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Unlocking Urban Density: Beyond Numbers and into Perception

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ABSTRACT

This paper explores the importance of investigating the perception of density in urban environments. It highlights the limitations of traditional, purely objective density metrics and argues for a more comprehensive approach that integrates subjective factors. The paper identifies supporting arguments for studying perceived density, examines counter-arguments, and presents recommendations for urban planners and researchers. By addressing the multifaceted nature of density perception, this paper advocates for the creation of more user-centric, sustainable cities that enhance residents' quality of life.



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Introduction

Urban density, often defined as the ratio of the total population to a reference area, stands as a pivotal measure for describing the density of cities (Alexander 1993; V Cheng 2010; Churchman 1999; Rapoport 1975; Sonne 2017). Traditional density metrics have conventionally been instrumental in urban development and planning, relying on demographic data to provide objective insights into the dynamics of urban landscapes. However, the concept of density possesses a multifaceted nature, encompassing both objective and subjective dimensions (V Cheng 2010; Rapoport 1975). While conventional objective metrics offer valuable quantitative data, they often fall short of encapsulating the intricate nuances inherent in how individuals perceive density (Alexander 1993; V Cheng 2010; Rapoport 1975).

This paper emphasizes the significance of studying perceived density and its transformative implications for urban planning and development. Urban environments, in their essence, are not mere agglomerations of buildings and people; they represent living ecosystems interwoven with psychological, social, and cultural dimensions (Newman and Hogan 1981). By illuminating the rationale for investigating perceived density, this work seeks to acknowledge the evolving landscape of urban planning that harmonizes quantitative metrics with the intricacies of human experiences and perceptions. Through this exploration, the paper aims to bridge the gap between quantitative data and human-centric urban design, ultimately shaping cities that mirror the well-being, comfort, and needs of their inhabitants.

The Density Dilemma: Numbers vs. Experience

The burgeoning interest in the concept of perceived density within the realms of urban design and cognitive psychology is not a mere academic curiosity but a response to the pressing challenges posed by high-density urban environments (Alexander 1993; V Cheng 2010; Lilli 2013; Rapoport 1975). As the world witnesses an unprecedented wave of urbanization, with more and more people flocking to cities in search of opportunities, it becomes imperative to explore the perceived comfort of individuals residing in these high-density settings. The quest to understand perceived density is not merely an intellectual exercise; it is a pragmatic approach to address the lived experiences of urban dwellers. While traditional density metrics provide valuable insights into the quantitative aspects of urban landscapes, they often fall short in gauging the qualitative dimensions of life in densely populated areas (Berghauer-Pont and Haupt 2007). The discomfort, stress, and perceived loss of quality of life experienced by many urban residents are indicative of the complexities that conventional metrics fail to capture.

The primary objectives of this paper are to conceptualize the notion of perceived density in urban environments and to underscore its significance in the realm of urban planning and design. It seeks to elucidate the multifaceted and subjective nature of density perception, shedding light on the factors that influence how individuals experience and interpret

density. The paper also aims to provide a compelling rationale for the study of perceived density, particularly in the context of high-density urban areas, by identifying the challenges and limitations of traditional, purely objective density metrics. It explores the complexities of density perception, emphasizing the impact of spatial characteristics, individual preferences, and cultural influences. Furthermore, the paper acknowledges counter-arguments that advocate for sticking to traditional objective metrics and addresses the potential challenges and complexities introduced by the subjective nature of perceived density. In conclusion, the paper offers recommendations for urban planners and researchers, encouraging the incorporation of perceived density into urban planning efforts and the development of standardized metrics. Overall, it aims to contribute to a deeper understanding of perceived density and its role in shaping user-centric and sustainable urban environments.

Grasping the Complexities of Perceived Density

Researchers in the field of urban studies have grappled with a significant challenge in recent years – understanding the public's perception of density. The crux of this challenge lies in the inherent subjectivity and relativity of the concept of density, which often leads to a diverse array of interpretations and experiences among individuals (Alexander 1993; Bergdoll and Williams 1990; Berghauser-Pont and Haupt 2007; V Cheng 2010; Flachsbarth 1979; Lilli 2013; Rapoport 1975).

One fundamental issue is that the same measured density, whether in terms of population or buildings per unit area, can be expressed in numerous ways, resulting in a wide range of urban forms. This diversity in interpretations of density is not merely an academic concern; it is an intrinsic aspect of urban development. Different interpretations can lead to drastically different urban forms, affecting how people experience and interact with their surroundings.

Moreover, the notion of density is not an absolute, universally applicable measure. Its perception depends on various contextual factors, including geographical location, cultural influences, and personal experiences (Churchman 1999; Rapoport 1975). For example, what might be considered moderate residential density in one country could be seen as low in another. This lack of a universally agreed-upon definition and the variations in perception make it challenging to generalize research findings.

To complicate matters further, individual characteristics, such as personal preferences and cultural background, also play a significant role in how density is perceived. One person's ideal urban density might be another person's definition of overcrowding (Freedman 1975; Mueller 1981; Rapoport 1975). These discrepancies in individual perspectives add another layer of complexity to the study of perceived density.

Another important aspect of this problem is the need to distinguish between the objective and subjective characteristics of density (Evans, Lepore, and Allen 2000; Taylor 1981). Density, as a quantitative metric, can be objectively measured, but this alone does not

encompass the full range of human experiences in urban environments. The objective characteristics of density, which can be quantified and analyzed, are not synonymous with how individuals subjectively perceive and experience density. To truly understand the intricacies of density in urban environments, it is essential to navigate the complex interplay between the objective metrics and the subjective, contextual, and individual factors that influence how people perceive and respond to density.

Hence, the challenges in comprehending the public's perception of density are rooted in the multifaceted, subjective, and relative nature of density itself. Researchers are tasked with grappling with these complexities to bridge the gap between objective metrics and the lived experiences of urban inhabitants, ultimately contributing to the creation of more user-centric and sustainable cities. To delve deeper into this intricate concept, the following section explores the varying definitions of density, shedding light on the complex and evolving nature of this pivotal urban attribute.

Density's Many Faces: From Physical Metrics to Perceived Experience

There is no universally agreed-upon definition of urban density that applies to all contexts. Urban density is generally understood as the measure of the concentration of people, activities, or structures within an urban area (Berghauer Pont et al. 2021; V Cheng 2010; Vicky Cheng 2010; Churchman 1999; Rapoport 1975; Sonne 2017). However, the definition of urban density has evolved over the years and varies across countries and disciplines. The complexity of the term arises from the diverse definitions of density across different contexts.

Definitions of density vary depending on the geographical location, cultural factors, and the specific objectives of a study or planning process (Alexander 1993; V Cheng 2010; Churchman 1999). While the term "density" is used universally, its precise definition can differ. For example, the Collins Dictionary (Collins English Dictionary 2023) defines density as the extent to which an area is full or covered with people or things, whereas the Cambridge Dictionary (Cambridge Academic Content Dictionary 2023) defines it as the number of people or objects relative to the size of a location.

Over time, the definition of density has been refined to encompass more specific concepts. Initially, density was described as a simple physical metric, indicating "space available per person." (DETR 1998) However, this definition did not account for variations in density perception due to factors such as daytime versus nighttime density or occasional visits versus permanent residence. To address these limitations, social density and spatial density (Freedman 1975; Loo 1990; Loo and Kennelly 1979a; Novelli 2010; Stokols 1972) were introduced. Social density measures how the number of people changes while space remains constant, while spatial density measures space changes while the number of people remains constant. These definitions are primarily applicable at the street scale. Despite these definitions, it became evident that a more refined and universally applicable definition was needed. This definition views urban density as a ratio of the number of people and the geographical area under consideration (Churchman 1999; DETR 1998;

Rapoport 1975; Stokols 1972). It provides a quantitative measure of how densely populated an urban area is. However, the flexibility of this definition raises challenges in terms of data collection and the variety of metrics used to describe physical density (Boyko and Cooper 2011). These challenges have led to the development of indoor and outdoor density measures.

These objective definitions coexist with another facet of density, which delves into the realm of perception. This concept divides density into physical density, manifesting through measurable parameters of the built environment, and perceived density, which is profoundly influenced by individual cognitive and sociocultural factors. Recent research endeavours have even introduced a multivariable density concept that integrates intensity, compactness, and network density. Nevertheless, even these advanced concepts may not provide a comprehensive grasp of perceived density, an aspect of density perception that adds a layer of subjectivity and complexity to the overall understanding of urban density (Alexander 1993; Stokols 1972). To address this, Alexander et al.(1993) defined three distinct forms of density, each of which represents a distinct phenomenon in a unique environment and which is discussed in the later sections.

Quantifying the Concrete: How Numbers Shape Urban Development

Objective density metrics are foundational tools in urban studies and planning, allowing the quantification of the concentration of people and buildings in urban areas by relying on demographic data and straightforward calculations. This data, often collected through censuses, surveys, or administrative records, is essential for assessing the demographic aspects of density. It forms the basis for calculating the ratio of population, dwelling units, or buildings to a reference area, typically measured in standardized units like square kilometres or square miles.

These metrics provide a data-driven foundation for urban professionals to make informed decisions in urban development, land use planning, infrastructure design, and zoning regulations. They guide spatial analysis, helping identify patterns of urban development and population distribution. Objective density metrics inform decisions about transportation, public services, and resource allocation based on empirical evidence.

However, it's crucial to acknowledge their limitations. While objective density metrics offer a quantitative perspective, they do not capture the qualitative dimensions of urban density, such as how individuals experience and perceive density in their daily lives. This is where the concept of perceived density becomes relevant, as it explores the subjective aspects of density that go beyond the numbers.

Scrutinizing the Definition of Density

The conventional definition of density in urban contexts primarily relies on objective metrics that quantitatively measure the concentration of people or buildings within a given area. While this definition serves as a fundamental basis for understanding density, it often oversimplifies the concept by reducing it to numerical ratios.

The first argument clearly distinguishes between objective characteristics of density and subjective perceptions. It acknowledges that individuals perceive and interpret density in diverse ways, and these perceptions are influenced by personal experiences, cultural factors, and various contextual elements. In essence, how people feel about density is not solely rooted in numerical metrics but extends to the sensory, emotional, and psychological aspects of their environment.

However, within this subjective realm of density perception, there exist objective characteristics that remain constant regardless of individual viewpoints. These objective characteristics pertain to the physical attributes of the built environment, such as the spatial arrangement, intensity, number, and distribution of buildings. For example, the visual impact created by a concentration of buildings in a small area contributes to the perception of density. The number and quality of these buildings—be it their size, volume, height, or spatial arrangement—can significantly influence how density is perceived.

This argument highlights the importance of distinguishing between the fluctuating realm of subjective perception and the stability of objective characteristics. While perceptions of density may vary widely, the physical attributes of the built environment play a critical role in shaping these perceptions. The objective nature of these characteristics allows for quantification and measurement independently of individual viewpoints, providing a foundation for understanding the "true nature" of density that is not swayed by individual subjectivity.

The second argument delves into the adequacy of the traditional definition. It categorizes adequacy into extensional (whether it captures the essential instances of the concept), intentional (whether it conveys the intended meaning), and sense adequacy (whether it aligns with how people understand and perceive the concept). The conventional definition of density excels in extensional and intentional adequacy, accurately representing the quantitative relationship between people or buildings and land area.

However, it falls short in terms of sense adequacy. People's perception of density extends beyond a mere numerical ratio. It involves a holistic experience influenced by sensory elements, spatial factors, and the overall feeling of crowdedness within the physical environment. As a result, the traditional definition fails to capture the complete sense or subjective perception of density fully.

These arguments collectively emphasize that while the traditional definition provides a comprehensive and scientifically rigorous understanding of density, it must be complemented by a more nuanced exploration of perceived density. Perceived density considers the holistic, subjective experience of density, acknowledging the significance of

sensory elements and individual perspectives in shaping how people interpret and respond to the concept. This transition from an objective to a more holistic perspective is discussed in greater detail in next section.

Perceived Density: A Multifaceted Perspective

Perceived density, a term introduced by Rapoport (1975) and further developed by other scholars, refers to an individual's subjective experience and interpretation of the level of crowding or population concentration in their immediate surroundings. It recognizes that density is not solely an objective, quantifiable measure, but rather a perceived experience influenced by various factors. Perceived density encompasses the interaction of three key components: physical density, individual cognitive factors, and sociocultural factors (Alexander 1993).

1. **Physical Density:** Physical density (Alexander 1993) encompasses both objective characteristics of the built environment and the measurable components of density. This includes measured density, such as population density and building density. In addition to these quantitative aspects, physical density considers the physical attributes of the urban environment that contribute to how density is perceived. These attributes can involve building height, spacing between structures, and the overall spatial arrangement, which are not typically included in objective density measures.
2. **Individual Cognitive Factors:** This aspect of perceived density takes into account an individual's cognitive and psychological responses to their environment (Alexander 1993; Rapoport 1975, 1982; Taylor 1981). It includes elements like feelings of control or lack thereof, privacy considerations (Brown 2001), personal preferences, and emotional states (Nasar 1989). These factors vary from person to person and influence how each individual perceives and responds to the level of density in a given setting.
3. **Sociocultural Factors:** Sociocultural factors encompass the impact of one's cultural background, social norms, and levels of social interaction on their perception of density (Alexander 1993; Evans et al. 2000). Cultural diversity, societal norms, and the degree of interaction among people in a specific context play a significant role in shaping how individuals experience and interpret density.

While the concept of perceived density remains consistent worldwide (i.e., it represents density as perceived by people), the specific descriptions and interpretations of the three contributing factors (physical density, individual cognitive factors, and sociocultural factors) may vary and be context-dependent. Measuring individual cognitive and sociocultural factors can be challenging, as they involve a wide range of variables, including beliefs, values, and cultural practices. Additionally, the methods used for data collection often rely on self-reporting, surveys, interviews, or observations, introducing subjectivity and potential biases. As a result, objective density has historically received more empirical and theoretical attention compared to perceived density in urban research and planning. Perceived density, however, is crucial for understanding the lived experiences of

individuals in densely populated urban areas and contributes to more user-centric and sustainable urban planning and design.

Beyond the Headcount: Measuring the Experience of Density

Perceived density, as a multifaceted concept, encompasses various indicators that can provide insights into how individuals experience and perceive density in urban environments. These indicators are instrumental in assessing the subjective dimensions of density perception, shedding light on the complexities associated with how people react to crowded or densely populated areas.

Crowding Perception serves as a fundamental indicator, referring to an individual's subjective assessment of how crowded or congested a particular area or space feels (Edney 1977; Freedman 1975; Mueller 1981; Stokols 1976). Typically measured through surveys, questionnaires, or direct observations, participants rate the level of crowding, offering valuable insights into the perceived density of a location.

The level of **Comfort and Discomfort** experienced by individuals in a given setting is a central indicator of perceived density (Campoli and Maclean 2002; Campoli and MacLean 2007). It reflects participants' feelings of comfort, discomfort, suffocation, or unease in crowded environments, which can help gauge the impact of density on their well-being.

Personal Space and Privacy are closely linked to perceived density. Individuals' preferences and feelings related to having adequate personal space and privacy in urban settings are significant indicators (Altman 1975; Brown 2001; Namazian and Mehdipour 2013). These preferences can provide insights into how perceived density relates to individual needs for personal space.

Satisfaction with the Environment is another crucial indicator. It reflects participants' overall satisfaction with their surroundings, shedding light on how they perceive the density in a specific area (Flachsbart 1979; Maruthaiah and Rashid 2014). This measure offers valuable information about the relationship between perceived density and overall satisfaction.

Behavioural Responses are observable indicators that provide insights into how people react to different levels of density (Altman 1975; Epstein 1982; Purcell 1987). Observing whether individuals tend to avoid or seek out more or less crowded areas can offer valuable data on their perceived density preferences.

Visual Perception is integral to understanding perceived density (McLeod 2023; Wagemans et al. 2012). It involves visual assessments of the urban environment, considering factors like building height, spacing between structures, and architectural design. Visual cues play a significant role in influencing how people perceive density in a given area.

Stress and Anxiety Levels provide physiological indicators of perceived density (Evans and Cohen 2004). Measures like increased heart rate, skin conductance, or self-reported stress levels can be used to assess the impact of perceived density on individuals' well-being and emotional states.

Finally, it's crucial to consider the role of cultural and sociocultural factors in shaping perceived density. Different cultures may have varying perceptions of crowdedness and personal space, and these cultural norms contribute to the diverse ways individuals experience density. Researchers often use a combination of these indicators to gain a more comprehensive understanding of how people experience and perceive density in specific urban contexts. The choice of indicators may vary based on the research objectives and the population being studied, allowing for a nuanced exploration of perceived density.

The Art of Balancing: Understanding Density's Subjective Side

The need for studying perceived density in urban environments arises from the persistent issues of discomfort and dissatisfaction among residents in high-density areas. These issues reflect a gap between the perspectives of design experts and the daily experiences of people in densely populated regions. Understanding how individuals perceive and experience density is crucial for bridging this gap effectively.

Perception of density in urban environments is a phenomenon influenced by an interplay of diverse factors. Spatial characteristics, individual preferences, and cultural influences converge to shape an individual's understanding and experience of density. This multifaceted nature of density perception highlights that it transcends mere quantitative metrics. While traditional objective measures provide valuable insights into the concentration of people within an area, they often fall short of encapsulating the richness of how people perceive and respond to urban density. Recognizing the intricate interplay of these factors is fundamental to comprehending density from a human-centred perspective (V Cheng 2010; Emo et al. 2017; Rapoport 1975).

Research has established a correlation between density and human health and well-being (Berghauer Pont et al. 2020, 2021; Loo and Kennelly 1979b). This implies the adverse physiological and psychological impacts that density can have on individuals and their quality of life (Altman 1975; Altman and City 1991; Ewing et al. 2018; Newman and Hogan 1981; Stokols, Altman, and Wiley 1987). The objective is to shed light on the importance of considering the subjective connotations of density in urban planning endeavours. Understanding how density perception influences the health and well-being of urban inhabitants is pivotal in shaping future urban environments that promote a healthier and more comfortable living experience.

Recent advances in the study of perceived density have revealed the pivotal role of spatial factors in mitigating how high density is perceived. Concepts such as spatial openness, visibility, and sky view factor have emerged as critical determinants of how individuals experience density (V Cheng 2010; Emo et al. 2017; Fisher-Gewirtzman 2003; Lilli 2013). This suggests the influence of the spatial arrangement of built environments, open spaces, and natural elements on density perception. It underscores how these spatial factors can be harnessed to create urban environments that offer more favourable and comfortable density experiences.

Research on perceived density encounters various challenges and limitations, particularly in data collection and study design (Boyko and Cooper 2011). These limitations underscore the need for a more comprehensive and standardized approach to studying perceived density.

Challenging the Subjective: The Complexity of Integrating Perceived Density

A counter-argument surfaces, asserting that using traditional objective density metrics is sufficient for urban planning and development. The argument posits that these objective metrics provide a comprehensive and standardized way to measure urban density, offering clear and quantifiable data that is valuable for making informed decisions in urban planning. It questions whether the introduction of perceived density adds value to the planning process and whether the subjectivity it introduces might hinder the objectivity that is typically expected in such endeavours.

The counter-argument also underscores the complexity and subjectivity introduced when perceived density is incorporated into urban planning. It contends that the inclusion of subjective factors may introduce elements of ambiguity and hinder the objectivity that is often central to effective planning and development. The counter-argument raises questions about the feasibility of successfully integrating subjective components into planning decisions and the potential for this complexity to hinder practical urban development efforts.

The Future of Urban Planning: Balancing Numbers and Feelings

The integration of perceived density into urban planning is a transformative endeavour that ushers in a new era of city development, one that harmonizes both the objective and subjective dimensions of urban life. As cities expand and diversify at an unprecedented pace, the importance of holistic urban planning cannot be overstated. This section outlines a series of recommendations that collectively represent a roadmap for urban planners and designers to navigate the dynamic landscape of high-density urban environments.

- **Incorporate Perceived Density into Urban Planning**

This recommendation urges urban planners and designers to adopt a more inclusive approach that considers both objective and subjective factors in decision-making processes. It emphasizes the need for a holistic urban planning approach that prioritizes the comfort and well-being of urban residents. Incorporating the subjective dimension of perceived density into planning efforts can lead to more user-centric and sustainable cities.

- **Develop Standardized Metrics for Perceived Density**

The importance of creating standardized metrics for perceived density is highlighted. These metrics should consider various factors, including spatial characteristics, land use mix, and visual composition, to provide a comprehensive understanding of density perception. The development of standardized tools and methods for measuring perceived density can significantly enhance the effectiveness of urban planning and design.

- **Granular Density Assessment**

This recommendation promotes a more detailed and granular approach to measuring density, allowing for the capture of fine-scale variations in different urban areas and communities. By leveraging geospatial technologies and data, urban planners and designers can gain a more nuanced understanding of how density varies across different contexts. This approach enables tailored design interventions that cater to specific areas and communities.

- **Community Engagement**

Emphasizing the significance of engaging local communities in the urban planning process, this recommendation underscores the need to understand the perceptions and preferences of residents. Community involvement is essential for creating cities that align with the unique needs and desires of their inhabitants. Engaging with the community ensures that urban planning efforts are more responsive and sensitive to the local context.

- **Interdisciplinary Research**

This recommendation encourages interdisciplinary research collaborations between urban planners, architects, psychologists, and sociologists. Such collaborations can provide a comprehensive and multifaceted perspective on how perceived density impacts the quality of life in urban environments. Interdisciplinary research allows for a deeper understanding of the complex interactions between the built environment and human experiences.

Urban Density Redefined: Towards a More Liveable City

This paper has delved into the multifaceted concept of perceived density and its significance in the context of urban planning. By investigating how individuals experience and interpret density in urban environments, this paper has aimed to bridge the gap between objective density metrics and the lived experiences of urban inhabitants. The findings presented here underscore the complexities of density perception and the limitations of purely objective measures.

The key takeaway from this exploration is the recognition that urban density is not a one-size-fits-all concept. Its definition varies based on geographical location, cultural factors, and specific study objectives. This diversity in definitions across countries and disciplines contributes to the complexity of the concept. The historical and contemporary

perspectives on density have shed light on the evolution of this term and its relevance in different eras of urban development.

Scrutinizing the definition of density revealed the need to distinguish between objective and perceived characteristics of density. Objective density metrics provide valuable quantifiable data, yet they may not fully capture the range of human experiences and perceptions related to density. Perceived density introduces the subjective, perceptual dimensions that influence how people experience and respond to density in urban environments.

The importance of studying perceived density is further accentuated by the multifaceted nature of density perception. It encompasses a wide range of factors, including spatial characteristics, individual preferences, and cultural influences. Recognizing that density is not solely a quantitative measure, but also a subjective experience, calls for a more comprehensive approach to urban planning.

While traditional objective density metrics have their merits, this paper has also highlighted the physiological and psychological impacts of density on human health and quality of life. It is imperative to consider the subjective connotations of density to create healthier and more comfortable living environments. Recent research on perceived density has shown that spatial factors play a vital role in mitigating how high density is perceived, emphasizing the need to consider the spatial arrangement of built, open, and natural environments in urban planning.

However, the paper also acknowledges the counter-arguments that advocate for sticking to objective and comprehensive metrics while raising concerns about the complexity and subjectivity introduced by perceived density in urban planning. Despite these counter-arguments, the case for studying perceived density remains strong, as it contributes to a more holistic and user-centric approach to urban planning.

In conclusion, this paper advocates for the incorporation of perceived density into urban planning. By considering both objective and subjective factors, cities can strike a balance between the benefits of density and the well-being of their inhabitants. This approach can lead to more efficient, user-centric, and sustainable cities that enhance the quality of life for their residents. ■

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