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# Structural Analysis of the Impact of Readability, Human Scale, Spatial Diversity, and Visual Quality of Urban Architecture on Spatial Justice and Psychological Components of Citizens

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**Abstract**
Urban architecture plays a critical role in shaping not only the physical form of cities but also the social and psychological experiences of their inhabitants. This study examines the structural relationships between key architectural qualities of urban environments including readability, human scale, spatial diversity, and visual quality, and their impacts on spatial justice and the psychological components of citizens. Using a cross-sectional survey design, data were collected from 312 adult residents in diverse urban public spaces. Validated measurement instruments were employed, and Structural Equation Modeling (SEM) was used to test the hypothesized model. The results indicate that all four architectural variables have significant positive effects on perceived spatial justice (readability: $\beta = 0.29$, $p < .001$; human scale: $\beta = 0.25$, $p < .001$; spatial diversity: $\beta = 0.21$, $p < .001$; visual quality: $\beta = 0.33$, $p < .001$). In turn, spatial justice significantly predicts citizens' psychological components, including sense of belonging, perceived safety, and emotional comfort ($\beta = 0.35$, $p < .001$). The model explains 61% of the variance in spatial justice and 68% of the variance in psychological outcomes, indicating strong explanatory power. These findings demonstrate that architectural and perceptual qualities of urban space are not merely aesthetic attributes but fundamental mechanisms through which justice and mental well-being are experienced in cities. The study contributes to urban design, spatial justice theory, and environmental psychology by empirically linking form, fairness, and psychological health. The results provide actionable insights for planners and policymakers seeking to create more inclusive, legible, and humane urban environments.

**Keywords:** urban architecture; spatial justice; environmental psychology; human scale; visual quality

## Introduction

Rapid urbanization has transformed cities into complex socio-spatial systems where the built environment plays a decisive role in shaping human experience, social relations, and access to opportunities. Urban architecture is not merely a physical container for activities; it actively mediates how citizens perceive, navigate, and emotionally respond to space. In recent decades, scholars across urban design, planning, and environmental

psychology have emphasized that qualities such as readability, human scale, spatial diversity, and visual quality are not aesthetic luxuries but structural determinants of urban justice and psychological well-being (Dalavong, et al., 2024; Dsouza, et al., 2023). These qualities influence how inclusive, legible, and supportive urban environments are for different social groups.

At the same time, the concept of spatial justice has gained prominence as a framework for understanding how urban space distributes advantages and disadvantages across populations. Spatial justice connects social equity with the spatial organization of cities, arguing that injustices are not only social or economic but also spatially produced and reproduced (Lorenzo, et al., 2023). Access to safe, readable, and psychologically supportive environments is increasingly recognized as a fundamental dimension of justice in urban life. However, while much research has examined socioeconomic and infrastructural aspects of spatial justice, fewer studies have structurally analyzed how architectural and perceptual qualities of space contribute to citizens' sense of fairness, belonging, and mental well-being (Monadi, 2025).

Urban architecture influences daily life through both functional and symbolic mechanisms. Functionally, design characteristics such as street layout, building scale, and visual coherence affect how easily people can orient themselves, interact, and feel safe in their surroundings. Symbolically, architecture communicates values about who belongs, who is prioritized, and whose presence is welcomed or marginalized (Vallebueno & Lee, 2023). When environments are confusing, hostile, monotonous, or visually degraded, they can intensify feelings of exclusion, stress, and powerlessness. Conversely, environments that are legible, human-scaled, diverse, and visually engaging tend to support psychological comfort, social interaction, and a sense of spatial dignity.

Readability refers to the ease with which people can understand and mentally map their surroundings. Legible environments allow users to identify paths, nodes, edges, districts, and landmarks, enabling orientation and cognitive clarity. Poor readability increases cognitive load, anxiety, and disorientation, conditions that disproportionately affect vulnerable groups such as the elderly, children, migrants, and people with disabilities. From a justice perspective, a city that is not readable to all its users effectively excludes some from full participation in urban life. Thus, readability is not only a design issue but also a political and ethical one (Monadi, 2025).

Human scale concerns the proportional relationship between built form and the human body, perception, and movement. Buildings, streets, and public spaces that respond to human sensory capacities such as walking speed, eye level, and need for social distance are more likely to foster comfort, safety, and sociability (Li, et al., 2021). In contrast, environments dominated by oversized blocks, excessive setbacks, or vehicle-oriented infrastructure can alienate pedestrians and weaken social life. Human scale is therefore closely tied to psychological components such as perceived safety, control, and emotional attachment to place.

Spatial diversity refers to the variety of uses, forms, activities, and experiences within urban environments. Diversity in land use, building types, and social presence is essential for urban vitality and safety. From a psychological perspective, diversity prevents monotony, stimulates curiosity, and supports multiple identities and lifestyles. From a justice perspective, spatial diversity enables different groups to find representation and opportunity within the city. Homogeneous and functionally segregated environments, by contrast, often reinforce exclusion, isolation, and spatial inequality (Chen, et al., 2018).

Visual quality encompasses the aesthetic coherence, richness, and sensory appeal of urban environments. It includes factors such as materiality, color, façade articulation, landscape integration, and the presence of art and nature. Visual quality influences first impressions, emotional responses, and long-term place attachment. Poor visual environments, characterized by neglect, disorder, and visual pollution, are consistently associated with stress, reduced well-being, and stigmatization of neighborhoods (Lim, et al., 2021). These visual conditions often coincide with socio-spatial marginalization, making visual quality a critical yet under-theorized dimension of spatial justice.

Parallel to these architectural qualities, the psychological components of citizens' urban experience including sense of belonging, perceived safety, environmental satisfaction, stress levels, and mental well-being have become central concerns in contemporary urban research. Environmental psychology demonstrates that the built environment shapes cognitive, emotional, and behavioral responses. People do not simply use space; they interpret it, feel it, and internalize it. When urban spaces undermine psychological needs for autonomy, competence, and relatedness, they can contribute to anxiety, alienation, and social withdrawal (Buckley, 2022).

Despite growing recognition of these relationships, existing literature often treats architectural qualities, spatial justice, and psychological outcomes in separate analytical silos. Studies on readability, human scale, diversity, and visual quality tend to focus on design performance or user satisfaction, while research on spatial justice often emphasizes policy, housing, and infrastructure. Similarly, psychological studies frequently examine well-being without structurally linking it to specific spatial and architectural variables. This fragmentation limits our ability to understand how urban form systematically produces both justice and injustice at the experiential level.

Therefore, there is a pressing need for integrated, structural models that connect architectural qualities of urban space with spatial justice and psychological components of citizens. A structural analysis allows

researchers to move beyond simple correlations and explore how design variables interact, mediate, and influence broader social and psychological outcomes. By examining the pathways through which readability, human scale, spatial diversity, and visual quality shape perceptions of fairness, inclusion, and mental well-being, it becomes possible to identify leverage points for more just and humane urban design.

This study responds to that need by proposing and testing a structural model that links key architectural qualities of urban space to spatial justice and psychological components of citizens. The central premise is that the way urban architecture is perceived and experienced plays a decisive role in how people evaluate the fairness of their city and how they feel within it. Specifically, the research investigates how readability, human scale, spatial diversity, and visual quality function as latent variables influencing spatial justice and psychological outcomes such as sense of belonging, perceived safety, and emotional comfort.

By situating architectural perception within a justice-oriented and psychologically informed framework, this paper contributes to three major bodies of knowledge: urban design theory, spatial justice studies, and environmental psychology. It offers a conceptual and empirical bridge between form and fairness, between design and dignity. In doing so, it seeks to support planners, architects, and policymakers in creating cities that are not only efficient and beautiful but also readable, humane, diverse, and just.

## Methods

### *Research Design*

This study adopts a quantitative, cross-sectional, correlational research design to examine the structural relationships between architectural qualities of urban space (readability, human scale, spatial diversity, and visual quality), spatial justice, and psychological components of citizens. Data were collected using a structured questionnaire and analyzed using Structural Equation Modeling (SEM) to test the hypothesized relationships between latent constructs. The research framework conceptualizes architectural-perceptual variables as exogenous constructs and spatial justice and psychological components as endogenous constructs. SEM was selected due to its ability to simultaneously test multiple dependent relationships and account for measurement error.

### *Study Area and Participants*

The study was conducted in urban public spaces, encompassing a wide range of architectural forms, land-use patterns, and socio-spatial conditions. Participants were adult residents (≥18 years) who regularly use public urban spaces, with inclusion criteria requiring at least one year of residency in the study area, regular use of urban public spaces (a minimum of twice per week), and the ability to understand and respond to the questionnaire. Stratified random sampling was employed across neighborhoods with varying socio-spatial characteristics to ensure diversity in urban experience. Sample size was determined using G*Power 3.1 software for multiple regression and SEM path modeling, with the following parameters: linear multiple regression (fixed model, $R^2$ deviation from zero), effect size $f^2 = 0.15$ (medium effect; Cohen, 1988), $\alpha = 0.05$, statistical power $(1–\beta) = 0.95$, and four predictors (readability, human scale, spatial diversity, and visual quality). The analysis indicated a minimum required sample size of 129 participants; however, to account for missing data and non-response bias and to meet SEM recommendations (10–15 cases per estimated parameter), the final target sample size was increased to at least 312 respondents.

### *Measurement Instruments*

All variables were measured using validated and widely used scales, adapted to the urban architectural context. Items were rated on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree).

### *Readability*

Measured using adapted items from Lynch's (1960) urban legibility framework and later operationalizations by Nasar (1994) and Ewing & Handy (2009).

Sample items included "It is easy to understand how to move through this area" and "Landmarks help me orient myself in this place." (Salazar-Miranda, et al., 2025).

### *Human Scale*

Measured using items derived from Gehl (2010) and Ewing et al. (2015) on pedestrian-scale urban form. Sample items included "Buildings and spaces here feel designed for people, not cars" and "The street environment feels comfortable at walking speed." (Yin, Yet al., 2023).

### *Spatial Diversity*

Assessed using urban diversity and land-use mix indicators adapted from Jacobs (1961), Frank et al.

(2010), and Nasar & Julian (1995).

Sample items included "There is a variety of activities and functions in this area" and "Different types of people and uses coexist here." (Lyu, et al., 2025).

***Visual Quality***

Measured using items from Nasar's (1994) visual preference scale and Ewing et al. (2015). Sample items included "This area is visually attractive" and "The design details and materials are pleasing." (Qiu, et al., 2021).

***Spatial Justice***

Operationalized using perceived spatial equity and access scales adapted from Soja (2010), Fainstein (2010), and Marcuse et al. (2009).

Sample items included "This area feels equally accessible to all social groups" and "Public space here is fairly distributed and inclusive." (Zang, et al., 2019).

***Psychological Components***

Psychological outcomes included sense of belonging, perceived safety, environmental satisfaction, and emotional comfort / stress (WHO-5 Well-being Index) (Huang, et al., 2024).

***Data Collection Procedure***

Data were collected through on-site surveys administered by trained researchers and supplemented by an online version distributed via community networks. Participation was voluntary and anonymous.

***Data Analysis***

Data were analyzed using SPSS 29 for preliminary screening and descriptive statistics and AMOS/SmartPLS for SEM. Prior to hypothesis testing, data were examined for missing values, outliers, and adherence to statistical assumptions. Missing data below 5% per variable were handled using the Expectation–Maximization method, and multivariate outliers were assessed using Mahalanobis distance with a $p < .001$ threshold. Normality was evaluated through skewness and kurtosis (acceptable range ±2), Shapiro–Wilk and Kolmogorov–Smirnov tests ($p > .05$ indicating normality), and visual inspection of histograms and Q–Q plots. Linearity and homoscedasticity were assessed using scatterplots of standardized residuals versus predicted values, while multicollinearity was examined using Variance Inflation Factor (VIF < 5) and tolerance values (> 0.20). Independence of errors was tested with the Durbin–Watson statistic (acceptable range 1.5–2.5). Reliability was evaluated using Cronbach's alpha and Composite Reliability (CR ≥ 0.70), and validity was assessed through Average Variance Extracted (AVE ≥ 0.50), the Fornell–Larcker criterion, and the HTMT ratio (< 0.85). Model fit was evaluated using $\chi^2/df < 3$, CFI ≥ 0.90, TLI ≥ 0.90, RMSEA ≤ 0.08, and SRMR ≤ 0.08, and bootstrapping with 5,000 resamples was applied to test the significance of direct and indirect effects within the structural model.

## Results

***Demographic Characteristics of Respondents***

A total of N = 312 valid questionnaires were analyzed. Table 1 presents the demographic profile of the respondents. The sample was balanced in terms of gender and represented a wide range of age groups, education levels, and residential tenure, supporting the representativeness of the urban population.

**Table 1.** Demographic Characteristics of the Sample (N = 312)

| Variable | Category | Frequency | Percentage (%) |
|---|---|---|---|
| Gender | Male | 158 | 50.6 |
| | Female | 154 | 49.4 |
| Age | 18–29 | 72 | 23.1 |
| | 30–39 | 89 | 28.5 |
| | 40–49 | 76 | 24.4 |
| | 50 and above | 75 | 24.0 |
| Education Level | High school or below | 61 | 19.5 |
| | Bachelor's degree | 158 | 50.6 |
| | Master's/PhD | 93 | 29.8 |
| Length of Residency | 1–5 years | 87 | 27.9 |
| | 6–10 years | 102 | 32.7 |
| | More than 10 years | 123 | 39.4 |

***Descriptive Statistics of Study Variables***

Table 2 presents the means, standard deviations, skewness, and kurtosis values for all latent variables. All variables showed acceptable dispersion and approximate normal distribution. All skewness and kurtosis values fell within the acceptable range of ±2, indicating no severe violations of normality.

**Table 2.** Descriptive Statistics and Normality Indicators

| Construct | Mean | SD | Skewness | Kurtosis |
|---|---|---|---|---|
| Readability | 3.64 | 0.71 | −0.42 | −0.38 |
| Human Scale | 3.58 | 0.74 | −0.36 | −0.44 |
| Spatial Diversity | 3.51 | 0.77 | −0.29 | −0.51 |
| Visual Quality | 3.69 | 0.68 | −0.47 | −0.41 |
| Spatial Justice | 3.46 | 0.73 | −0.33 | −0.48 |
| Psychological Factors | 3.72 | 0.65 | −0.51 | −0.39 |

***Assumption Testing Results***

Normality was further assessed using the Shapiro–Wilk test and Kolmogorov–Smirnov test. For all constructs, test results were non-significant ($p > .05$), confirming approximate normal distribution. Multicollinearity diagnostics showed VIF values ranging from 1.42 to 2.08, well below the threshold of 5, and tolerance values above 0.48. Linearity and homoscedasticity were confirmed through residual plots, and independence of errors was supported by a Durbin–Watson value of 1.93. No influential multivariate outliers were detected using Mahalanobis distance ($p < .001$ criterion).

**Table 3.** Assumption Testing Summary

| Test / Indicator | Acceptable Range | Observed Values | Result |
|---|---|---|---|
| Skewness / Kurtosis | ±2 | −0.51 to −0.29 | Acceptable |
| Shapiro–Wilk (p) | > .05 | .071 – .284 | Normal |
| VIF | < 5 | 1.42 – 2.08 | No collinearity |
| Tolerance | > 0.20 | 0.48 – 0.70 | Acceptable |
| Durbin–Watson | 1.5 – 2.5 | 1.93 | Acceptable |

***Measurement Model: Reliability and Validity***

Cronbach's alpha and Composite Reliability (CR) values exceeded 0.70 for all constructs, and AVE values exceeded 0.50, confirming internal consistency and convergent validity. Discriminant validity was supported using the Fornell–Larcker criterion and HTMT ratios (< 0.85).

**Table 4.** Reliability and Convergent Validity

| Construct | Cronbach's α | CR | AVE |
|---|---|---|---|
| Readability | 0.86 | 0.89 | 0.63 |
| Human Scale | 0.88 | 0.91 | 0.66 |
| Spatial Diversity | 0.84 | 0.88 | 0.61 |
| Visual Quality | 0.89 | 0.92 | 0.68 |
| Spatial Justice | 0.87 | 0.90 | 0.65 |
| Psychological Factors | 0.90 | 0.93 | 0.69 |

***Structural Model and Main Findings***

The structural model showed good fit to the data: $\chi^2/df = 2.21$, CFI = 0.94, TLI = 0.93, RMSEA = 0.061, SRMR = 0.048. Readability, human scale, spatial diversity, and visual quality all had significant positive effects on spatial justice, and both direct and indirect effects on psychological components were observed. The model explained 61% of the variance in Spatial Justice ($R^2 = 0.61$) and 68% of the variance in Psychological Components ($R^2 = 0.68$), indicating strong explanatory power.

**Table 5.** Structural Path Results

| Hypothesis | Path | β | t-value | p-value | Result |
|---|---|---|---|---|---|
| H1 | Readability → Spatial Justice | 0.29 | 4.81 | <.001 | Supported |
| H2 | Human Scale → Spatial Justice | 0.25 | 4.12 | <.001 | Supported |
| H3 | Spatial Diversity → Spatial Justice | 0.21 | 3.74 | <.001 | Supported |
| H4 | Visual Quality → Spatial Justice | 0.33 | 5.29 | <.001 | Supported |
| H5 | Readability → Psychological Factors | 0.22 | 3.89 | <.001 | Supported |
| H6 | Human Scale → Psychological Factors | 0.26 | 4.44 | <.001 | Supported |
| H7 | Spatial Justice → Psychological Factors | 0.35 | 6.02 | <.001 | Supported |

## Discussion

This study set out to structurally examine how key architectural qualities of urban environments including readability, human scale, spatial diversity, and visual quality, shape spatial justice and, through it, the psychological components of citizens. The findings provide strong empirical support for the central premise of the research: that urban architecture operates not only as a physical framework but as a socio-psychological system through which equity, belonging, and well-being are produced. Overall, the results confirm that perceptual and experiential qualities of space play a decisive role in how people evaluate the fairness of their city and how they feel within it.

First, the significant positive effects of readability on spatial justice and psychological outcomes highlight the importance of legible urban environments. Consistent with Lynch's theory of urban imageability and subsequent work in environmental psychology, the results suggest that when people can easily understand and navigate their surroundings, they feel more in control, less stressed, and more included (Monadi, 2025). From a justice perspective, readability appears to function as a form of spatial accessibility: environments that are confusing or fragmented subtly exclude those with less spatial capital, such as newcomers, older adults, and marginalized groups. The present findings thus reinforce the argument that legibility is not merely a design convenience but a justice-relevant quality of space (Monadi, 2025).

Second, human scale emerged as a strong predictor of both spatial justice and psychological components, supporting the work of Gehl (2010) and others who emphasize the human body and sensory experience as the foundation of urban life. When streets, buildings, and public spaces are designed at proportions that relate to walking speed, eye level, and social distance, people feel more comfortable and safer (Wang, et al., 2025). The results indicate that such environments foster perceptions of dignity and respect, key elements of spatial justice, and enhance emotional comfort and place attachment. In contrast, environments dominated by oversized, vehicle-oriented, or impersonal forms may generate feelings of insignificance and exclusion (Rhee, et al., 2023).

Third, the positive role of spatial diversity confirms Jacobs' argument that variety of uses, people, and activities is essential for vibrant and socially just cities. The findings show that diversity not only contributes to liveliness but also to fairness and psychological well-being (Gao & Liu, 2021). Environments that support multiple functions and identities allow different social groups to see themselves reflected in the urban landscape. This reinforces the idea that justice is experienced not only through formal rights and services but through everyday encounters with difference in shared spaces. Monotonous and functionally segregated environments, by contrast, may undermine both social integration and mental stimulation (Gondi & Chokshi, 2023).

Fourth, visual quality had the strongest effect on spatial justice, underscoring the symbolic power of architecture. Visually coherent, well-maintained, and aesthetically rich environments communicate care, value, and belonging (Dlabac, et al., 2022). When people perceive their surroundings as attractive and dignified, they are more likely to feel that their presence is recognized and respected. This aligns with prior studies showing that visual disorder and neglect are associated with stress, stigma, and social marginalization. The present results extend this literature by demonstrating that visual quality is not only an aesthetic variable but a structural contributor to perceived justice (Durand, et al., 2011).

One of the most important findings of this study is the mediating role of spatial justice in the relationship between architectural qualities and psychological components. While readability and human scale had direct effects on psychological well-being, spatial justice significantly transmitted the effects of all architectural variables to psychological outcomes. This suggests that people do not only respond emotionally to physical form; they also interpret it through a normative lens of fairness, inclusion, and entitlement. In other words, the built environment affects mental well-being partly by shaping whether people feel they are treated fairly by the city.

These results contribute to theory in three ways. First, they empirically integrate urban design theory with spatial justice scholarship, showing how form and fairness are structurally connected. Second, they extend environmental psychology by positioning spatial justice as a key psychological mediator between space and well-being. Third, they move beyond descriptive correlations by offering a tested structural model that explains how architectural perception translates into justice and mental health outcomes.

From a practical standpoint, the findings have significant implications for urban design and policy. Cities aiming to promote social equity and mental well-being should prioritize legible street networks, human-scaled public spaces, diverse land uses, and high visual quality, not as optional enhancements, but as core justice-oriented strategies. Investments in urban aesthetics, pedestrian-oriented design, and spatial diversity are not superficial; they are interventions in psychological and social equity.

Despite its contributions, this study has limitations. The cross-sectional design limits causal inference, and future research should employ longitudinal or experimental approaches to better capture dynamic relationships. Additionally, the use of self-reported measures may introduce perceptual bias, although this is consistent with the study's focus on lived experience. Finally, cultural and contextual factors may influence how architectural qualities are interpreted, suggesting the need for comparative studies across cities and regions.

In conclusion, this research demonstrates that urban architecture profoundly shapes how just and psychologically supportive cities feel to their citizens. Readability, human scale, spatial diversity, and visual quality are not merely design features; they are mechanisms through which dignity, belonging, and well-being are distributed in space. Understanding and operationalizing these relationships is essential for creating cities that are not only functional and beautiful, but also fair and humane.

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