

## Talking about landscape spaces. Towards a spatial-visual landscape design vocabulary

Liu, Mei; Nijhuis, Steffen

**DOI**

[10.1080/14606925.2021.2021672](https://doi.org/10.1080/14606925.2021.2021672)

**Publication date**

2022

**Document Version**

Final published version

**Published in**

Design Journal

**Citation (APA)**

Liu, M., & Nijhuis, S. (2022). Talking about landscape spaces. Towards a spatial-visual landscape design vocabulary. *Design Journal*, 25(2), 263-281. <https://doi.org/10.1080/14606925.2021.2021672>

**Important note**

To cite this publication, please use the final published version (if applicable). Please check the document version above.

**Copyright**

Other than for strictly personal use, it is not permitted to download, forward or distribute the text or part of it, without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license such as Creative Commons.

**Takedown policy**

Please contact us and provide details if you believe this document breaches copyrights. We will remove access to the work immediately and investigate your claim.

# Talking about landscape spaces. Towards a spatial-visual landscape design vocabulary

Mei Liu & Steffen Nijhuis

To cite this article: Mei Liu & Steffen Nijhuis (2022) Talking about landscape spaces. Towards a spatial-visual landscape design vocabulary, The Design Journal, 25:2, 263-281, DOI: [10.1080/14606925.2021.2021672](https://doi.org/10.1080/14606925.2021.2021672)

To link to this article: <https://doi.org/10.1080/14606925.2021.2021672>



© 2022 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group



[View supplementary material](#)



Published online: 14 Feb 2022.



[Submit your article to this journal](#)



Article views: 547




[View related articles](#)



[View Crossmark data](#)

# Talking about landscape spaces. Towards a spatial-visual landscape design vocabulary

Mei Liu  and Steffen Nijhuis

Section Landscape Architecture, Department of Urbanism, Delft University of Technology, Delft, The Netherlands

## ABSTRACT



Spatial-visual landscape design vocabulary is important for landscape architects to understand, design, and communicate about landscape spaces. Despite the importance, there is no comprehensive overview available. This article aims to fill this gap by reviewing and categorising the spatial-visual design vocabulary for the field of landscape architecture and to provide a systematic framework for understanding landscape spaces inter-subjectively. Based on the analysis of the vocabulary used in the extensive body of literature available in landscape architecture and related disciplines, four dominant categories are selected in describing spatial and visual organisation. The categories identified and discussed are sequence, orientation, continuity, and complexity. In addition, a landscape design syntax is developed to understand and to describe the visual manifestation of landscape spaces, how space is organised, and what ordering principles play a role from both qualitative and quantitative perspectives.


## KEYWORDS

Design vocabulary, landscape design, spatial-visual organisation, spatial composition, landscape metrics, landscape spaces

## Introduction

In the field of landscape architecture, landscape design is an important area of knowledge and activity (Evert et al. 2010). It is about the articulation of outdoor spaces which results in landscape architectonic compositions. Landscape architectonic compositions deal with form and meaning. They provide physical, functional, and aesthetic arrangements of a variety of structural elements to achieve desired social, cultural, and ecological outcomes (Vroom 2006; Nijhuis 2013). In order to understand and communicate about the spatial and visual characteristics (in short: spatial-visual characteristics) of

**CONTACT** Mei Liu  [m.liu-1@tudelft.nl](mailto:m.liu-1@tudelft.nl)  Section Landscape Architecture, Department of Urbanism, Delft University of Technology, BG.West.170, Julianalaan 134, 2628 BL Delft, The Netherlands.

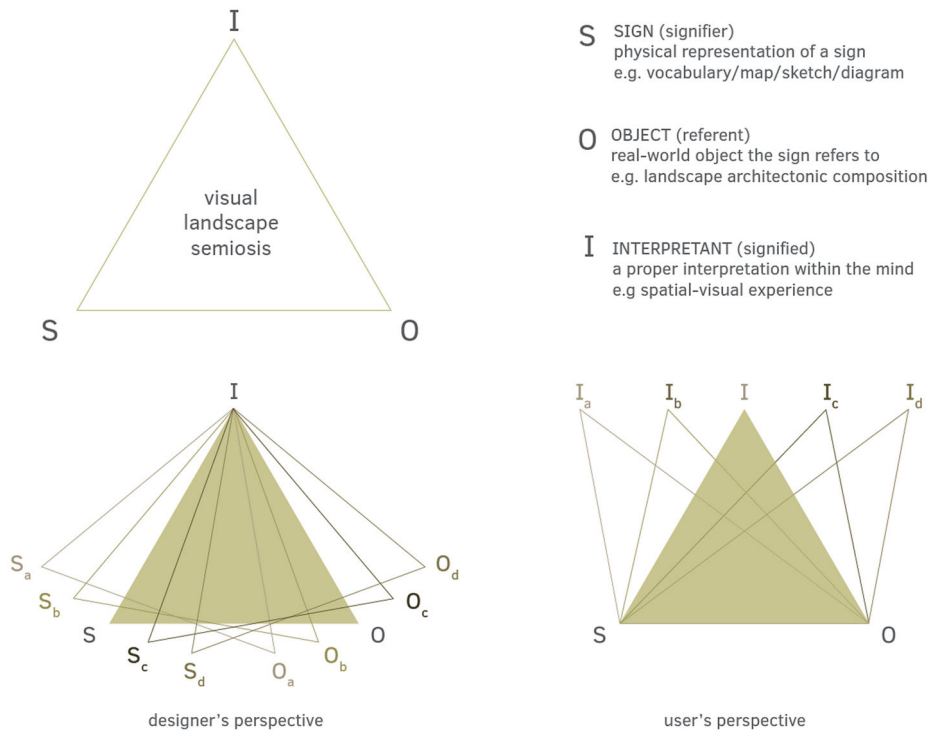
 Supplemental data for this article is available online at <https://doi.org/10.1080/14606925.2021.2021672>.

© 2022 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group  
This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

landscape architectonic compositions, vocabulary, representation, and tools are of fundamental importance to landscape architecture (Nijhuis 2011).

As early as in the eighteenth century, Kant (1781) addressed space as: *'nothing other than merely the form of all appearances of outer sense'*. According to Kant, space is 'the subjective condition of sensibility', with which 'outer intuition is possible for us' (Hatfield 2006). This doctrine of space remarks a core of Kant's epistemology by suggesting that a certain transcendental structure exists a priori in one's experience of a space. In other words, the sensibility in and of a space is a common faculty for all human beings. However, Kant's notion may lead to an understanding of one's experience of space as a pure extension of subjective sensibility and this approach may neglect the fact that a common sense of space may consist in human's intersubjectivity. At this point, phenomenology demonstrates how a common cognition of the spatial experience is possible. Addressing Kant's ideas, Merleau-Ponty (1962) emphasised that both the act of seeing and feeling of the reality help construct correlations between the individual's exploration and the sensorial responses of the world. Although people use all senses to perceive the space they encounter, the principal way of experiencing the environment is through vision (Harris and Ruggles 2007). American psychologist James J. Gibson (1979) describes the optic array or flow field as spatio-temporal features establishing a direct relationship between humans and the physical surroundings. To capture the true nature of this intersubjectivity in an individual's spatial experience, a groundwork of semiotics of signs and language has long been considered as an important approach to understand the correlations among the perceptions of the space and its architectonic compositions.

It may be helpful to refer to Charles S. Peirce's logic of semiotic theory, where there is a distinction between the sign (a physical representation of a sign), object (the real-world reference the sign refers to), and the interpretant (the proper interpretation within the mind) (Peirce 1991). In the field of landscape architecture, semiosis between the representation of design notion (sign-signifier), landscape architectonic composition (object-referent), and a progression of meaning-interpretation (interpretant-signified) plays an important role for either designers to transform mental design concepts into substantial design interventions or for users to recognise and perceive the landscape (Figure 1 top). As signs, design vocabulary and visual representations (e.g. sketches, diagrams, and 3D models) are invented and commonly used by spatial designers to raise awareness of a specific design phenomenon and then to imply a conscious morphology of landscape space. While, from the users' points of view, signs here could be a guide/site map or a paragraph of introductory text of the landscape which aims to portray an overview of the space. Considering that the spatial-visual experience leads to



**Figure 1.** Visual landscape semiosis indicating the relationship among sign, object, and interpretant (adapted from Charles S. Peirce and his model of semiosis).

a relatively inter-subjective cogitation of the space, and can thus be regarded as common sense for different individuals, designers often project these experiences the fundamental purposes for design interventions in terms of various visual representation ways and landscape architectonic compositions (Figure 1 bottom-left). However, when a person is perceiving the landscape, a gradual transition to a more subjective and alternative interpretation of the three-dimensional spatial composition and visual organisation is taking place (Figure bottom-right). Because everyone has their own personal agenda, there is no identical and stable interpretation of meaning/perception (interpretant) for each sign and object.

As put forward by Stahl (2005), *'vocabulary knowledge equals to knowledge; the knowledge of a word does not only imply a definition, but it also implies an understanding of how that word fits into the world'*. Words make people aware of a certain phenomenon and each word implies a conscious observation and identification. In other words, a landscape architect's level of understanding of spatial-visual aspects is related to the vocabulary a landscape architect uses. The design vocabulary that spatial designers use is often based on traditional and personal descriptions and understanding. This results in a lot of missed opportunities for alternative approaches because of a lack of awareness for other options.

Despite the importance of a design vocabulary, there have been only a few attempts to develop a distinct vocabulary. From a landscape design and qualitative point of view, several researchers elaborate on the two- and three-dimensional layouts of the landscape architectonic composition and the commonly-used vocabulary to describe the spatial construction of spaces, paths, edges (i.e. surfaces, screens, objects), foci, thresholds, and spatial-visual relationships like sequences, views and vista's (e.g. Simonds 1997; Motloch 2000; Dee 2004; and Loidl and Bernard 2003). Bell (1993) elaborates on spatial landscape elements and organisational structures by employing vocabulary such as 'balance', 'tension', 'rhythm', or 'proportion'. In landscape-focused research, the emphasis is placed on quantitative clues for the development of operational landscape indicators that link measurements, spatial descriptions, and performances, such as 'proximity', 'connectivity', and 'coherence' (McGarigal and Marks 1995; Tveit, Ode, and Fry 2006; Salat 2011). From both a qualitative and quantitative perspective, they offer powerful clues to an understanding of landscape spaces. However, a comprehensive overview of different types of spatial-visual vocabulary available for landscape design is lacking.

This article aims to provide an overview of spatial-visual design vocabulary for the field of landscape architecture, and then introduce a systematic framework understanding and communicating the spatial-visual characteristics of this vocabulary into a coherent whole. In addition, the authors seek to contribute to the advancement of the theoretical foundations of landscape architecture in two ways: (1) by reviewing the spatial-visual design vocabulary and establishing an original framework for interlinking qualitative and quantitative approaches to understanding landscape spaces; and (2) proposing a landscape design syntax as the result of the systematic analysis in which the spatial effects and visual manifestation of landscape architectonic compositions is revealed.

## **An overview of spatial-visual design vocabulary**

### ***Spatial-visual vocabulary in various research fields***

To fully grasp the range of existing knowledge on the topic of landscape architecture, an extensive literature review was conducted. For the analysis, Google Scholar was accessed in April 2018, as this database offers a broad selection of literature including journal articles, conference papers, books, chapters, academic reports, policy documents, conference proceedings, and MSc./PhD theses. The discourse on landscape spaces is not restricted to landscape design but also includes urban design, urban morphology, landscape psychology, landscape ecology, visual design, and visual landscape studies. These are also potential research fields with direct and indirect relations to



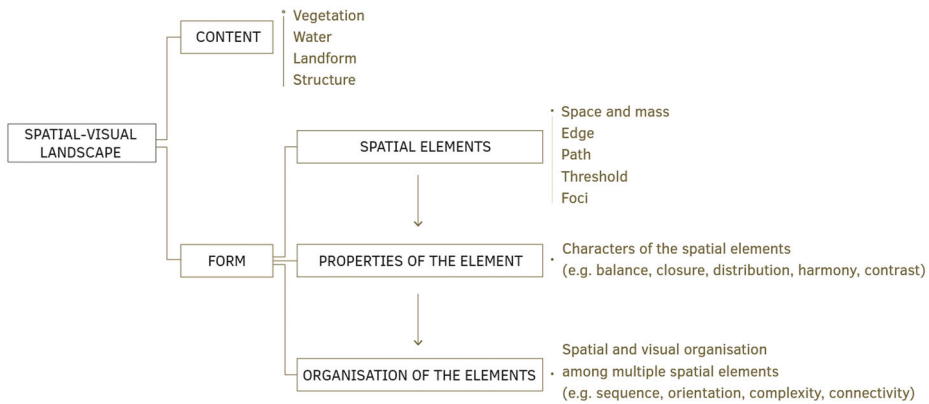
**Figure 2.** A spatial-visual design vocabulary cloud generated from various research fields. The size of a word indicates how often it is used to describe spatial-visual properties in the literature.

the spatial-visual aspects of landscape. The search combined keywords ‘spatial and visual’ and the related research fields with the Boolean operation ‘AND’ to find precise matches (e.g. spatial and visual AND landscape design). Content referring to spatial-visual properties of landscape space were to be found either in the title, the keywords, or in the body text. However, content of cited literature or literature descriptions, figure captions, indices, footnotes, as parts of author descriptions or affiliations was excluded.

Using the most relevant literature, an initial design vocabulary cloud with relation to spatial-visual characteristics of landscape and from various research domains was generated (Figure 2). Landscape architecture and urban design commonly use design vocabulary to describe spatial-visual compositions, for example ‘sequence’, ‘diversity’, ‘unity’, ‘enclosure’, ‘circulation’, ‘integration’, ‘variation’, and ‘connectivity’ (e.g. Lynch 1960; Bell 1993; Motloch 2000; Dee 2004). A few urban design approaches have developed morphological indicators to evaluate urban configurations from a quantitative perspective like ‘intensity’, ‘proximity’, and ‘connectivity’ (e.g. Salat 2011). The field of landscape ecology also includes indicators to measure visual characters of landscape spaces, such as ‘diversity’, ‘evenness’, and ‘contagion’ (e.g. McGarigal and Marks 1995). A small part of landscape character assessment and landscape psychology research focuses on people’s perception of spaces via visual concepts, which are ‘enclosure’, ‘variety’, ‘coherence’, ‘legibility’, ‘complexity’, and ‘mystery’, etc. (e.g. Kaplan and Kaplan 1989; Stamps 2004; Ode, Tveit, and Fry 2008; Blumentrath and Tveit 2014).

### ***The nature of spatial-visual design vocabulary***

In order to grasp the vast amount of spatial-visual design vocabulary, it is important to understand what aspects of landscape spaces are indicated and



**Figure 3.** Layers describing the nature of spatial-visual design vocabulary.

discussed by this lexicon. To answer this question, it is useful to make a distinction between form and content (Motloch 2000; Loidl and Bernard 2003; Nijhuis 2015). Content is everything that comprises a landscape architectonic object, and its physical, biological, and cultural substances, such as landform, vegetation, water, and built structures. Form involves the way in which two- and three-dimensional elements are assembled into a landscape architectonic composition (Nijhuis 2015). It is constructed of five basic spatial elements containing spaces and mass, edges, paths, foci, and thresholds (adapted from Lynch 1960; De Veer and Burrough 1978; Dee 2004).

Spatial-visual design vocabulary describes the formal properties, organisations and spatial-visual landscape elements. As shown in Figure 3, some design vocabulary categorised as ‘properties of the element’ are commonly used to describe the spatial and/or visual properties of landscape elements. For example, the ‘enclosure’ of the vegetation edge, the ‘balance’ of spaces, sizes, the ‘dominance’ of the monument as a landmark, or the ‘openness’ of the natural space. Meanwhile, some other design vocabulary regarded as ‘organisation of the elements’ tends to establish organisational structures and visual relationships among multiple spatial elements to indicate perceptual experiences in landscapes, such as the ‘connectivity’ of a series of spaces, the ‘sequence’ in motion, and the navigational ‘orientation’ of the landscape.

As the literature review points out, design vocabulary from different authors sometimes overlaps and these terms are not mutually exclusive. ‘Properties of the element’, as simple design vocabulary, indicates straightforward spatial-visual effects based on the specific characteristics of spatial elements; while ‘organisation of the elements’, as compounded design vocabulary, presents composite structures and organisations of spatial elements. Compounded design vocabulary can be created through the combination of simple design vocabulary. For example, ‘sequence’ can be shaped by the ‘connection’ of a series of spaces with different degrees of ‘enclosure’.



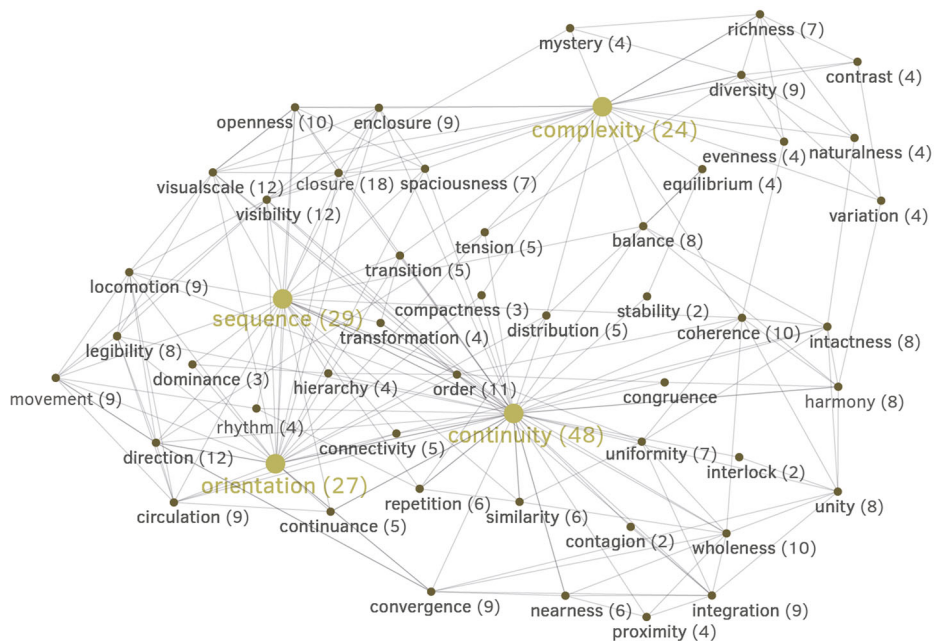
Here 'continuity', as a compound design word, can be formed through the combination of two simple design terms, 'connection' and 'enclosure'. In different research fields, the same design terms might have various interpretations in terms of spatial-visual characteristics. In the context of landscape psychology and visual landscape studies, 'complexity' expresses how much a scene contains, which can be determined by the richness of spatial and visual properties of landscape elements. Likewise, in landscape ecology, 'complexity' is related to the heterogeneity of spatial compositions and configuration, such as evenness, edge density, and shape diversity (Palmer 2000; Stamps 2004). A detailed literature review is available in Appendix 1, which summarises the spatially- and visually-oriented explanation of the initial design vocabulary from representative references and identifies whether they are used to describe properties of the spatial element or spatial-visual organisation of multiple elements.

### ***Dominant categories in describing spatial-visual organisation***

Concerning the paraphrasing of each spatial-visual design term from representative studies, detailed inner-mechanisms among landscape elements are revealed according to their structural characteristics and organisations. The 'organisation of elements' design term, representing spatial-visual experiences in a landscape, is related to one or multiple 'properties of the element', depicting spatial properties and structures of the element. Also, some terms look different but have synonymous or similar meanings of landscape spaces in spatial-visual aspects.

To specifically explore and identify the nature of landscape forms in terms of spatial-visual landscape characteristics, a network analysis is conducted here which demonstrates the 'compose and be composed' relations between design vocabulary based on the explanation of each spatial-visual design term. In the network analysis, each design vocabulary is depicted as a node; while lines are linked if there is direct or indirect relationship between the terms. Figure 4 is developed using *Flourish*, an open-source visualisation platform, and this software application automatically generates as a matrix form. As a result, four design vocabularies are most frequently linked with the others, which can be recognised as the predominant 'organisation of the elements' design vocabulary describing compounded spatial-visual organisation and experience of landscape spaces, which are (Table 1):

In order to study how landscape elements are formed together to interpret these main spatial-visual organisations in detail, and how they are manifested in visual ways, each design vocabulary and associated synonyms related to landscape design were further analysed using bibliometric analysis (via Google Scholar). For example, 'sequence' combined with 'landscape



**Figure 4.** Network analysis showing the relations between the spatial-visual design vocabulary according to the literature review. Nodes are design vocabulary; lines are the direct or indirect relations; numbers mean how many times it is connected with others in the matrix. Automatically conducted by an open visualisation platform Flourish, see input and original output at: <https://app.flourish.studio/visualisation/2574736/edit>.

**Table 1.** Dominant categories of design vocabulary in describing spatial-visual organisation.

Categories of design vocabulary related to spatial-visual organisation	Representative vocabulary	Synonymous vocabulary
Vocabulary about a sequential relationship and experience composed by a series of ordered or repeated landscape elements and rhythmical organisation along movement.	Sequence	Rhythm; order
Vocabulary regarding landscape architectonic compositions which guide physical movement and visual arrays for further wayfinding and exploration.	Orientation	Direction; legibility; circulation
Vocabulary referring to the construction of spatial elements linked to each other as a whole, which allows going or looking through.	Continuity	Connectivity; connection; integration; proximity; continuance
Vocabulary concerning the diversity and richness of spatial and visual elements in a landscape scene.	Complexity	Diversity; richness; evenness; mystery

design' by Boolean operator 'AND' are used as keywords to filter the literature. The top one hundred publications were scanned through abstracts first, in order to select relevant references referring to spatial-visual landscape, and then intensive reading was applied to analyse and explore how this potential spatial-visual organisation is structured and represented in order to select the most relevant references. The four most dominant categories of special-visual vocabulary are presented and explained as follows.

## Four dominant categories in spatial-visual vocabulary

As the literature review points out, sequence, orientation, continuity, and complexity play an important role in the spatial-visual vocabulary of landscape architecture and related spatially oriented disciplines. These terms overlap and are not mutually exclusive. Also, there are synonyms and terms that, at first glance, look different but can have similar meanings in understanding landscape spaces. The following section will explain the compositional mechanisms of landscape elements shaping certain spatial-visual organisations and the relevant design vocabulary indicated.

### *Sequence*

An overwhelming majority of research studies define 'Sequence' as independent nodes that are related and connected with each other through access links, to provide a visual sensation along certain movements through a landscape. In a linear linkage, path structure is the most frequently used element that connects design nodes to create a spatial sequence. This helps build an inner-relationship and perceptive experiences within the landscape. Creating nodes along a route can be done in a number of ways, through the creation of sequential spaces, landmarks, joints, thresholds, and symbolic objects (Lynch 1960; Dee 2004; Jackson 2008; Kiss 2017). Regarding roads and highways, topographic elements such as elevation, flat forms, wave forms, and climax forms, play an essential role in shaping sequential experiences (Blumentrath and Tveit 2014). In particular, the organisation of views also provides a visual sequence that broadens the observers experience and appreciation (Nijhuis 2011; Apostol et al. 2016).

'Rhythm' as a synonymous term suggests that a composition, through the repetition of similar elements, creates a sequence, which can be seen as a specific unified 'Sequence'. Jackson (2008) defines rhythm as a principle closely related to sequence, which is a result of repetition. Characterised by Motloch (2000) and Ching (2014), this coherent sequence is created through repeating landscape patterns, such as line, form, colour, value, or texture.

Other relevant studies point out that an edge is also an important spatial-visual element that shapes a sequence, such as water boundaries, vegetation edges, or the enclosure of an edge along a path. Appleyard, Lynch, and Myer (1964) describe that the sequence of a landscape can be influenced by changing the enclosure of the water boundary. In this case, the width of the water course is indicated as relaxed flow and accelerated flow to present the sequential changes of landscapes. However, Thiel (1961) analyses and discusses that the sequence as a three-dimensional composition, which are composed by surfaces, screens, and objects in over, side, and under positions. This experience mostly refers to the alternate types of enclosure, the

degree of enclosure, the permeability of an edge, the height of an edge etc. (Jakle 1987; Loidl and Bernard 2003; Booth 2011). A detailed literature review is available in Appendix 2.

### **Orientation**

The majority of research studies assert that creating landmarks or/and openness is important to establish a sense of direction, as well as provide an way to orient oneself in the landscape. Landmarks are foci set in specific positions and indicate a tangible direction dedicated to guide people's movement through the landscape (Motloch 2000; Loidl and Bernard 2003; Nijhuis 2011). Research and practical experiences in traffic design also show the significance of using foci (such as monument, specimen, and building) to form orientation (Appleyard, Lynch, and Myer 1964; Queensland Government 2013).

Furthermore, Booth (1989) states that space is like liquid which always tends to open views with the least the resistance (Appleton, 1975; Bell 1999; Franco et al. 2003). From a landscape psychology perspective, legibility means the perception of finding your way or back to any given point in the environment, which carries a sense of orientation (Kaplan, Kaplan, and Ryan 1998; Stamps 2004). The related research also highlights the importance of reference points (i.e. foci) and openness (i.e. space, edge, and visual impact), which are able to enhance the cognition of visual orientation and can make the space more readable (De la Fuente de Val, Atauri, and de Lucio 2006).

Edges of water, spaces, and paths are always used for orientation (Cullen 1961; Ronnen et al. 2005). Moreover, landscape ecologists demonstrate that an edge is an essential spatial element that influences orientation in landscape spaces. Relevant characteristics like the length of an edge and its orientation are measured to show the elasticity of space (Dramstad, Olson, and Forman 1996; Beck 2012). Characteristics of an edge can also indicate the visual orientation by forming an openness to the landscape, such as the height of the edge, relationship between the foreground, mid-ground and background, and the permeability of the edge (Kaymaz 2012; Rega 2014). Also, in the urban context, the continuity of a building facade along a path and an exposed sky helps to maintain a sense of direction (Thwaites, Helleur, and Simkins 2005). A detailed literature review is available in Appendix 3.

### **Continuity**

Continuity has a strong relationship with visual and physical access and strengthens an awareness of the fore way which connects subspaces to the whole. Continuous movement often happens in open spaces, which allows for permeable views and accessibility. These approaches form spatial

elements with certain characteristics, such as the openness of space, the permeability of edges, and the layers of a scene (foreground, middle ground and background) (Robinson 2004; Pancholi, Yigitcanlar, and Guaralda 2015). In the urban context, the skyline can also provide an eye-level visual experience of continuity (Homma, Morozumi, and Iki 1998).

The spatial-visual characteristics of continuity generally focuses on the shape of landscape elements, such as the shape of water, spaces, and paths. It indicates edge forms and materials that can directly influence the experience of continuity. For example, enhancing repetitive and similar edge patterns can guide a person's perception of continuity (Bell 1993; Thwaites 2001; Torreggiani et al. 2014). In addition, the manipulation of landforms such as moderating slope elevation and the angle of elevations could also offer continuity in spaces, views, and motion (Lynch 1960; Ronnen et al. 2005). In morphological studies, space syntax has become a primary research branch in helping measure the connectivity and the integration of path networks, but also presents the continuity of the spatial system from a larger scale (Hillier 1997; Weitkamp et al. 2007).

Continuity is also an important indicator for landscape ecology in the urban and rural environment. Landscape infrastructure, such as green corridors, greenways, and river corridors, suggest that the width and creating successive paths are able to enhance spatial continuity for landscape planning (Nassauer and Opdam 2008; Liu et al. 2016). Also, a number of detailed characteristics like patch area, patch perimeter, edge to edge distance, and the number of joints are commonly used to calculate indicators for continuity such as the interspersion/juxtaposition index, contagion index, cohesion index, isolation index, and proximity index (Simova and Gdulova 2012). A detailed literature review is available in Appendix 4.

### **Complexity**

Definitions of complexity have always varied in research domains which mainly includes studies on landscape design, landscape preference assessment, and landscape ecology. Kaplan (1988) proposes that complexity should reflect how much is happening in a particular scene. Landscape morphology and psychology studies have mentioned the importance of visual array and diversity during the perception of complex environments. They predominantly appear as variations of textures, forms, patterns, and colours of visible landscape scenes (Dunnett and Hitchmough 2004; Mok, Landphair, and Naderi 2006). Landforms are widely-used to shape diverse experiences within a landscape by changing people's visual perception (Loidl and Bernard 2003; De la Fuente de Val, Atauri, and de Lucio 2006; Sang, Hägerhäll, and Ode 2015). The shape and length of the paths and routes are also frequently

used to enhance the complexity of a landscape (Steinitz 1990; Thwaites 2001). Furthermore, the degree of openness within a landscape is significant in promoting motives to explore. Hence, the corresponding spatial-visual characteristics such as the degree of an enclosure, the permeability of an edge, and view depth are widely applied to provide opportunities to create a sense of complexity (Olwig 2016).

On the other hand, in landscape ecology, there is a large amount of research dedicated to the calculation of spatial complexity. Depending on the grain size (scale) of landscape, landscape ecologists commonly use quantifiable indicators to describe spatial complexity and to interpret composition and configuration. They can be represented by land-use diversity, edge density, and landscape shape index (McGarigal and Marks 1995). These landscape metrics indicate a series of explicit indices like Shannon's diversity index, Simpson's diversity index, patch richness density, Shannon's evenness index, and Simpson's evenness index. The corresponding variables referred to indices such as: patch type, patch size, the perimeter of the patch, and the grain size etc. (Turner et al. 1989; Surová, Pinto-Correia, and Marušák 2014). Moreover, in order to gain more inter-subjective clues, Palmer (2000) establishes a significant relationship between landscape preference appraisals and landscape metrics. A detailed literature review is available in Appendix 5.

### ***Summary of the four dominant categories in spatial-visual vocabulary***

To conclude, interpretations of spatial-visual landscape design vocabulary are diverse and involves various of research fields. They show spatial structures and visual effects by composing the contents and characteristics of spatial-visual elements from both horizontal and vertical perspectives. Spatial designers such as landscape architects and urban designers predominantly concentrate on empirical descriptions of spatial compositions and visual organisations. By contrast, researchers of landscape ecology, urban morphology, and visual landscape studies tend to use indicators and quantitative measurements to explore spatial-visual compositions and configurations. According to the literature synthesised in this paper, the four spatial-visual landscape design vocabulary can be defined as:

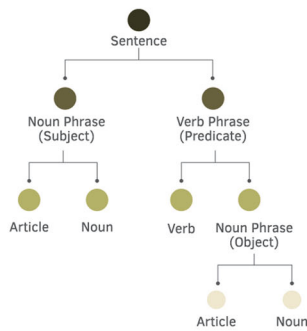
- Sequence: a series of ordered objects which directs the visual experience along movements
- Orientation: the sense of physical and visual access within landscapes to approach a destination
- Continuity: the level of connectivity between adjacent spaces to guide the flow of experience
- Complexity: richness in structure and variety of scenes in the landscape

## From linguistic syntax to landscape design syntax

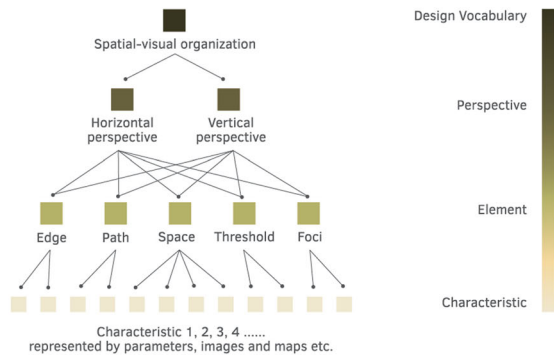
As exemplified by this research, the spatial-visual design vocabulary is a fundamental instrument used by designers serving interpretation and communication of landscape architectonic compositions. It is fully implied to represent design intentions, spatial properties, or perceptual experiences of the landscape with peers and the public from a design perspective. To understand what is the meaning of the design terms, what are the corresponding representations, what design objects and spatial-visual experience it might be intended to refer, is a genuinely linguistic or even broader as a semiotic approach. In light of the Peircean approach to sign studies, verbal and visual representations, as signifiers, have commonalities between semiotics in both language and design phenomena, which can be converted into signified representations through appropriate interpretation. Language can be defined as a sign system articulating human consciousness (Shaumyan 1987). Either textual information or the production of speech (i.e. words, sentences, paragraphs) are used to show the awareness of knowledge and thoughts for self-expression and communication with/between others. Similarly, with the design approach, designers use instantaneous signs (e.g. vocabulary, maps, drawings, schematic diagrams, models) to describe spatial objects but also evoke the intangible experience of space. The idea of using these symbolic representations to convey a thought, both unfolding from various dimensions and realising hidden potentials, is due to the iterative and dynamic process of design thinking (Corner 2011). To generate the meaning of the design vocabulary, it is essential to investigate the structure of those sentences/words (syntax). Grasping the vocabulary used to describe the spatial-visual organisation of landscapes is complex, as it consists of many layers of abstraction. However, using the analysis of syntax in linguistics as a reference, landscape design syntax shows a similar hierarchical structure in dealing with constitutions and procedures for depicting landscape spaces. There are four levels that guide the description and interpretation of a landscape from a design perspective which include: design vocabulary (spatial-visual organisation), perspective, element (components) and characteristics.

As shown as [Figure 5](#), vocabulary related to spatial-visual organisation is used to describe designers' visual appreciation of distinctive spatial structures (Layer 1-design vocabulary). This design vocabulary is always composed of complex spatial compositions and configurations, which can be seen as an umbrella concept. Perspectives are the dimensions that designers use to define landscape spaces (Layer 2-perspective). Typically, horizontal, and vertical points of view are the two primary perspectives (Antrop 2007). The horizontal dimension explores the landscape from an observer's point of view (from the inside-out) and addresses the visual space and characterises spatial

## LINGUISTIC SYNTAX



## LANDSCAPE DESIGN SYNTAX



**Figure 5.** The hierarchical structure of landscape design syntax.

attributes or patterns from an eye-level perspective. The vertical dimension considers the landscape from 'above' – in the form of a map, or the view from the sky – showing spatial patterns and relationships. Elements are the basic components of a landscape, which are path, space, edge, threshold, and foci (Dee 2004) (Layer 3-element). Characteristics indicate the size, shape, and spatial characteristics, which work together to achieve a certain spatial-visual organisation of landscape (Layer 4-characteristic). This framework of landscape design syntax provides a hierarchical process of developing a spatial-visual organisation from an ambiguous concept to a detailed landscape character. In this study, the characteristics of spatial-visual organisation are as Table 2. To show the application of spatial-visual characteristics in the design process, Liu and Nijhuis (2020) provided a hypothetical landscape design experiment to show how a design project can be benefited by the translating of practical challenges into spatial-visual design language and then to identify the spatial-visual characteristics which are most likely to be addressed.

## Summary and conclusions

In this research, a comprehensive overview of design vocabulary, in terms of spatial-visual characteristics, has been reviewed and categorised. As the skeleton of a landscape, both the spatial composition and the visual organisation (i.e. spatial-visual characteristics) play an important role as the predominant and intuitionistic mediators for landscape architects to describe and understand the design mechanisms and effects of space. This article provides a systematic framework for reviewing spatial-visual-related design vocabulary for the field of landscape architecture and interlinks qualitative and quantitative approaches for understanding landscape spaces. Based on the analysis of vocabulary used in the extensive body of literature available on landscape



**Table 2.** The interpretation of spatial-visual characteristics/organisation through a landscape design syntax.

Spatial-visual characteristics/organisation	Perspective	Element	Characteristic	
Sequence	Vertical perspective	Path	Series of landmarks, joints, connections, spaces, symbolic objects along movements.	
		Edge	Shape of water boundary.	
Orientation	Horizontal perspective	Path & visual impact	Enclosure, views, vistas, screens along the movement; topography of path.	
		Edge	Enclosure of edges.	
	Horizontal perspective	Foci & visual impact/ Threshold & visual impact *(with/without path)	Visible landmarks like monuments, buildings, specimen, signposts, gateways, thresholds.	
		Edge & visual impact/ Edge & space & visual impact *(with/without path)	Open views (permeability of edge, enclosure of space); height of edge; topography of space; foreground, middle ground, and background.	
Continuity	Vertical perspective	Path	Shape of path; path patterns (surface, width etc.); direction of path.	
		Edge	Shape of water, mountain, space.	
	Vertical perspective (ecology)	Space	Elasticity of space (shape of edge; shape of space).	
		Edge	Length of edge; direction of edge.	
Complexity	Horizontal perspective	Edge & visual impact/ Edge & space & visual impact	Enclosure (permeability of edge, enclosure of space), views along the movement; height of edge; foreground, middle ground, and background.	
		Space	Topography of space.	
	Vertical perspective	Path	Horizontal shape of skyline.	
		Edge	Shape of water edge/space edge/path edge; length of edge/path.	
	Vertical perspective (morphology)	Foci/threshold * (with/without path)	Bridges, landmarks, linkages, junctions can enhance or decrease the continuity.	
		Path	Repetition of nodes' characters (size, shape, form, texture etc.) along the path.	
		Path (corridor)	Width of corridor.	
		Edge	Interspersion/juxtaposition/contagion index.	
	Complexity	Vertical perspective (ecology)	Space	Proximity index (patch area, nearest neighbour distance).
			Path & threshold	Connectivity/integration index (the number of paths across the crossing).
Horizontal perspective		Edge	Gamma index (number of edge).	
		Visual impact	Visual diversity (types of elements; texture, form, colour of the elements).	
Vertical perspective		Space & edge & visual impact	Openness (permeability of edge, enclosure of space); height of edge; topography of space; foreground, middle ground, and background; depth between the viewpoint and scenes.	
		Path	Shape of path (curve); length of path.	
Vertical perspective (ecology)	Edge	Edge density; number of edges; length of field borders; landscape shape index.		
	Space	Mean fractal dimension (perimeter/area of patch); patch richness index; patch richness density; Shannon's evenness index; Shannon's diversity index; Simpson's evenness index; Simpson's diversity index.		

architecture and related disciplines, four dominant categories in describing spatial-visual organisation are identified and discussed. In addition, a landscape design syntax is developed to help understand and describe the visual manifestation of landscape spaces, how space is organised, and determines what role principles play (and in what order) from a qualitative and quantitative perspective. The output from this research is a useful step in establishing a better knowledge base and form of communication for spatial designers through the establishment of a more systematic design vocabulary. In addition, it also exemplifies the potentialities of creating 'common language' in the field of landscape architecture to enhance the increasingly multidisciplinary and multicultural practice contexts. However, an empirical combination of design vocabulary and landscape metrics is still lacking. It is a necessity to provide mixed approaches to fill the gap between practice and academia. Therefore, merging different mapping methods to achieve more comprehensive notions of landscape space is a prospect for further development in landscape studies.

### Disclosure statement

No potential conflict of interest was reported by the author(s).

### Funding

This study was partly funded by the China Scholarship Council (CSC No. 201506120085). The authors would also like to acknowledge the editing by James Nelson and Dr. Paul W. Fox of an earlier draft of this paper.

### ORCID

Mei Liu  <http://orcid.org/0000-0002-6039-1117>

### References

- Antrop, M. 2007. *Perspectieven op Het Landschap. Achtergronden om Landschappen te Lezen en te Begrijpen*. Gent: Academia Press.
- Apostol, D., J. Palmer, M. Pasqualetti, R. Smardon, and R. Sullivan. 2016. *The Renewable Energy Landscape: Preserving Scenic Values in Our Sustainable Future*. UK: Routledge.
- Appleton, J. 1975. *The Experience of Landscape*. London: Wiley.
- Appleyard, D., K. Lynch, and J. R. Myer. 1964. *The View from the Road*. Cambridge, MA: The MIT Press.
- Beck, T. 2012. *Principles of Ecological Landscape Design*. Washington, DC: Island Press.
- Bell, S. 1993. *Elements of Visual Design in the Landscape*. UK: Routledge.
- Bell, S. 1999. *Landscape: Pattern, Perception and Processes*. UK: Taylor & Francis.
- Blumentrath, C., and M. S. Tveit. 2014. "Visual Characteristics of Roads: A Literature Review of People's Perception and Norwegian Design Practice." *Transportation Research Part A: policy and Practice* 59: 58–71.

- Booth, N. 2011. *Foundations of Landscape Architecture: integrating Form and Space Using the Language of Site Design*. Hoboken, NJ: John Wiley & Sons.
- Booth, N. K. 1989. *Basic Elements of Landscape Architectural Design*. US: Waveland Press.
- Ching, F. D. 2014. *Architecture: Form, Space, and Order*. Hoboken, NJ: John Wiley & Sons.
- Corner, J. 2011. "Chapter 1.12 the Agency of Mapping: Speculation, Critique and Intervention." In *The Map Reader; Theories of Mapping Practice and Cartographic Representation*, edited by M. Dodge, R. Kitchin, and C. Perkins. Hoboken, NJ: John Wiley & Sons.
- Cullen, G. 1961. *Concise Townscape*. UK: Routledge.
- De la Fuente de Val, G., J. A. Atauri, and J. V. de Lucio. 2006. "Relationship between Landscape Visual Attributes and Spatial Pattern Indices: A Test Study in Mediterranean-Climate Landscapes." *Landscape and Urban Planning* 77 (4): 393–407. doi:10.1016/j.landurbplan.2005.05.003.
- De Veer, A. A., and P. A. Burrough. 1978. "Physiognomic Land- Scape Mapping in The Netherlands." *Landscape Planning* 5 (1): 45–62. doi:10.1016/0304-3924(78)90015-1.
- Dee, C. 2004. *Form and Fabric in Landscape Architecture: A Visual Introduction*. London and New York: SPON Press.
- Dramstad, W., J. D. Olson, and R. T. Forman. 1996. *Landscape Ecology Principles in Landscape Architecture and Land-Use Planning*. Washington, DC: Island Press.
- Dunnett, N., and J. Hitchmough. 2004. *The Dynamic Landscape: design, Ecology and Management of Naturalistic Urban Planting*. UK: Taylor & Francis.
- Evert, K. J., E. B. Ballard, I. Oquinena, J. M. Schmerber, and R. E. Stipe. 2010. *Encyclopedic Dictionary of Landscape and Urban Planning. Multilingual Reference Book in English, Spanish, French, and German*. 2 vols. Heidelberg: Springer.
- Franco, D., D. Franco, I. Mannino, and G. Zanetto. 2003. "The Impact of Agroforestry Networks on Scenic Beauty Estimation: The Role of a Landscape Ecological Network on a Socio-Cultural Process." *Landscape and Urban Planning* 62 (3): 119–138. doi:10.1016/S0169-2046(02)00127-5.
- Gibson, J. J. 1979. *The Ecological Approach to Visual Perception*. London: Lawrence Erlbaum Associates.
- Harris, D., and D. F. Ruggles. 2007. "Sites Unseen." *Landscape and Vision*. Pittsburgh: University of Pittsburgh Press.
- Hatfield, G. 2006. "Kant on the Perception of Space (and Time)." In *The Cambridge Companion to Kant and Modern Philosophy*, edited by P. Guyer. Cambridge, England: Cambridge University Press.
- Hillier, B. 1997. *Space is the Machine: A Configurational Theory of Architecture*. US: CreateSpace Independent Publishing Platform.
- Homma, R., M. Morozumi, and K. Iki. 1998. "Network-Based Dynamic Evaluation Process for Urban Landscapes." *Proceedings of the Third Conference on Computer Aided Architectural Design Research in Asia*. Osaka, Japan: Osaka University.
- Jackson, L. L. 2008. "Who "Designs" the Agricultural Landscape?" *Landscape Journal* 27 (1): 23–40. doi:10.3368/lj.27.1.23.
- Jakle, J. A. 1987. *The Visual Elements of Landscape*. Cambridge, MA: The MIT Press.
- Kant, I. 1781. *Critique of Pure Reason*. Cambridge, MA: Houghton Mifflin.
- Kaplan, S. 1988. "Perception and Landscape: Conceptions and Misconceptions." In *Environmental Aesthetics: Theory, Research, and Application*, edited by J. Nasar, 45–55. Cambridge: Cambridge University Press.
- Kaplan, R., and S. Kaplan. 1989. *The Experience of Nature: A Psychological Perspective*. Cambridge, England: CUP Archive.

- Kaplan, R., S. Kaplan, and R. L. Ryan. 1998. *With People in Mind: Design and Management of Everyday Nature*. Washington, DC: Island Press.
- Kaymaz, I. C. 2012. "Landscape Perception." In *Landscape Planning*, edited by M. Ozyavuz, 251–276. London, UK: InTech.
- Kiss, D. 2017. *Designing Outside the Box: Landscape Seeing by Doing*. North Carolina, US: Lulu.com.
- Liu, M., and S. Nijhuis. 2020. "Digital Methods for Mapping Landscape Spaces in Landscape Design." *Journal of Digital Landscape Architecture* 2020 (5): 125–161.
- Liu, K., K. W. M. Siu, X. Y. Gong, Y. Gao, and D. Lu. 2016. "Where Do Networks Really Work? The Effects of the Shenzhen Greenway Network on Supporting Physical Activities." *Landscape and Urban Planning* 152: 49–58. doi:10.1016/j.landurbplan.2016.04.001.
- Loidl, H., and S. Bernard. 2003. *Open (Ing) Spaces: Design as Landscape Architecture*. Berlin: Walter de Gruyter.
- Lynch, K. 1960. *The Image of the City*. Cambridge, MA: The MIT Press.
- McGarigal, K., and B. J. Marks. 1995. "FRAGSTATS: Spatial Pattern Analysis Program for Quantifying Landscape Structure". Gen. Tech. Rep. PNW-35 1. USDA Forest Service, Pacific Northwest Research Station, Portland, OR.
- Merleau-Ponty, M. 1962. *Phenomenology of Perception*. UK: Routledge.
- Mok, J. H., H. C. Landphair, and J. R. Naderi. 2006. "Landscape Improvement Impacts on Roadside Safety in Texas." *Landscape and Urban Planning* 78 (3): 263–274. doi:10.1016/j.landurbplan.2005.09.002.
- Motloch, J. L. 2000. *Introduction to Landscape Design*. Hoboken, NJ: John Wiley & Sons.
- Nassauer, J. I., and P. Opdam. 2008. "Design in Science: extending the Landscape Ecology Paradigm." *Landscape Ecology* 23 (6): 633–644. doi:10.1007/s10980-008-9226-7.
- Nijhuis, S. 2011. "Visual Research in Landscape Architecture." *Research in Urbanism Series* 2: 103–145.
- Nijhuis, S. 2013. "Principles of Landscape Architecture." In *Flowscales: Exploring Landscape Infrastructures*, edited by E. Farina, and S. Nijhuis. Madrid: Francisco de Vitoria University.
- Nijhuis, S. 2015. GIS-Based Landscape Design Research. Stourhead Landscape Garden as a Case-Study (Doctoral Dissertation). Delft University of Technology, A+BE, the Netherlands.
- Ode, Å., M. S. Tveit, and G. Fry. 2008. "Capturing Landscape Visual Character Using Indicators: touching Base with Landscape Aesthetic Theory." *Landscape Research* 33 (1): 89–117. doi:10.1080/01426390701773854.
- Olwig, K. R. 2016. "Virtual Enclosure, Ecosystem Services, Landscape's Character and the 'Rewilding' of the Commons: The 'Lake District' case." *Landscape Research* 41 (2): 253–264. doi:10.1080/01426397.2015.1135320.
- Palmer, J. F. 2000. "Reliability of Rating Visible Landscape Qualities." *Landscape Journal* 19 (1–2): 166–178. doi:10.3368/lj.19.1-2.166.
- Pancholi, S., T. Yigitcanlar, and M. Guaralda. 2015. "Public Space Design of Knowledge and Innovation Spaces: learnings from Kelvin Grove Urban Village." *Journal of Open Innovation: Technology, Market, and Complexity* 1 (1): 13. doi:10.1186/s40852-015-0015-7.
- Peirce, C. S. 1991. *Peirce on Signs: Writings on Semiotic*. Chapel Hill, NC: UNC Press Books.
- Queensland Government. 2013. "Road Landscape Manual." *Environmental Protection*. 2nd ed. Australia: Queensland Government. <https://www.tmr.qld.gov.au/-/media/busind/techstdpubs/Environment-management/Road-Landscape-Manual>.
- Rega, C. 2014. *Landscape Planning and Rural Development: Key Issues and Options towards Integration*. Berlin, Heidelberg: Springer.

- Robinson, N. 2004. *The Planting Design Handbook*. UK: Routledge.
- Ronnen, G., Y. Demura, M. Kawasaki, and T. Higuchi. 2005. Visual Perception of Landscape – From Kyoto city to its surrounding Mountains. 景觀デザイン研究論文集 2005 (1): 236–239.
- Salat, S. 2011. *Cities and Forms: On Sustainable Urbanism*. Paris: Hermann.
- Sang, N., C. Hägerhäll, and Å. Ode. 2015. “The Euler Character: A New Type of Visual Landscape Metric?” *Environment and Planning B: Planning and Design* 42 (1): 110–132. doi:10.1068/b38183.
- Shaumyan, S. 1987. *A Semiotic Theory of Language*. Bloomington, Indiana: Indiana University Press.
- Simonds, J. O. 1997. *Landscape Architecture: A Manual of Site Planning and Design*. US: McGraw-Hill.
- Simova, P., and K. Gdulova. 2012. “Landscape Indices Behavior: A Review of Scale Effects.” *Applied Geography* 34: 385–394.
- Stahl, S. A. 2005. “Four Problems with Teaching Word Meanings.” In *Teaching and Learning Vocabulary: Bringing Research to Practice*, edited by H. Elfrieda, and M. Kamil, 95–114. Groningen: L. Erlbaum Associates.
- Stamps, A. E. 2004. “Mystery, Complexity, Legibility and Coherence: A Meta-Analysis.” *Journal of Environmental Psychology* 24 (1): 1–16. doi:10.1016/S0272-4944(03)00023-9.
- Steinitz, C. 1990. “Toward a Sustainable Landscape with High Visual Preference and High Ecological Integrity: The Loop Road in Acadia National Park, USA.” *Landscape and Urban Planning* 19 (3): 213–250. doi:10.1016/0169-2046(90)90023-U.
- Surová, D., T. Pinto-Correia, and R. Marušák. 2014. “Visual Complexity and the Montado Do Matter: landscape Pattern Preferences of User Groups in Alentejo.” *Annals of Forest Science* 71 (1): 15–24. doi:10.1007/s13595-013-0330-8.
- Thiel, P. 1961. “A Sequence-Experience Notation.” *Town Planning Review* 32 (1): 33. doi:10.3828/tpr.32.1.53n454100g514634.
- Thwaites, K. 2001. “Experiential Landscape Place: An Exploration of Space and Experience in Neighbourhood Landscape Architecture.” *Landscape Research* 26 (3): 245–255. doi:10.1080/01426390120068927.
- Thwaites, K., E. Helleur, and I. M. Simkins. 2005. “Restorative Urban Open Space: Exploring the Spatial Configuration of Human Emotional Fulfilment in Urban Open Space.” *Landscape Research* 30 (4): 525–547. doi:10.1080/01426390500273346.
- Torreggiani, D., Z. Ludwiczak, E. Dall’Ara, S. Benni, E. Maino, and P. Tassinari. 2014. “TRuLAN: A High-Resolution Method for Multi-Time Analysis of Traditional Rural Landscapes and Its Application in Emilia-Romagna, Italy.” *Landscape and Urban Planning* 124: 93–103. doi:10.1016/j.landurbplan.2014.01.011.
- Turner, M. G., R. H. Gardner, V. H. Dale, and R. V. O’Neill. 1989. “Predicting the Spread of Disturbance across Heterogeneous Landscapes.” *Oikos* 55 (1): 121–129. doi:10.2307/3565881.
- Tveit, M., A. Ode, and G. Fry. 2006. “Key Concepts in a Framework for Analysing Visual Landscape Character.” *Landscape Research* 31 (3): 229–255. doi:10.1080/01426390600783269.
- Vroom, M. J. 2006. *Lexicon of Garden and Landscape Architecture*. Basel: Birkhäuser-Publishers for Architecture.
- Weitkamp, G., A. Bregt, R. van Lammeren, and A. van den Berg. 2007. “Three Sampling Methods for Visibility Measures of Landscape Perception.” In *International Conference on Spatial Information Theory*, 268–284. Berlin, Heidelberg: Springer.