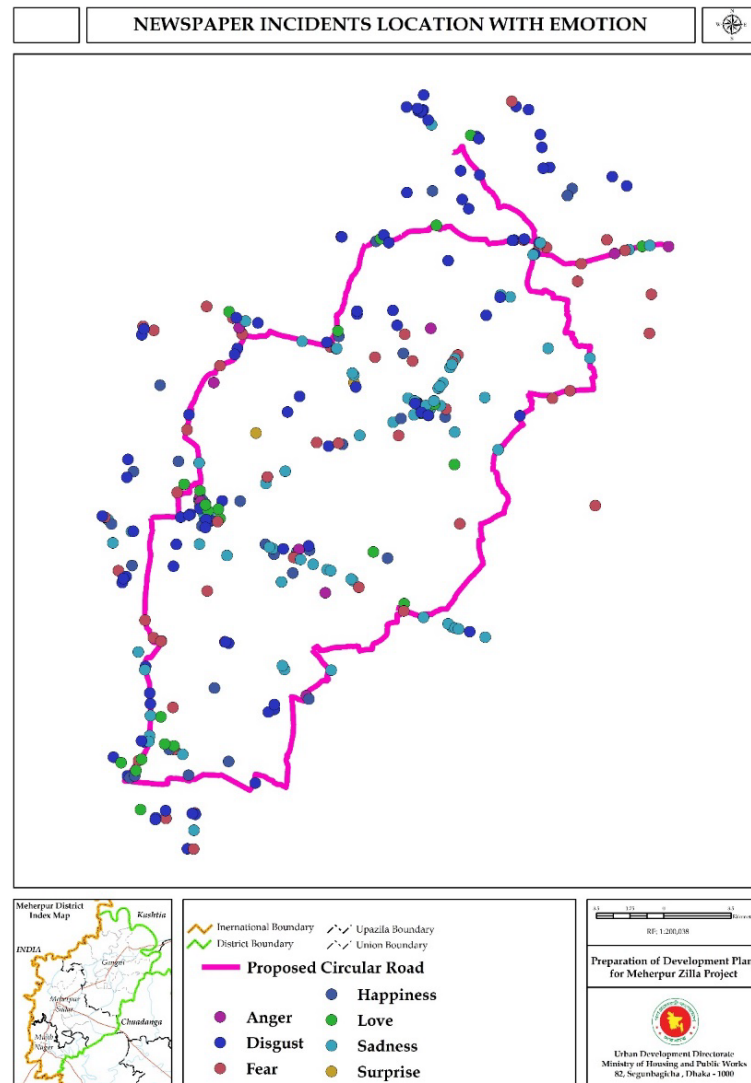


Figure 1. Spatial Distribution of Newspaper Incident Emotion Points
Source: Author's Preparation, 2026

4.2 Participant Selection and Perception Mapping

Sixteen participants (10 female and 6 male) were selected to participate in the perception mapping exercise. All participants received the same emotional point map and identical instructions to ensure consistency.

Participants were asked to carefully observe the spatial arrangement of the emotion points and connect them according to their own cognitive understanding of the spatial relationships among locations. No predefined analytical rules or constraints were imposed, allowing participants to interpret the emotional landscape freely.

A specific condition was introduced whereby the connected points had to form a meaningful and recognizable spatial structure rather than arbitrary lines. This process generated 16 individual Human Visual Perception Pattern Maps, each representing a unique interpretation of the emotional geography of Meherpur.

4.3 Digitization and GIS Overlay Analysis

All participant-generated perception maps were digitized and transferred into a GIS platform. The digitized maps were then superimposed using spatial overlay techniques to identify recurring patterns and areas of collective agreement.

A standardized grid system was applied across the study area. The frequency with which each grid cell appeared within participant maps was calculated and classified into four levels of perceptual consensus:

- 100% Consensus: Present in all participant maps
- 95% Consensus: Present in nearly all maps
- 90% Consensus: Frequently recurring locations and corridors
- 80% Consensus: Broader perception zones with moderate agreement

This overlay process enabled the identification of:

- Dominant cognitive nodes
- Collective perception corridors
- High-consensus spatial zones
- Shared cognitive structures

4.4 Validation with Transportation Infrastructure

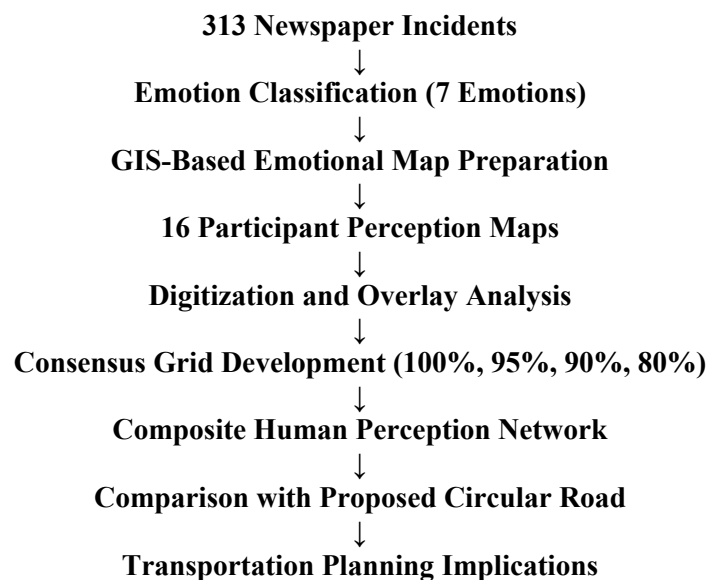
To evaluate the planning relevance of the perception patterns, the composite perception network was compared with the proposed Circular Road alignment of Meherpur District.

The proposed transportation corridor was overlaid on the collective perception network to examine spatial correspondence between:

- Perception corridors
- Consensus zones
- Proposed road segments

The analysis assessed whether the transportation proposal coincided with locations that residents collectively perceive as important, connected, and spatially significant. This comparison provided a human-centered validation framework alongside conventional engineering and transportation planning approaches.

4.5 Analytical Framework



5. Findings and Discussion

5.1 Individual Perception Patterns

The individual perception maps demonstrated substantial variation in form and configuration. Participants connected emotion points differently based on personal interpretation and cognitive judgment. Some emphasized localized connections, while others developed broader district-scale structures.

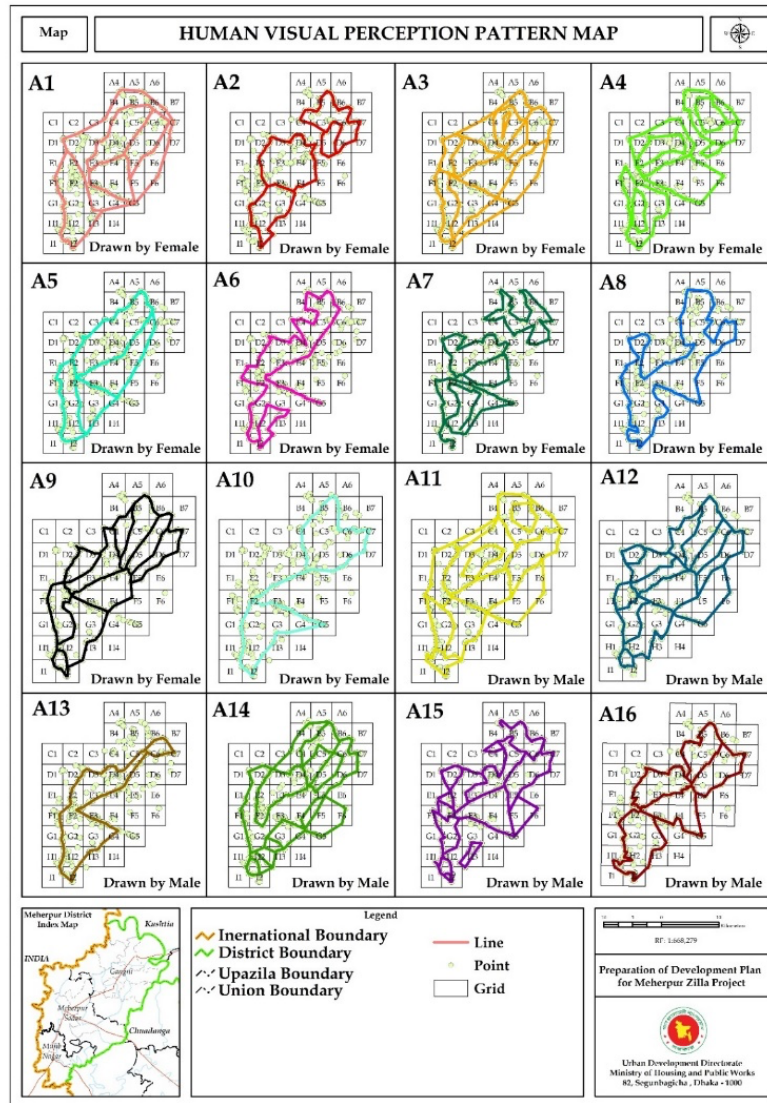


Figure 2. Individual Human Visual Perception Pattern Maps

Source: Author's Preparation, 2026

Despite these differences, several recurring spatial relationships appeared consistently across multiple maps, suggesting the presence of shared cognitive understanding among participants.

5.2 Composite Perception Network

Overlaying the sixteen perception maps produced a composite perception network that revealed dominant cognitive nodes and recurrent perception corridors. These features represented locations and connections repeatedly recognized by participants as spatially significant.

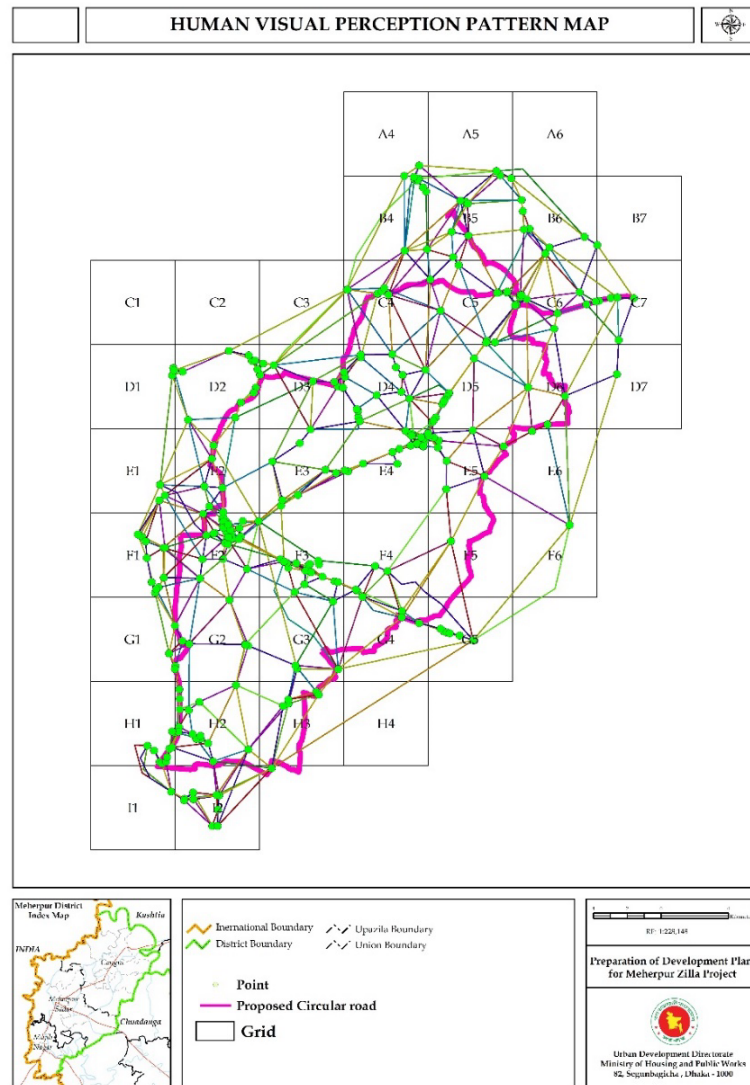


Figure 3. Composite Human Visual Perception Pattern Network and Proposed Circular Road
 Source: Author's Preparation, 2026

The resulting network illustrates that residents do not perceive the district as a collection of isolated locations. Instead, they mentally organize space through interconnected corridors and recognizable spatial structures.

5.3 Consensus Grid Analysis

The consensus analysis identified a hierarchical perception framework.

The 100% consensus grids formed the perceptual core of the district, representing locations recognized by all participants. The 95% and 90% grids extended this core through connecting corridors, while the 80% grids defined the broader extent of the collective perception network.

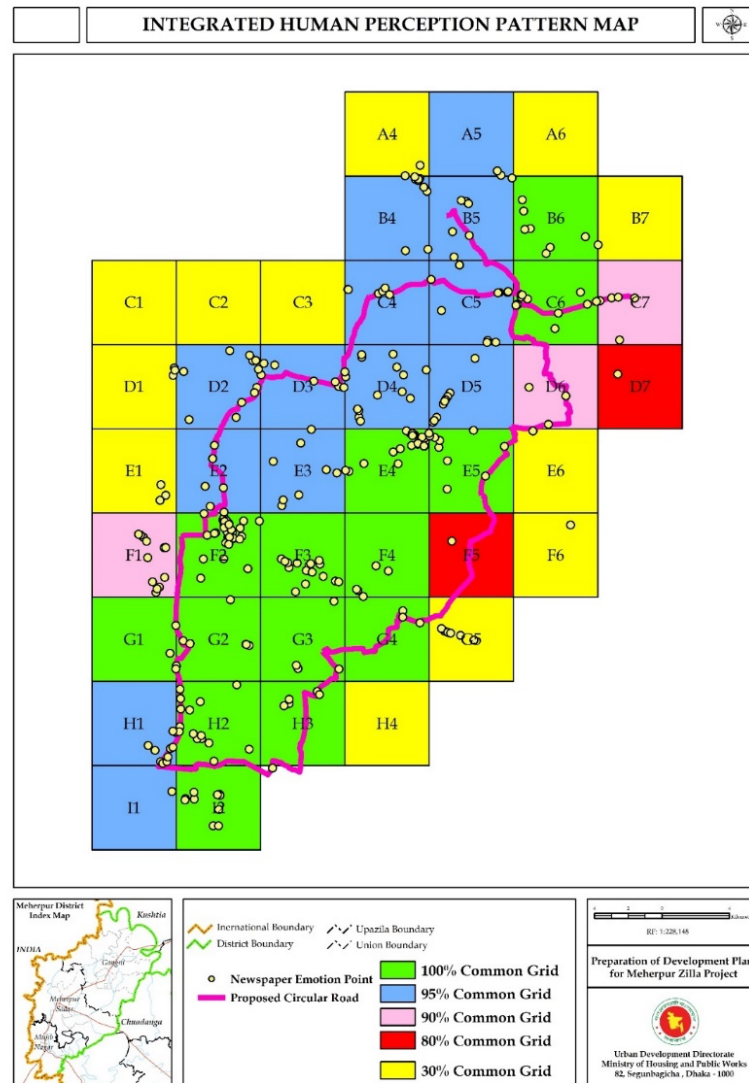


Figure 4. Collective Perception Consensus Grid Map
Source: Author's Preparation, 2026

This hierarchy demonstrates varying levels of spatial familiarity and cognitive significance across different areas of the district.

5.4 Implications for Transportation Planning

A notable finding of the study is the spatial correspondence between the composite perception network and the proposed Circular Road alignment. Several segments of the proposed transportation corridor intersected high-consensus perception zones and dominant cognitive corridors.

This correspondence suggests that the proposed road network reflects not only engineering considerations but also the collective spatial understanding of residents. Consequently, perception-based analysis can serve as a complementary validation tool for transportation planning and infrastructure development.

The findings also demonstrate that emotional mapping and spatial cognition analysis offer a cost-effective approach for incorporating community perspectives into planning processes.

6. Limitations of the Study

This study has some limitations that should be considered when interpreting the findings. First, the emotional database was developed from newspaper-reported incidents collected between 2019 and 2024. Therefore, the database may not include all events or experiences that were emotionally important to local residents, as some events may not have been reported in newspapers. Second, the perception mapping exercise involved only 16 participants. Although the participants produced several common spatial patterns, this relatively small sample cannot represent the perceptions of the entire population of Meherpur District. Third, both the emotion classification and the participant perception mapping involved some degree of subjective interpretation. The emotion categories were assigned based on the contextual meaning of the reported incidents, while participants were allowed to interpret and connect the emotion points according to their own understanding. Therefore, the results should be considered as a complementary perception-based approach rather than a complete representation of community perception. Future studies could use a larger and more diverse participant group, additional data sources, and a more formal coding and reliability procedure to strengthen the findings.

7. Conclusion

This study demonstrates the potential of integrating human perception into transportation planning through emotional mapping and spatial cognition analysis. By transforming newspaper-reported incidents into an emotional geography database and examining how individuals organize these locations cognitively, the research identified collective perception structures embedded within Meherpur District.

The findings reveal that residents share common cognitive frameworks characterized by dominant nodes, perception corridors, and consensus zones. These structures emerged consistently despite differences in individual interpretation, supporting the theoretical foundations of Gestalt Theory and Structuralism.

The observed alignment between collective perception patterns and the proposed Circular Road further highlights the practical relevance of perception-based analysis for infrastructure planning. Incorporating human perception alongside conventional engineering assessments can contribute to more inclusive, responsive, and people-oriented transportation planning.

The proposed methodology provides a novel framework for bridging emotional geography, cognitive perception, and spatial planning, offering planners an additional perspective for evaluating future transportation investments and urban development strategies.

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Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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