# Townscape and Wayfinding: A Review of Existing Literature

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**Abstract:** *Amidst the urban public health challenges in Malaysia, where obesity, cardiovascular diseases, and road traffic accidents are increasing, the importance of walkability in cities is gaining recognition. This paper provides an overview of the existing literature on the visual structure of townscapes and its impact on pedestrian navigation, investigating two main factors: environmental (visibility and saliency) and psychological (navigational competency). Urban visual studies and the theoretical progression are explained and compared. The review concludes that there is a general consensus on the significance of visual characteristics in orienting the urban environment. Specifically, the degree of permeability of the townscape visual scene and the availability of salient visual cues significantly influence wayfinding performance. Additionally, individual difference, including spatial ability, also reflects the utilisation of visual cues for wayfinding. However, further research is needed to explore a holistic approach encompassing the visual scene as a whole (gestalt) of the townscapes in the context of visual navigation.*

**Keywords**: Visual cues, Townscape, Wayfinding, Visual Perception, Urban Design

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## 1. Introduction

Malaysia faces significant public health challenges, including rising obesity, cardiovascular diseases, and road traffic accidents (Department of Statistics Malaysia, 2022). Despite the growing recognition of the importance of walkability in urban environments, there is a significant gap in our understanding of the specific physical attributes that contribute to walkability (Fonseca et al., 2022). While many walkability studies in Malaysia have focused on factors such as land use and proximity-based approaches (Qureshi et al., 2022; Ramli et al., 2022; Kumar & Sarip, 2021), limited attention has been given to the urban environment's wayfinding aspect despite the lack of evidence to support the direct causation between walkability factors and pedestrian activity (Cambra & Moura, 2020; Dovey & Pafka, 2020; Liao et al., 2020; Iftikhar, 2022).

Effective visual perception is crucial for navigating intricate urban environments as it enables individuals to interpret and utilise visual cues for wayfinding, allowing them to reach destinations that may not be immediately visible or apparent (Montello, 2005; Montello & Sas, 2006). It relies on individuals' ability to interpret environmental cues, makes spatial judgments, and select appropriate routes. Difficulties often arise when individuals attempt to locate pertinent information within public settings. The challenges encountered in wayfinding can be

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traced back to issues related to information processing (Arthur & Passini, 1992; Jamshidi & Pati, 2021). Townscape design is crucial in shaping urban environments' walkability and overall experience. However, assessing townscape design attributes has been challenging due to limited microscale data and a reliance on subjective assessments. Fonseca et al. (2022) highlight that this limitation has hindered the objective evaluation of design attributes, leading to an increased dependence on subjective measures (Qureshi et al., 2022). To bridge this gap and enhance walkability evaluation, there is a pressing need for more research on the impact of design attributes and the development of objective measurement techniques, particularly focusing on complexity and imageability (Fonseca et al., 2022).

Previous studies have acknowledged the importance of townscape visual structure in pedestrian wayfinding, yet the role of specific visual attributes remains underexplored. Although some research has investigated the influence of visual cues and landmarks on navigation, a comprehensive understanding of the underlying mechanisms and optimising these attributes for improving wayfinding efficiency is still lacking (Iftikhar, 2022). Therefore, this literature review aims to fill this research gap by critically analysing and synthesising existing studies on townscape visual structure and its implications for pedestrian navigation.

## 2. Method

This paper aims to investigate how pedestrians navigate through townscapes and how the visual structure influences their wayfinding abilities and spatial judgments. Additionally, it seeks to identify the consensus and gaps in the existing literature on townscape navigation, providing valuable insights for future research in this field. By addressing these questions, the review aims to shed light on the visual characteristics that enhance effective wayfinding in townscapes while pinpointing areas for further investigation. The study employed a comprehensive search in electronic databases and manual searches, followed by a two-step screening process based on predefined criteria. Thematic analysis of selected studies was conducted to identify common themes and patterns, and the quality of the studies was assessed using appropriate tools. The research focused on visual cues, and a table (Table 1) summarising the parameters related to wayfinding in townscape design was created for reference. The findings were synthesised to provide valuable insights into the impact of townscape design on pedestrian wayfinding.

Table 1
*Visual attributes introduced in earlier research papers*

| | Visibility | | | | Saliency | | | | | Navigational Competency | | | | | |
| | Textural | | Surface & Contour | | Visual | | Contextual | | | Trait | Strategy | | Experience | Demographic | |
| | Lighting | Distance | Angle of incidence | Angle of Vision | Identity | Structure | Congruence | Transparency | Legibility | Sense of Direction | Orientation Strategy | Route Strategy | Familiarity | Gender | Age |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Kim et al. (2023) | | | | | * | * | | | * | | | | | | |
| Zolkefil & Talib (2022) | | * | | * | * | * | | | | | | | | | |
| Parush et al. (2022) | * | | | * | | | | * | * | | | | | | |
| Hapsari et al. (2022) | | | | | * | * | * | * | * | | | | | | |
| Iftikhar et al. (2021; 2022) | | | | | * | * | * | | * | * | * | * | * | * | |
| Nurlaela et al. (2021) | | | | | | | | | | * | * | | * | | |
| Yesiltepe et al. (2021) | * | * | | | * | * | | | * | | | | | | |
| Shamsuddin et al. (2022) | | | | | * | * | | * | * | | | | | | |
| Jayaraman et al. (2021) | | | | * | | * | | | * | | | | | | |
| Jamshidi & Pati (2021) | | | | | | | | | | | * | * | | | |
| Kim et al. (2021) | | | | | | | | | | * | | | * | * | * |
| Fouda et al. (2021) | | | | | * | | | | * | | | | | | |
| van Nes & Yamu (2021) | | * | * | * | | * | | | | | | | | | |
| Golombek & Marshall (2021) | | * | | | * | * | | | | | | | | | |
| Adiastuty et al. (2020) | | | | | | | | | | * | * | * | * | * | |
| Narindrasani & Fuad (2020) | | | | | * | * | | | * | | | | | | |
| Psarras et al. (2019) | * | * | | * | | * | | | * | | | | | | |
| Kuliga et al. (2019) | | | | | | | | | | * | * | * | | | |
| White & Shah (2019) | | | | | * | | | | * | | | | | | |
| Bremer et al. (2019) | | * | * | * | | * | | | | | | | | | |
| Markvica et al. (2019) | * | | | | | | | | * | | | | | | |
| Pazzaglia et al. (2018) | | | | | | | | | | * | * | * | | | |
| Heft (1979; 1983; 2011; 2013) | * | * | * | * | | * | * | * | * | * | * | * | * | | |
| Caduff & Timpf (2008) | | * | | | * | * | | | * | | | * | | | |
| Montello (2005; 2006) | | * | | * | * | * | | * | * | * | * | * | * | * | |
| Shamsuddin (1997; 2011) | * | | | | * | * | | | * | | | | * | | |
| Passini (1992) | | * | | | * | * | | * | * | * | * | * | * | | * |
| Gehl (1987; 2013) | | | * | | | | | | * | | | | | | |
| Appleyard et al. (1981) | | * | | * | * | | | | * | | | | | | |
| Ashihara (1962; 1979; 1986) | | * | | * | | | | | | | | | | | |
| Rapoport (1976; 1977; 1981) | | | | | * | * | | | * | | * | | * | * | |
| Norberg-Schulz (1971) | * | | | | * | * | | | | | * | | * | | |
| Cullen (1961) | | | | * | * | | | | * | | | | | | |
| Lynch (1960; 1981) | | | | | * | * | * | * | * | | | | * | | |
| Higuchi (1975) | * | * | * | * | | | | | | | | | | | |
| De Wolfe (1963) | | * | * | * | * | * | | | * | | | | | | |
| Gibson (1950a; 1950b; 1979) | * | * | * | * | | | * | | | | * | | | | |
| Sharp (1946) | | | | * | * | * | | | | | | | | | |
| Sitte (1889) | * | * | | * | | | | | | | | | | | |

## 3. Visual Perception of Townscape

A townscape is a scene observed from a particular viewpoint (Higuchi, 1975). It involves the arrangement, organisation, and composition of perceptible visual elements within the observed townscape. Townscape visual perception is about how people perceive and interpret their surroundings. Cullen (1961) and Lynch (1960) emphasise the importance of visual structure and its cues in urban wayfinding. According to Cullen, visual perception is crucial to people's comprehension and interpretation of their surroundings since vision is the primary sense through which they see their surroundings (van Nes et al., 2021). He postulated that individuals receive sequential and intermittent visual input, focusing on specific aspects or cues during wayfinding. (1961, p. 9).

Lynch, however, emphasised that successful wayfinding requires the systematic application and arrangement of environmental cues (landmark, node, district, patch, and edge). These cues enhance spatial orientation, decision-making processes, and urban navigation (Yavuz et al., 2020). Lynch's concept of organised cues and Cullen's visual structure emphasise the importance of environmental components in navigation and facilitating efficient movement. Rapoport in Pasalar and Hallowell (2020) suggests that cultural and personal traits intentionally filter our perception and participation in the environment, influencing how we perceive and interact with our surroundings. In contrast, Heidegger challenges the Cartesian notion of subject-object dualism and argues that the filters influencing our perception and action are inherent within the phenomenon (McGilchrist, 2019). Heidegger believed that these filters were intrinsic to human existence. Heidegger believed that perception was deeply connected to the phenomenon being viewed. He rejects the idea of a detached spectator, emphasising our interdependence with the environment.

Studies of wayfinding have shown the importance of townscape visual organisation in the visual characteristics of landmarks (Yesiltepe et al., 2021), the presence of wayfinding information (Shamsuddin et al., 2022; Chen et al., 2019; Mazurkiewicz et al., 2021), the role of vistas in spatial perception (Gibson, 1979), transitions between vistas (Heft, 1979, 1983, 1996), and the complexity of buildings (Kuliga, 2019).

In addition to environmental factors, personal factors also play a role in the perception of the townscape during wayfinding. Individual preferences, cognitive abilities, and prior experiences can influence how individuals perceive and navigate the environment (Higuchi, 1975; Pazzaglia et al., 2018; Iftikhar, 2022; Kim et al., 2021). The visual structure of the townscape encompasses the dynamic relationship between the external features and elements of individual buildings and the collective composition of the entire urban environment. This relationship extends beyond the physical attributes of buildings to include the overall character, arrangement, and connections within the townscape. The interplay between the external appearance of buildings and the overall composition of the townscape emphasises how each building contributes to the visual harmony and coherence of the urban environment (Ashihara, 1983; Yoshimura et al., 2022). Cullen (1961) further emphasises the concept of relationship in defining townscape as an art form. Cullen posits that a townscape is about how buildings and elements interact, including considering the visual linkages, proportions, and spatial interactions between buildings, roadways, open spaces, and other external aspects of the city (Tahalea et al., 2022). Thus, a townscape's visual structure results from intricate relationships and interactions between a city's external parts to produce a visually unified and meaningful urban environment.

## 4. Wayfinding in Urban Environment

Wayfinding in urban environments involves examining how the visual characteristics of a town or urban environment contribute to effective navigation. Scholars have researched this topic extensively, drawing insights from various disciplines such as urban planning, environmental psychology, and cognitive science. The existing literature on the visual characteristics of townscapes and their influence on wayfinding has identified several vital categories that contribute to effective navigation: visibility, saliency, and navigational competence (Table 1). Wayfinding relies on visibility to identify townscape characteristics. Visible things are more likely to be noticed and used as navigational aids (Lynch, 1960; Heft, 2013). Visibility and saliency are strongly connected. Salient traits attract and orient people. Townscape studies also include ease of vision, a non-latent variable. It refers to visual clues' clarity and readability. Lighting, distance, and visual obstructions affect vision. Well-lit, unobstructed cues aid navigation (Lynch, 1960). The literature defines navigational competence as navigating a town or city. It includes spatial cognition, map reading, and environmental awareness. Higher navigational competency improves wayfinding and townscape visual cue interpretation (Passini, 1992; Iftikhar, 2022).

Passini proposes that disorientation and navigation difficulties can result in confusion, anxiety, or frustration when a person cannot navigate effectively in a given environment (Hossam et al., 2022). Disorientation can result in a feeling of being lost or confused, which can have a negative impact on a person's emotional health. Disorientation and wayfinding difficulties can be regarded from a functional perspective regarding a person's ability to navigate and find their way in a given environment that requires physical and mental exertion, as individuals may require physical exertion to explore the environment and mental exertion to process and interpret spatial signals and information. Both emotional and functional perspectives are considered.

### 4.1 Visibility of Townscape
The term "townscape," as defined in "A Dictionary of Architecture and Landscape Architecture" by Curl and Wilson (2015), pertains to a "portion of the urban fabric that can be viewed at once". The term emerged during the 1940s and was widely adopted in various publications, including the Architectural Review (AR) and Thomas Sharp's book "The Anatomy of the Village" (1946). In line with this definition, Higuchi (1975) emphasised that analysing a townscape's visual structure should not focus on its visual appeal but rather on its mere visibility. The critical consideration is whether it can be perceived or seen at all, highlighting the importance of discerning the presence and visibility of the townscape elements (Sarihan, 2021). It encompasses factors such as unobstructed sightlines (Bremer et al., 2019; Nurlaela et al., 2021), unobstructed building profiles (Ashihara, 1983), absence of visual clutter (White & Shah, 2019; Benita & Tunçer, 2019), adequate lighting conditions (Markvica et al., 2019), and atmospheric factors (Higuchi, 1975; Wu et al., 2020) which facilitate the detection and recognition of landmarks and cues for wayfinding (Lynch, 1960). In urban environments, the visibility of visual signals and landmarks is crucial for pedestrian navigation. Clear visibility facilitates visual information's perception and interpretation, facilitating orientation and navigation. The visibility and significance of visual signals and landmarks in the urban landscape are closely related.
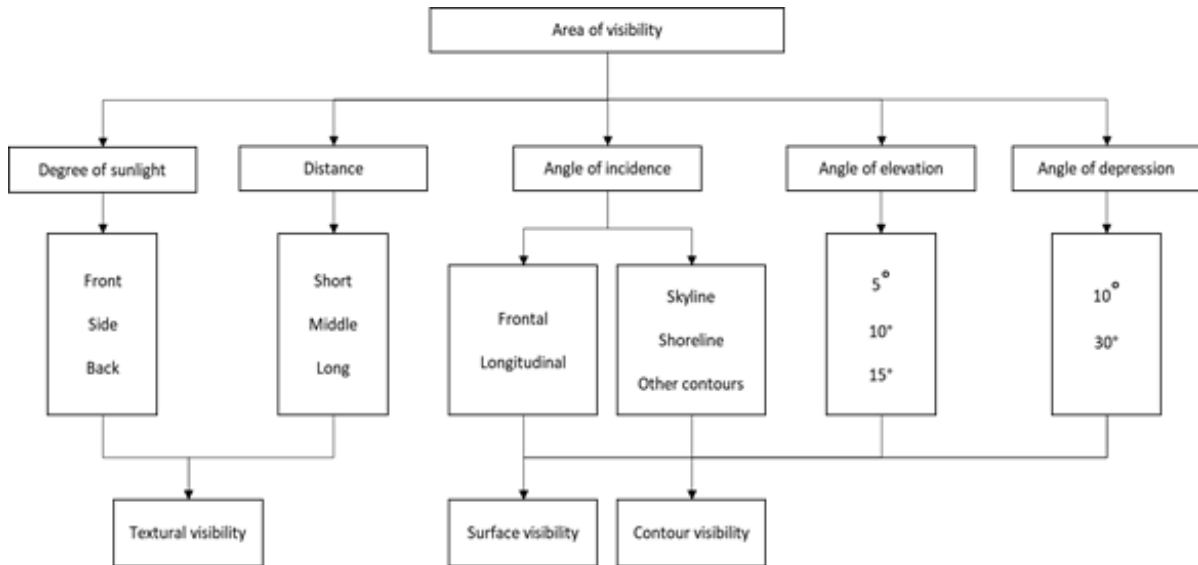
**Figure 1: Visibility of urban landscapes**
**Source: Higuchi (1975)**

According to Higuchi, there are three categories of visual cue visibility: textural, surface, and contour visibility (Primeau, 2022). Each type pertains to distinct dimensions of the townscape and is influenced by various factors. Textural visibility refers to the scene's texture's legibility and clarity. It is affected by variables such as observer distance, illumination conditions, and atmospheric conditions. Textural visibility is crucial in determining how well the details and features of a townscape can be perceived and comprehended (Hapsari et al., 2022). Surface visibility refers to the visibility of the surfaces or facades of objects or structures in the urban environment. The observer's field of view plays a significant role in surface visibility. Depending on the viewing angle, certain surfaces may be visible, influencing the general impression of the townscape (Ashihara, 1983; Yoshimura, 2022). The visibility of the contours or outlines of objects within the townscape is the focus of contour visibility. Similar to how the angle of vision affects the visibility of surfaces, it also affects the visibility of contours. The angle of incidence aligns better with the observer's line of sight if the buildings are parallel to the hill's slope (Higuchi, 1975). Repeated angles of incidence can explain the "folding screen" effect that sharply curving roads have when running up hills in a townscape. These twisting roadways offer wide, shifting frontal views of the townscape. As they traverse the twisting roadways, the observer's line of sight interacts with the townscape at consecutive angles of incidence. Each turn or curve changes the angle of incidence between the spectator and the townscape objects, creating a dynamic and continually ageing experience.

Urban design and planning must account for incidence angles to maximise visibility and create a legible cityscape. By considering natural topography, varying viewing angles, and the alignment of elements, designers can improve the ease of vision and the overall perception of a townscape (Higuchi, 1975). Different observation angles can disclose or conceal specific contours, influencing how the townscape is perceived visually (Cullen, 1961).

### 4.1.1 Townscape Visibility in Wayfinding Studies
In the past decade, there have been significant developments in the understanding and analysis of townscape visibility. Researchers have employed various methods to study and measure visibility, considering both objective measurements and subjective perceptions. One approach utilised is the aerial method, as described by Higuchi (1975). This method involves tracing

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lines of observation on a map to determine the sight lines apprehended by an observer. By analysing these lines, researchers gain insights into the environment's visibility patterns and potential visual connections. The aerial method has been incorporated into isovist analysis in space syntax, allowing for a better understanding of how visibility impacts wayfinding (van Nes & Yamu, 2021). Digital terrain models have also played a significant role in measuring townscape visibility. These models use technologies like LiDAR to capture high-density data of urban streetscapes in three dimensions. By analysing these models, researchers can derive descriptive statistics and metrics related to visibility, providing valuable insights into the visibility of streetscape features (Golombek & Marshall, 2021). In addition to objective measurements, researchers in the field of ecological psychology have conducted visual perception tests to understand how individuals perceive and utilise visible cues for wayfinding. Such tests involve participants watching walkthrough videos and identifying visible cues that aid in finding their way. These tests shed light on the effectiveness of different cues and features in supporting navigation (Heft, 2013).

Advancements in digital visualisation and simulation techniques have also revolutionised the analysis of townscape visibility. Computer-generated models and virtual reality simulations allow for more accurate assessments of the visibility of townscape elements, providing realistic visualisations that simulate various conditions and viewpoints (Belaroussi et al., 2023). Cognitive and perceptual approaches have gained prominence, considering attention, memory, and mental mapping factors in analysing townscape visibility. These approaches aim to understand how individuals perceive and interpret visual information within the townscape and how visibility influences their wayfinding and orientation (Gath-Morad et al., 2021). Recent studies have also explored the role of visual preference and aesthetics in townscape perception. Researchers have examined how different visual cues impact aesthetic evaluations and emotional responses to the townscape, investigating the influence of architectural styles, colour schemes, and urban design elements (Kim et al., 2023).

Moreover, the study of townscape visibility now considers social and cultural factors. Researchers have explored how sociocultural contexts, historical backgrounds, and cultural practices shape the visibility and legibility of the townscape. This broader perspective recognises the influence of values, experiences, and social interactions on the perception and interpretation of the urban environment (Askarizad & Safari, 2020). The concept of townscape visibility has also been integrated into sustainable urban design practices. Researchers have investigated how visibility analysis creates walkable, accessible, and inclusive urban environments that consider the visibility of pedestrian paths, public spaces, and landmarks to enhance wayfinding, promote social interaction, and improve overall livability (Ashihara, 1983; Yoshimura, 2022).

In conclusion, "townscape visibility" plays a crucial role in understanding how pedestrians navigate urban environments. It refers to the visibility and legibility of visual cues within the townscape, which significantly influences wayfinding and orientation. The review of existing literature highlighted three main categories of visual cue visibility: textural, surface, and contour visibility, each influenced by various factors such as illumination, atmospheric conditions, and observer viewpoints. Researchers have employed diverse methods, including aerial analysis, digital terrain models, perceptual tests, and virtual simulations, to study and measure townscape visibility.

## 4.2 Saliency of Townscape

Townscape structure goes beyond the mere visibility of visual elements. It encompasses the legibility and clarity of those elements, enabling individuals to perceive and understand their surroundings accurately. Legible townscape elements are easily recognisable and distinguishable, allowing quick and effortless identification (Lynch, 1960), including prominent landmarks, distinct architectural styles, and recognisable spatial patterns that aid in wayfinding (Yesiltepe et al., 2021). When the visual elements of the townscape are legible, individuals can form mental maps and develop a sense of spatial orientation, facilitating their navigation through the urban environment. Lynch (1960) argues that for a cue to be considered effective, it must undergo a three-step process which he calls identity. The identity process begins with distinguishing the object from its surroundings. Instead of resemblance, it accentuates the object's distinctiveness. Second, evaluate the spatial or pattern link between the item, the observer, and other things in the surroundings. This level emphasises the need to know how the object affects the observer and surroundings. Finally, the thing should provide practical or emotional value to the viewer. This phase recognises that perception is subjective and that personal experiences and values influence the relevance of environmental objects.

Lynch's 1981 book "A Good City Form" expands on identity as a subset of location. He underlines how easily the environment may be recognised, identified, and cognitively connected to other events and places to construct a cohesive representation of time and space. Lynch also brings structure, congruence, transparency, "immediacy," and intelligibility, which relate the environment to other elements of our existence. Lynch's "sense" can be compared to the concept of visual saliency, a visual entity's distinguishing feature that makes it stand out from its surroundings. Lynch's sense of place and saliency emphasise visual distinction and recognition (Caduff & Timpf, 2008; Seetharaman et al., 2021).

Visual saliency of the townscape structure encompasses various factors that contribute to the distinctiveness and prominence of objects within the visual environment. These factors, such as size (Ligonnière et al., 2021), shape (Seetharaman et al., 2021), contrast (distinctness), colour (Yesiltepe et al., 2021), and uniqueness (Götze & Boye, 2016) of visual cues, play a crucial role in capturing visual attention and guiding individuals during wayfinding and navigation. Visual cues that exhibit high contrast or larger size, possess unique or irregular shapes, display vibrant or contrasting colours, or represent distinctive elements are more likely to stand out and be visually salient. Individuals can effectively orient themselves, make spatial judgments, and navigate the urban environment by attending to visually salient cues and landmarks. Caduff and Timpf (2008) argue that saliency arises from the interaction between spatial features, the environment, and the observer. It depends on the observer's perspective, environment, and viewpoint. The dynamic interaction between all three components determines a feature's salience. Visual saliency emphasises detecting and recognising visually prominent aspects to improve townscape intelligibility and wayfinding. Lynch surveyed and interviewed people to determine how visual cues affect space memorability (Michalsky, 2020). The goal was to identify the city's most distinctive features. These surveys and interviews asked participants about their favourite city features. The focus was finding the most memorable visual clues defining the urban environment. Lynch sought to understand how individuals see urban landscapes by studying their imageability.

### 4.2.1 Townscape Saliency in Wayfinding Studies

Researchers have developed computational models and algorithms to simulate and predict visual saliency in urban environments. These models utilise techniques such as machine learning and computer vision to analyse spatial features, object characteristics, and contextual factors to determine the saliency of visual cues (Zhang et al., 2023). These models provide valuable insights into the perceptual importance of different elements in the townscape and aid in urban design and planning processes. Eye-tracking technology has been increasingly used to study visual attention and saliency in urban environments. By tracking the eye movements of individuals as they navigate through the townscape, researchers can identify the visual cues that attract the most attention and guide wayfinding behaviour (Zheng et al., 2022). Eye-tracking studies provide empirical evidence of how people visually engage with the urban environment and help validate and refine theories of visual saliency.

Recent research has expanded the concept of visual saliency to include other sensory modalities, such as auditory and olfactory cues. These studies explore how the combination of visual, auditory, and olfactory stimuli influences the saliency and perception of the townscape (Filipan et al., 2019). Understanding the multimodal saliency of cues can provide a more comprehensive understanding of how individuals experience and engage with the urban environment. Advances in virtual reality (VR) and augmented reality (AR) technologies have opened up new possibilities for studying visual saliency in townscape analysis. Researchers can create immersive virtual environments or digital overlay information onto the real-world environment to investigate how individuals perceive and interact with visually salient cues (Bian et al., 2022). VR and AR simulations allow controlled experiments and provide realistic and interactive representations of the townscape for research and design purposes.

Theoretical developments in the past decade have emphasised the importance of considering social and cultural factors in understanding visual saliency. Researchers recognise that the salience of cues can vary across different cultural contexts and social groups (Moradi et al., 2020). Theoretical frameworks now incorporate sociocultural perspectives to explore how values, experiences, and social interactions influence the perception and interpretation of visually salient elements in the townscape. These theoretical developments have expanded our understanding of visual saliency in townscape analysis. They have provided new insights into computational modelling, empirical studies, multimodal perception, virtual reality, and the influence of social and cultural factors on visual saliency. Integrating these advancements into urban design and planning can create more legible, perceptible, and engaging townscape environments.

In conclusion, townscape structure encompasses more than just visibility; it includes the legibility and clarity of visual elements, enabling accurate perception and understanding of the surroundings. Legible townscape elements, such as prominent landmarks and distinct spatial patterns, facilitate wayfinding and mental mapping, enhancing navigation in the urban environment.

### 4.3 Navigational Competency of Townscape

Navigational competence refers to individuals' ability to effectively utilise visual cues and make informed decisions regarding route selection and navigation (Sharma & Kim, 2022). It involves cognitive processes such as spatial orientation, mental mapping, and the integration of visual information into coherent mental representations of the townscape. Several factors contribute to navigational competence. Reliable and consistent visual cues, such as well-placed

signage and recognisable landmarks, enhance individuals' ability to navigate and make accurate decisions (Heft, 1979, 1983, 1996). Familiarity with the environment also plays a significant role, as individuals who are more familiar with a particular area tend to have better spatial knowledge and can navigate more effectively (Kim et al., 2021; Iftikhar et al., 2021). Spatial abilities encompass spatial perception, mental rotation, and spatial memory, contributing to an individual's capacity to understand and navigate the urban environment (Montello, 2005; Montello & Sas, 2006). Strong spatial abilities enable individuals to interpret the spatial layout of the townscape, anticipate landmarks, and plan efficient routes.

According to a study by Adiastuty et al. (2020), gender differences can also predict wayfinding abilities. The research found that men report being better at using orientation strategies and demonstrate higher overall wayfinding competence than women. The study suggests that men may be more inclined to use orientation-based strategies, which involve relying on directional cues, landmarks, and mental maps to navigate their surroundings. These strategies often prioritise spatial relationships and a sense of direction. On the other hand, women may have different wayfinding preferences and may rely on strategies, such as route-based strategies, which involve following specific routes or instructions. This difference in strategy preference may contribute to the perception that men are better at overall wayfinding competence.

### 4.3.1 Navigational Competency in Wayfinding Studies
Recently, there have been several theoretical developments in understanding navigational competence and its underlying factors, shedding light on various aspects of individuals' navigational abilities and strategies. Advancements in cognitive mapping and spatial cognition research have deepened our understanding of how individuals mentally represent and navigate the townscape. Studies have explored the cognitive processes involved in spatial orientation, mental mapping, and the integration of visual information into coherent mental representations (Fernandes et al., 2019). These developments have helped elucidate how individuals acquire and utilise spatial knowledge for effective navigation. The proliferation of smartphones and navigation apps has revolutionised how people navigate urban environments. Theoretical developments have focused on understanding the impact of digital navigation tools on navigational competence. Researchers have examined the effects of reliance on digital maps, GPS systems, and augmented reality interfaces on individuals' wayfinding abilities (Iftikhar, 2022). These studies have explored the potential benefits and drawbacks of technology-mediated navigation and the implications for individuals' navigational competence.

Navigational competency theory has highlighted Environmental perception and design in the past decade. Researchers have examined how visual cues, landmarks, and signage affect navigation performance (Iftikhar, 2022). These studies have shown that readable, visually distinct, and unambiguous navigational cues in urban situations improve navigational competency. Individual and social variables affect navigational competence. Gender disparities in wayfinding have been studied (Adiastuty et al., 2020). Cultural characteristics, socioeconomic level, and age might affect spatial abilities and wayfinding methods; research has examined their effects on navigational competence. Multimodal navigation and accessibility have been theorised. Researchers have examined how people use walking, cycling, public transport, and other means to get around (Jayaraman et al., 2021). Multimodal navigation and how urban landscapes can enable multiple modes of movement have been studied using theoretical frameworks.

In conclusion, navigational competence refers to individuals' ability to effectively use visual cues and make informed decisions during wayfinding. Key factors contributing to navigational competence include the presence of reliable visual cues, familiarity with the environment, and strong spatial abilities. Recent theoretical developments have deepened our understanding of cognitive mapping and spatial cognition, shedding light on how individuals mentally represent and navigate the townscape. Additionally, the rise of digital navigation tools has been explored, examining their impact on navigational competence and considering both the advantages and potential drawbacks of technology-mediated navigation.

Moreover, navigational competence theory emphasises the crucial role of environmental perception and design in enhancing navigation performance. Studies have highlighted the importance of providing readable, visually distinct, and unambiguous navigational cues in urban environments to improve navigational competence. Furthermore, research has explored how individual and social variables, such as gender, cultural characteristics, socioeconomic status, and age, can influence navigational abilities and wayfinding strategies. Additionally, the concept of multimodal navigation and accessibility has been theorised, investigating how people use various modes of movement, such as walking, cycling, and public transport, to navigate the urban landscape. Understanding these theoretical frameworks can guide urban design and planning efforts to create more navigable and inclusive townscape environments.

Overall, the advancements in navigational competence research have provided valuable insights into the complexities of human wayfinding and the interplay between individual capabilities, environmental factors, and technological influences. By incorporating these insights into urban design and planning, cities can become more user-friendly, supporting efficient and enjoyable pedestrian navigation experiences for residents and visitors alike.

## 5. Conclusion

The townscape denotes the visual elements of the urban environment that pedestrians directly encounter and engage with during their city experiences. It was noted that certain terms, such as perceivable (visible) and discernible (salient), were used repeatedly by multiple authors to describe the characteristics of the urban environment. Townscapes were identified as the framework within the urban visual environment that allows pedestrians to utilise visual cues, such as landmarks, signage, and perceivable objects, to orient themselves. Past studies clarified that the visual structure of townscapes allowed them to affect the effectiveness of pedestrian navigation by selecting observable and legible visual cues within the townscape. Our investigation delved into these visual structures, considering environmental factors (visibility and saliency of townscapes) and psychological aspects (navigational competence).

The visibility of townscapes has been extensively discussed in various papers, with a consensus emerging around three key categories: obstruction of sightlines, angle of vision, and lighting conditions. The primary factor influencing visibility is the lighting condition, whether the townscape is well-lit through natural or artificial lighting. The brightness of the visual scene significantly impacts pedestrians' ability to identify and comprehend the visual environment they are experiencing. Moreover, our investigation revealed that the townscape can be perceived in two dimensions: frontal and longitudinal. These perceptions further informed the importance of sightlines, townscape distance, and the angle of vision, particularly in hilly townscapes where topography plays a significant role. Building alignment and curving roads in urban design and planning can influence visual experiences and visibility. The next aspect

to consider in navigating townscapes beyond visible streets is the availability of salient cues within the urban environment. Here we believe that the distinctness and prominence of visual elements serve as essential reference points for pedestrians, aiding their orientation and wayfinding. Saliency was discovered to be categorised into visual and contextual. In the case of visual characteristics, identity and structure were mentioned in several studies. The visual saliency represents the overall distinctness of the compositional elements of the townscape by various authors. The alternative to urban saliency can also be identified by Lynch (1981) as the sense of the place. We believe that the visual structure of the townscape can also be identified as the sense of the townscape. Moreover, contextual characteristics such as the semantics of the visual cues are significant in influencing wayfinding choices. Therefore, these characteristics are key metrics in creating an easily navigable urban environment.

It is also useful to consider the spatial ability limitation in designing townscapes. Different individuals may possess varying levels of spatial ability, which can influence their wayfinding performance in urban environments. Several authors have highlighted the importance of navigational competence in predicting how pedestrians navigate within townscapes. Individuals with high navigational competence tend to understand the townscape's layout better, possess effective mental maps, and can anticipate the relationships between landmarks and destinations. They are more adept at selecting optimal routes, adapting to environmental changes, and successfully completing wayfinding tasks. On the other hand, individuals with lower navigational competence may experience challenges in interpreting the visual cues and spatial information presented by the townscapes. They may struggle with creating mental maps, recognising landmarks, and forming accurate spatial representations of their surroundings. As a result, their wayfinding performance may be less efficient, leading to increased navigation errors, longer travel times, and heightened feelings of disorientation.

In addressing the second question, it is possible to state that numerous gaps in the literature can be addressed in future research. In the case of visibility, most studies on the visual structure of townscape compositions are conducted in other countries. Studies on townscape in Malaysia tend to look into the saliency of the townscape, such as identity and structure, rather than compositional visibility. Future research could therefore focus on the visual exclusivity of Malaysian townscapes. Though the studies on saliency were conducted fragmentally, future works should consider the townscape's gestalt phenomenon in its entirety. Cultural differences in the visual perception of townscapes in Malaysia seem limited in their investigation. Therefore, the degree of navigability of Malaysian pedestrians could be a valuable metric in understanding the social impact of the visual structure of townscapes.

## 6. Future works

Future research should address several key issues in the existing literature on townscape navigation. While previous studies have highlighted the influence of visual and structural characteristics, limited research still utilises holistic measures in urban navigation-related experiments. Developing and employing new tools to compare the components of visibility, saliency, and navigational competence could lead to a more effective understanding of their impacts on wayfinding behaviour. Additionally, exploring alternative conditions, such as task variations, familiarity levels, and layout differences, in comparative experiments could provide valuable insights into how these factors influence the usage of visual cues in pedestrian wayfinding. This approach may offer comprehensive insights into the factors influencing pedestrians' perception and utilisation of visual cues within urban environments.

Moreover, further investigation is needed to understand the relationship between different townscape characteristics, especially in tropical urban environments like Malaysia. For example, recent findings have found that visual clutter negatively affects public appreciation of Kuala Lumpur streets, especially for older people (Adam et al., 2022). By examining the combined impact of various visual measures, researchers can gain a deeper understanding of how these elements interact within specific urban contexts. Our research focused on the "environment" and "people" in determining the criteria for townscape legibility. Our review of relevant papers demonstrated that both factors significantly influence townscape wayfinding. Therefore, it is evident that townscape navigation is a complex process shaped by multiple interrelated factors that should all be considered for a comprehensive understanding. Given the multifaceted nature of townscape wayfinding, there is a need for collaborative efforts involving multidisciplinary research groups. By integrating expertise from diverse fields, we can better understand townscape legibility and its implications for pedestrian navigation. This collaborative approach will be instrumental in guiding urban planning and design strategies, ultimately leading to the creation of more navigable and user-friendly urban environments.

In conclusion, addressing these research gaps will contribute to a more comprehensive and nuanced understanding of how townscape visual structure influences pedestrian wayfinding, benefiting the design and planning of pedestrian-friendly urban environments.

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