A Theoretical Framework for Constructing Biophilic Urban Nature

Based on the Analysis of Biophilic Aesthetics Cognition and Its Landscape Space Carriers

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Abstract

Guiding people to form biophilic aesthetic cognition is an effective means to enhance public ecological awareness. The research and practice related to the biophilia have mostly focused on the pure natural science and the micro and medium space scales, however, there is relatively scarce research on a comprehensive framework of the planning and design methods of biophilic landscape space at the urban scale. Based on the analysis of biophilia and biophilic aesthetic cognition, as well as the empirical research on biophilia promoting environmental preference, put up that nature, wild nature and urban nature are respectively the totality, origin and living landscape spaces supporting the occurrence of biophilic aesthetic cognition. Meanwhile, through three contents of design points, planning pictures and living visions, and with the urban biophilic green network, urban biophilic green community, and one-step away from nature as a scale framework, the living landscape space construction bearing the cognition of the biophilic aesthetics, namely the biophilic urban nature construction, was mainly explored. The aim is to provide useful reference for the construction of biophilic aesthetic cognition, and the identification, planning and design of its landscape space carriers.

Keywords

Theoretical framework, Constructing urban nature, Biophilia, Aesthetic cognition, Landscape space carriers

1. Introduction

Aesthetic cognition is an important component of landscape cognition and human consciousness development. The ecological consciousness presented by the public in aesthetic cognition is often the key factor to measure the construction level of social ecological civilization. The new thinking of ecological governance system also emphasizes that compared with the ecological construction and control of material space, it is also an important aspect to promote the construction of ecological civilization to achieve leapfrog development by leading the public ecological consciousness to a new level of caring for nature and ethical justice through the construction of aesthetic cognition.

The basic cognition of biophilia is that there is an innate emotional connection between human beings and other life and life processes, emphasizing that people can maintain positive emotional response and behavioural expression to direct or indirect life stimuli. Based on the nature of human being, it is an

effective means to enhance public ecological awareness to guide people to form a life-friendly aesthetic cognition through the identification of life-friendly landscape space and its planning and design.

The research and practice related to the biophilic concept has always been a hot spot in international research, and mostly focused on the pure natural science and the micro and medium space scale, such as finding evidence in neuroscience, traceability of evolutionary ecology, measurement of environmental ecological psychology, architectural design and evaluation, and exploration of the aesthetic preferences of landscape experiencers for certain landscape features (Jiang et al., 2020; Pritchard et al., 2006; Soderlund & Newman, 2015; Xue et al., 2019), however, there is relatively scarce research on a comprehensive framework of the planning and design methods of biophilic landscape space based on the urban scale.

Taking the concept of biophilia as a new viewpoint, and based on the analysis of biophilia and biophilic aesthetic cognition, as well as the empirical research on biophilia promoting environmental preference, identify the types of landscape space carriers supporting the occurrence of biophilic aesthetic cognition. And on this basis, through three contents of design points, planning pictures and living visions, and with the urban biophilic green network, urban biophilic green community, and one-step away from nature as a scale framework, the living landscape space construction bearing the cognition of the biophilic aesthetics, namely the biophilic urban nature construction, was mainly explored. The aim is to provide useful reference for the construction of biophilic aesthetic cognition and the identification, planning and design of its landscape space carrier.

2. Theoretical grounding of biophilic aesthetic cognition

2.1. Biophilia

In 1964, American social psychologist Erich Seligmann Fromm first used the term "Biophilia" in his book "The Heart of Man", and explained it as "a psychological tendency to be attracted to all things alive and vibrant" (Erich, 1980). In 1984, Edward O. Wilson, the founder of socio-biology, argued in his book "Biophilia" that "man's biophilic need for contact with nature is as indispensable as his metabolic need for nutrients and air", and expanded the definition of biophilia as "the urge to connect with other life forms", "the desire to make contact with animals, plants and natural landscapes" or "the inherent tendency of man to seek connection with nature and other life forms" (Edward, 1984). That is, from the perspective of biological evolution, biophilia is a deep spiritual connection and genetic preference of human beings to the whole life that supports their development and prosperity in the long evolutionary dependence, and for the living objects and life support systems (habitat, ecological process, etc.) has natural closeness and love.

The essence of biophilia is the emotion of love and a physiological stress that depends on other life forms to achieve co-existence and evolutionary adaptation (Naderi, 2009). Therefore, from the perspective of environmental ethics, biophilia is a more profound virtue ethics of human-land relationship, which takes the human nature of paying attention to and loving life and life-like processes as the basic needs of coevolution, and combines the needs of emotional connection between man and other life with the rational analysis of evolution (Clowney, 2013).

2.2. Empirical research on biophilia promoting environmental preference

For a long time, scholars have verified the proposition that "more exposure to life and natural elements can improve learning efficiency, promote stress reduction and attention recovery, accelerate the healing of negative and depressed emotions, and reduce the use of analgesic drugs". For example, Salingaros and others pointed out from the perspective of neuroscience that the physiological basis of human sensory experience and the establishment of its system depends on the long-term evolutionary adaptation to the

characteristics of ecology, life and visual complexities in nature. The information circuits contained in these characteristics are closely related to the pleasure centre of the brain and constitute the original source of human "neurotrophic". Environments that deliberately avoid these characteristics may have a negative impact on physical, mental health and well-being (Salingaros & Masden, 2009). From the perspective of fractal geometry, Joye and other scholars put forward that the visual objects with the medium equivalents ($1.3 \sim 1.5$) of fractal dimension D value helps the brain to carry out simpler perceptual processing and make it more popular in aesthetics, and the medium value of D value of 1.3 is the most common fractal dimension in natural landscape. Therefore, the natural landscape environment often becomes the core influencing factor to improve the environmental preference of landscape experimenters because it presents better visual fluency in fractal geometry (Joye et al., 2016). Other scholars' relevant studies, from the perspectives of natural colour investigation (Wang, 2018), plant sound landscape experience (Hao et al., 2019), effects of forest biodiversity abundance (Foo, 2016), visual complexity analysis of natural landscape (van den Berg et al., 2016), biodiversity cognition and protection practice (Deborah et al., 2020), and comparative evaluation of the effects of hospital greening environments on patients' recovery (Jamshidi et al., 2020) are also the direct verification of life, biological elements or natural characteristics in various types of landscape environment to promote environmental preference and physical and mental health.

2.3. Biophilic aesthetic cognition

If one does not have the opportunity to develop a love of life in his living, then he tends to take a retrograde and destructive life path. Industrial civilization has been promoting the belief, or knowledge, that humans could ignore their connections to other life and often measure progress in terms of their ability to transform the natural world (McDonald et al., 2018). This illusion encourages our increasingly serious deviation from the source of life, and the non-ecological aesthetic cognitive orientation reflected behind it is not unrelated to the continuous deterioration of the current environment.

Biophilia is an objective existence of human subconscious. From the perspective of environmental pedagogy, this innate sense of empathy, compassion and love for other life forms also has the obvious characteristics of plasticity. If we can actively guide and cultivate the biophilia from childhood, it is expected that when one grows up, he will not treat other creatures and nature with the attitudes of aggression, possession, exploitation and domination. That is, the connotation of aesthetic cognition of biophilia lies in people's close contact experience with other life forms and their life support systems to stimulate, maintain and strengthen people's biophilic instinct, so as to promote thinking activities of perceptual care and common sense of wholeness in aesthetic cognition for other life forms and even the overall environment on the emotional and spiritual levels.

3. The landscape space carriers of biophilic aesthetic cognition

3.1. Nature -- the overall landscape space carrier supporting the occurrence of biophilic aesthetic cognition

On the one hand, from the essence of consciousness development, aesthetic cognition of biophilia is also an adaptive thinking activity of information extraction, processing, learning, evaluation and feedback from the spatial environment. Its substantial occurrence should still be supported by the material spaces carrying life. On the other hand, in terms of the existence logic of life, life originates from nature and returns to nature. Nature is the basis and mother of life existing and breeding life. A place with nature is often a space for life and life potential. Especially in the long-term flood of the ground hardening, artificialization, mechanization of urban space, nature has long been regarded as a spatial cognitive

symbol or feature representing life. Therefore, in a broad sense, nature constitutes the landscape space as a whole that bears the occurrence of aesthetic cognition of biophilia.

Generally speaking, for a certain space which is suitable for life reproduction, the degree of naturalization of space can be used to describe the number of natural lives in space, the diversity of life forms and the complexity of life support system. That is, if space is divided into two types, "completely natural space" and "partially natural space", based on the difference in the depth of human interference and influence on nature, the former tends to show more characteristics of life vitality and the gravitational effect of life than the latter.

What is the supporting effect of "completely natural space" and "partially natural space" on the occurrence of aesthetic cognition of biophilia? In addition, with "partially natural space" including a wide range of secondary space types, it is difficult to be analysed in detail here. Therefore, this paper mainly focuses on the two landscape space types, namely the wild nature with the most abundant life elements and the urban nature with the most barren life elements but most closely related to human production and living, to make targeted discussions on: (1) the supporting effect of the two on the aesthetic cognition of biophilia; (2) how to build a biophilic urban nature from the perspective of landscape planning and design.

3.2. Wild nature -- the original landscape space carrier supporting the occurrence of biophilic aesthetic cognition

Man comes from the wilderness, rooted in the wilderness, and evolves all the way from the wilderness - the wilderness is the source and root of the life world.

Transcendentalist philosopher Henry David Thoreau firmly believed that the wilderness was powerful, wild and natural, and he wrote "nature and rich life forms in the wilderness are making us healthy every moment" (Cheng, 2011). Aldo Leopold believes that the enjoyment of wilderness is a higher "standard of living" than material enjoyment and a basic human right (Leopold, 2020). In the eyes of Edward Abbey, an ecological literature writer, "wilderness is an indispensable spiritual home for human beings. It is as important to our lives as water and bread" (Abbey, 2011). Chinese philosopher Chuang Tzu said, "heaven and earth have great beauty without words" (Chen, 2007); ancient Greek philosopher Aristotle said, "every field of nature is wonderful" (Aristotle, 1984). Wilderness is the source and root of the world of life. More than anywhere, it can teach people to have reverence for life and nature. Returning to the wilderness is like returning to the world of life to find roots. Humans need to go into the wilderness to experience the magnificence, mystery and vastness of nature and life; While appreciating the beauty of nature and natural life, learn to return to nature and revere the truth of life -- wilderness nature constitutes the original landscape space carrier of biophilic aesthetic cognition.

3.3. Urban nature -- the living landscape space carrier supporting the occurrence of biophilic aesthetic cognition

With the expansion of urban scale and the acceleration of urbanization, cities have become the main space of people's life. At the same time, the natural environment of the city is gradually replaced by reinforced concrete, and the opportunity of human contact with nature is greatly deprived - all people can see is artificial landscape, but human beings, as natural objects, are in the landscape world of de-naturalization and pseudo-naturalization.

Nature should not be a wilderness or nature reserve that we can only visit in our spare time or on a regular basis. Daily contact with nature should be a basic living and spiritual need of mankind. City is a highly artificial human habitation, and it is also the most "alienated" place from nature. Urban people

need urban nature as a spatial carrier for biophilic aesthetic cognition -- urban nature is the living landscape spatial carrier of biophilic aesthetic cognition.

4. Biophilic urban nature construction

Based on the environmental virtue ethics "biophilia" as the basic value cognition, and taking the emotional attachment and physiological needs of human beings eager to contact with other life forms to realize coevolutionary survival as the core starting point, the biophilic urban nature construction aims to eliminate the isolation of contact between human beings and other life forms and stimulate as well as awaken human instinct to be close to other life and life-like processes, by increasing the opportunities for expression of nature -- the landscape space carrier supporting the occurrence of biophilic aesthetic cognition -- in all aspects of urban life, to realize the emotional and behavioural expression of human love for all creatures in the world in the dimensions of psychology, physiology and ethics.

4.1. Overview of the current situation of biophilic urban nature construction

At present, the studies on biophilic urban nature construction mainly focuses on two aspects: "biophilic infrastructure construction" and "biophilic perceptual design", with the strategies of "biophilic ratio improvement" (Beatley, 2011; Beatley, 2018; Carrus et al., 2015; el-Baghdadi & Desha, 2017; Kambo et al., 2019; Zhang et al., 2014) and "biophilic management" (Beatley, 2011; Langemeyer et al., 2018; Parsaee et al., 2019), and "biophilic visual connection" (Coburn et al., 2019; Lee, 2019; World Green Building Council, 2014; Yin et al., 2020) and "biophilic non-visual connection" (Ghezeljeh et al., 2017; Soga et al., 2018) were used to achieve the related goals respectively.

Table 1. The main contents of studies on biophilic urban nature construction

Categories	Strategies	Design contents	Representative literature
Biophilic infrastructure construction	Increasing biophilic ratio	Improve green space and plant canopy coverage.	Carrus et al., 2015
		Increase the proportion of native species and biodiversity.	Zhang et al., 2014
		Increase the proportion of water area and enrich the shapes and appearances of water area.	Kambo et al., 2019
		Optimize the network integrity of the walking (or cycling) system and its connection to natural elements.	Beatley, 2011
		Increase the proportion and sharing rate of natural elements in public open spaces such as green spaces and squares.	Beatley, 2018
		Increase the ratio and area of indoor, vertical and roof greening.	el-Baghdadi et al., 2017
Biophilic Perceptual design	Biophilic management	Improvement of natural landscape quality with low management intervention.	Langemeyer et al., 2018
		Application of permeable surface layer in ecological storm-flood management.	Beatley, 2011
		Enhanced natural ventilation/airflow, thermal comfort and daylight and shadow design.	Parsaee et al., 2019
	Biophilic visual connection	Wood, bamboo, rock and other natural materials and natural textures, as well as patterns and colors are preferred.	WGBC, 2014
		Optimize the perception of natural landscape and weather changes from window view.	Lee, 2019
		Enrich indoor and outdoor potted plants and green wall environments.	Yin, 2020
	Biophilic non-visual connection	Biological architectural forms and facades, as well as interior designs and decorations.	Coburn et al., 2019
		Strengthen the maintenance and design of natural soundscape	Ghezeljeh et al.,

non-visual connection	Aromatic plant planting and patch planning in urban agriculture	2017 Soga et al., 2018
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Although the relevant researches have involved many contents at the medium and micro spatial scales, there is still no a comprehensive framework at the city scale to fully express the panoramic contents of the biophilic urban nature construction. Based on this, the biophilic urban nature is divided into three scales: urban biophilic green network, urban biophilic green community, and one step away from nature in the city. And according to the landscape characteristics of different scales, the design contents in previous studies are adaptively refined and supplemented to form a panoramic framework of biophilic urban nature construction with design points, planning pictures and life visions as the main contents.

4.2. Biophilic urban green network construction

Biophilic urban green network construction aims to connect natural areas, parks and other open spaces in the city to form a strategic space to protect the original nature of the city (Figure 1). On the one hand, the biophilic green network can play a role in protecting the native capacity of city nature. For example, the construction of green corridors of rivers and trees can not only maintain their original functions in flood management and water purification, but also provide necessary habitats for animals and plants in cities. On the other hand, open spaces such as parks embedded in the green network are intended to provide urban residents with public places to have close contact with the original nature, so as to promote the public to carry out outdoor biophilic aesthetic cognitive activities. Based on this, this study puts forward five design points that should be included, six planning scenarios that should be achieved, and six life visions that should be realized, in the construction of biophilic urban green network (Table 2).

Figure 1. A green Network plan for Harris County, Texas, USA (2012-2035). Source: https://www.swagroup.com/projects/bayou_greenways/

Table 2. The main contents of green network construction for biophilic cities

Design points	Planning scenarios	Living visions
1. There are large "wilderness or native" natural spaces that maintain a minimum of human interference. 2. There are systematic green trails and cycling systems. 3. There are systematic park systems. 4. Includes rainwater gardens, ecological wetlands, vernacular landscape gardens, permeable surfaces and other ecological elements. 5. There are clearly defined natural corridor protection spaces such as rivers.	1. Connectivity: all parks and trails are interconnected with "original" spaces to form a comprehensive green network system 2. Wild nature and domesticated nature: there are many types of "green" spectra, from neatly manicured grass beaches to wooded trails to the original (or restored) wilderness. 3. Water treatment: the green network fully imitates the natural system model of rainwater management, so as to effectively prevent floods and improve water quality. 4. Biodiversity: provide habitats for animals and plants and promote the necessary links between them; The proportion of local species has been increasing year by year, or at least it can maintain a relatively stable state. 5. Conservation: ecologically sensitive land is strictly protected; areas that allow development are regulated by eco-friendly guidelines. 6. Planning cooperation: form cooperative relations among cities, villages, and regions to maintain the integrity and health of the large regional green network.	1. The proportion of green land in urban construction land has been increasing year after year 2. Citizens' outdoor activities in the urban green network have increased significantly, with children often playing near forests, grassy beaches, streams and lakes. 3. Citizens have discovered new biophilic green corridors between parks or green spaces that allow them to ride for miles without leaving nature. 4. The river and lake banks are no longer eroded, and the natural landscape of waterfront space is restored obviously. The water in the rivers and lakes is clear and clean, and one can relax in fishing and other hydrophilic activities. 5. No serious flooding occurs during the rainstorm. 6. More and more wild animals can be seen in cities.

4.3. Biophilic green community construction

Community is not only the cell unit of a city, but also the basic carrier of biophilic urban nature construction. From the perspective of the essence of the relationship between community and people, community is a human settlement area formed by residents living in the same area. It is a living and cultural circle with distinctive regional characteristics, as well as a habitat for human beings to live together and the home of the group soul. Therefore, the community is not only a place for urban residents to experience life directly after they finish their hard work, but also a place where people can establish identity and connection with nature, and then form emotional memory and attachment. Therefore, through the construction of urban biophilic community, community residents have more opportunities to get close to natural elements, which can not only heal, purify and sublimate people's soul, but also be of great significance for effectively cultivating people to understand nature more thoroughly, love nature more deeply and protect nature more consciously.

The six design points that should be included, five planning scenarios that should be achieved, and seven life visions that should be realized in the construction of urban biophilic green community are shown in Table 3.

Table 3. The main contents of biophilic green community construction

Design points	Planning scenarios	Living visions
1. Create richer life elements and more green areas in various spaces of the community. 2. Create a comprehensive living space connected by animal and plant clues, including residential,	1. Multi-dimensional green: the community gives active guidance, support and overall planning to all kinds of green spaces and life forms, forming a multi-dimensional green environment in the community.	1. It is not uncommon to see neighbors chatting passionately on the sidewalks, in the shades or in front of landscape arts. 2. Because of the vivid and increasing green and vitality, the sale and rental

commercial, recreational and office functions.	2. Convenient and accessible: residents can enjoy green and convenient travel between their residence and other places of different types, such as shops, schools and parks, through the collocation and combination of multi-selective green paths.	of houses in the community has become extremely popular.
2. Establish the adoption and conservation responsibility mechanism of the green zone or build small-scale public participation nursery, farm and other facilities, so as to increase the long-term interaction between community residents and other life.	2. Walkability: the community has a complete and direct network of walking trails and sidewalks. Along the way, one can experience the rich perceptual interest brought by natural elements in the surrounding environment.	3. Most children prefer to walk or bike to school because they can interact more with nature on the road.
4. Through the construction of green environments and the accesses of elements carrying life, such as planting tree species suitable for bird habitat, biophilic public activity spaces are created.	4. Outdoor attraction: the construction of the external environment of the building pays attention to the aesthetic expression of public art, so as to increase the opportunity and duration of public outdoor activities; landscaping of all sites, streets rainwater planting, street tree planting, etc. provide a lot of "green and life" elements	4. Tourists will often visit the community and take photos with green plants, water and other characteristic landscapes.
5. Provide children (and adults) with long-term play and playful spaces with natural elements as clues.	5. Healthy and active: citizens have a variety of outdoor space experience options, and can integrate into nature and heal body and mind through parks, leisure centers, trails and other ways.	5. Eager for more opportunities to get in touch with nature, community residents prefer to walk or bike in the community or the surrounding way for recreation, dining, shopping and other daily activities.
6. Natural elements such as ventilation, microclimate, sunlight, shadow, aromatic plants and soundscape are considered and networked in design.		6. The neighborhood is full of residents walking, jogging and biking through lush greenery.
		7. Green has become an important component of community identity and enjoys a unique position in the minds of community residents. Community residents gain more happiness because of green, and are often inspired and encouraged by the interdependent life community.

4.4. Construction of a step away from nature in the city

Another core attribute of the city's biophilia is that there is only "one step" between living and nature. In a biophilic city, citizens do not have to travel long distances to explore nature. Nature is close at hand and has become an integral part of citizens' daily life. Therefore, biophilic urban nature construction also aims to guide citizens to go outdoors and create the possibility of interaction with nature. For example, the biophilic buildings (Figure 3, 4) and streets are not only the spatial framework deeply integrated with natural elements, but also the entrance and passage for the public to enter more natural areas, aiming to promote the daily leisure contact between citizens and nature. At the same time, a step away from nature is also a spiritual experience of many microscopic nature around us: crickets on the courtyard steps, birds in the grass and trees, and the breeze that carries the fragrance of flowers and plants.

The seven design points that should be included, four planning scenarios that should be achieved, and seven life visions that should be realized in the construction of "one step away" from nature are shown in Table 4.

Table 4. The main contents of biophilic green community construction

Design points	Planning scenarios	Living visions
1. Clear and attractive entry spaces lead to natural areas.	1. Integration with nature: the building follows the design principle of "biophilia", integrating nature into the building structure, including the diversified use of life wall, green roof, three-dimensional planting, natural light, etc.	1. Children often carry magnifying glasses in their bags to observe insects and flowers during recess.
2. Streets filled with "green" landscapes form small linear parks.		2. Everyone can use parks and natural landscapes as a reference when giving directions.
3. The facades of the buildings are integrated with natural		3. Harvest fruits from the life wall of your

elements such as plants and water features.	2. Green sea: every corner of the city is filled with natural life; It can be seen everywhere that there are planes and three-dimensional spaces to carry and appreciate micro-natural elements such as flowers, birds, insects, fish, sunshine, rain and dew.	home, office, or the vegetable patch in your yard; enjoy the joy and touch of planting.
4. Public building roof gardens.	3. Accessibility: It is easy to find and reach parks, water surfaces and other open spaces; each natural area has clear guide signs and fast direct access.	4. Fewer people are playing indoor sports, and more people are running and frolic outdoors in the natural environment.
5. The design of architecture and featured landscapes takes micro natural elements such as birds, insects, sunshine, wind and rain into account to strengthen the biophilic perception.	4. Year-round activity: indoor planting and other public facilities can be used to ensure the sustainability of the biophilic experience, even in cold and hot seasons.	5. People in cities can interact with nature on a daily basis, connecting with nature all the time, even if it is as simple as soaking in the sun and wind.
6. Building styles, facades, decorations and pattern designs of biological form and color.		6. Everyone has the opportunity to touch some natural space or at least some natural elements in their life, study and work.
7. Natural materials, such as wood, bamboo, pebbles, rocks, etc., shall be selected as much as possible for the shaping of space and place.		7. Enjoy microscopic nature: residents are aware of microscopic natural elements such as birds, insects, wind and rain around them every day.

5. Conclusion

From the perspectives of virtue, morality and ethics, it is easier to cross the boundaries of market, culture and theory. People with biophilic ethical virtue and aesthetic cognition can have emotional resonance beyond their own interests in respecting, appreciating and protecting non-human life. Therefore, compared with the "rigid" ecological theory and practical development such as low environmental impact design and the application of ecological science knowledge, the biophilia oriented landscape space construction is a "flexible" sustainable planning and design method based on love, which plays an important role in promoting and supplementing the timely evolution and continuous improvement of the current landscape ecology related concepts and design paradigms.

The construction of aesthetic cognition is a very grand proposition, which needs to study a wide range of contents and involves many different disciplines. The cultivation of biophilia oriented aesthetic cognition cannot be achieved overnight. It is necessary to start from the core catalyst of human's biophilic nature and take the wisdom of landscape architecture as an important support, so as to provide people with long-term biophilic experience through reasonable landscape space design, and truly promote the effective improvement of public ecological consciousness. At the same time, from the perspective of biophilia, what kind of landscape space can most effectively stimulate biophilic emotion, and what natural elements and their combination play the most significant role in promoting the cognitive development of biophilic aesthetics are also important research directions to be explored by more cross perspectives and evidence-based methods in the future.

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