Children's Landscape Environment Creation Based on Brain Plasticity and Cognition

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ABSTRACT

In light of the key role of landscape environment (LE) in children's growth, the modern children's LE construction should accommodate the requirements of cultivating the children brain plasticity and cognitive capacity in order to promote the children's physical and psychological health fundamentally. In this paper, the research method of behaviour analysis-landscape psychology-environment creation was applied. Firstly, the paper analyses the children's brain plasticity and the behaviour features of cognition, then integrates them with the LE on the basis of the children's mental activity by behaviour mapping, and finally in terms of landscape planning and design, creates the LE suitable for the children's brain plasticity and cognition. Besides, this paper studies the LE creation by cultivating the brain plasticity and cognitive capacity: the brain plasticity can be enhanced in 7 aspects: naturality, diversity, interestingness, informatization, artistry, movability and comfort; the cognitive capacity shall be improved in such aspects as differentiation between the cognitive phases, five senses and emotion etc.

Key Words: Brain Plasticity, Cognition, Behaviour, Child, Landscape Environment

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Introduction

It is socially accepted that child means the one at age 0-14. Per the data issued by National Bureau of Statistics of China, in 2016 the children occupied 16.6% of total population in China. The children bring hopes for national future, so their healthy growth has a long-term influence on national development. Convention on the Rights of Child (CRC) states: the child rights must be regarded seriously and protected, and the whole society should provide a sound environment for childhood development. The children's growth is the continuous brain development and cognition deepening process, so the environment has a critical influence on it. As one of the key environments in children's growth, the LE influences the children greatly. Lots of researches indicate that the urban external environment is of crucial importance to the child health. Playing can promote the cognitive, physical, social and emotional health, to be the essential condition of their healthy growth (Benton and Dias, 2017). The outdoors activity can promote the children's physical and psychological health (Christiana *et al.*, 2017), e.g. for pre-school children, it can help them improve the concentration, avoid the attention deficit hyperactivity disorder (Ulset *et al.*, 2017).

The children's growth, as one complicated process, often brings about some behaviour problems for various reasons. In the survey about Achenbach Child Behaviour Checklist (CBCL) in Dalian, China showed (Ren *et al.*, 2005), about 14% children had behaviour problems, and the comprehensive intervention measures should be taken accordingly. Furthermore, in China, the outdoors activity of child is limited in two aspects: firstly, for the Chinese children under the greater learning pressure, they have quite limited time in outdoor activity, e.g. one survey in Shanghai

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indicated that over 80% children preferred the outdoor activity, but the satisfaction degree of Shanghai Children about activity duration, activity space size etc. was beyond below that of the children in Tokyo (Zhang and Wang, 2017); secondly, shortage of children activity places also affects the children outdoor activity. As more attention is paid to children outdoors space by the society, the construction of children outdoor places has developed rapidly in recent years. However, there still exist many drawbacks with the LE construction of children, mainly including two aspects: the demands for cultivating both brain plasticity and cognitive capacity haven't been considered seriously in the children's LE construction.

Brain plasticity means the unceasingly embellishing and regrouping ability of brain structure and function with the variation of internal and external environment, and it's a lifelong ability (Chen *et al.*, 2011). The main influencing factors on brain plasticity includes earlier experience and environment, cerebral injury, gender, nutrition, pressure and disease etc. (Liu and Li, 2006). The brain plasticity can be improved by external environment; the related research in brain science showed that the unfavourable environments shall injure the brain development, e.g. the family violence, family negligence and poverty, and the physical environments such as deficient nutrition, toxic chemicals, and disease, whereas the favourable environment can help to build an effective neural circuit, promoting the brain development (Shan and Yuan, 2016). The cognition including feeling, consciousness, memory, thought, imagination, and language etc. is the process of knowledge acquisition and application, or information processing by human. In the cognitive process, the external incoming information is received through brain, which information is then converted into innate psychological activity for further governing the people's behaviour.

Now there have been lots of researches and practices about children LE in China, but mainly focused on the preference of children's activity place (Luo and Wang, 2017), spatial design (Hong *et al.*, 2010), and plant furnishing (Zou, 2015) etc. Also, these researches and practices always are in lack of scientific basis, esp. the medical support. The creation of children's LE is one scientific task by deeper analysis for the child behaviour and psychology. The LE is not only a place for children amusement, but also can improve the children brain plasticity and their cognitive capacity.

Methods

In behaviour psychology, psychology determines behaviour, and behaviour is psychological representation; the behaviour expression derides from psychological activity, similarly, the child's behaviour in the LE also derives from psychological activity. Therefore, the creation of children LE should satisfy their behaviour and psychological demands. In this paper, the research method of behaviour analysis-landscape psychology-environment creation was applied. Firstly, the paper analyses the children's brain plasticity and the behaviour characteristics of cognition, then integrates them with landscape environment on the basis of the children's mental activity by behaviour mapping, and finally in terms of landscape planning and design, creates the LE suitable for the children's brain plasticity and cognition.

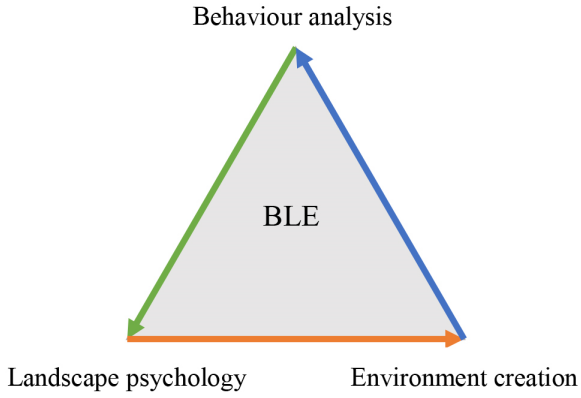

Figure 1. Diagrammatic sketch of research method

Children's brain plasticity-motivated LE creation

Environment diversity stimulates the cerebral development. The enriched environment stimuli can change the neuro-morphological structure and behavioural function, enabling it to be one effective and low-risk rehabilitation method of cerebral injury (Lu and Zhao, 2005). The research on the spatial learning ability elder rats in the short-term enriched environment showed that the rich environment played a significant role in enhancing the learning ability (Huang *et al.*, 2009). The multimedia bio-stimulation with multi-sensory stimuli could build the logic link with the diverse information and integrate the information into one interactive system by the comprehensive treatment of different multi-

media information such as text, graph, animation, still video, active video and sound etc. in the multi-technology (Yan *et al.*, 2006). The sci-fi scenes and multi-media facility are the ideal elements of landscape environment (Qu and Han, 2015). Hence, in the landscape environment construction, the sound and light technologies etc. can be utilized to make sensory stimuli for the children.

The viewpoints, content and method of natural education thought have the great advantages in developing children's creativity feature and overcoming the negative factors influencing child creativity, esp., the natural sensory stimuli plays a critical role in the neuronal growth in multi-encephalic regions of cerebral cortex, the synapse formation and neural network construction (Zheng *et al.*, 2014). So, the LE construction should emphasize on the application of natural quality, thought impetus and morality rule followed by natural education thought (Quan and Zhang, 2011); whereas, on one hand, loss of nature can reduce the use of child sense organs, followed by other healthy problems such as difficult concentration, increased incidence of the physical and mental diseases, myopia rate, obesity of children and adults, lack of Vitamin D etc.; on the other hand, it indirectly impair the sound development in terms of children's taste, naturalist intelligence and morality (Liang *et al.*, 2017). In china, there still exists series of problems, including the limited average indoors/outdoors space, excessive institutionalization, and shortage of natural resources etc., esp., the naturalist elements ignored in the kindergarten environment construction (Xu, 2017).

It is also very necessary to provide a sufficient and diverse exercise space in the LE construction. The proper exercise not only enhances the motion functions of patients, but also has effects on the learning and memory ability (Gao *et al.*, 2013). Besides, the labour experience and artistic atmosphere have a positive impact on children's creativity; the handmade process is the key means for cultivating the children's hand and brain capacity, and inspiring their creative thinking (Liu, 2013); art therapy can effectively relieve the unhealthy emotions and behaviour of the aggressively-behaved children, and also have other functions in increasing the functional level of mentally-retarded children, improving the communication ability of autism children with others, and help the brain-injured children express emotions and thoughts in the condition of impaired sensory, linguistic and cognitive capacity (Zhou, 2007). The microclimate is also of great importance to children activity places, with the influence of thermal environment factors (radiation, wind speed and temperature etc) on the child activity, therefore, the shading is one of the key elements in children activity place (Vanos *et al.*, 2017).

The LE plays a positive role in brain plasticity. By behaviour analysis, the brain plasticity-based LE creation is mainly implemented in terms of the following features: naturality, diversity, interestingness, informatization, artistry, movability and comfort.

Children cognition-cultivated LE creation

Children cognitive phases-based LE creation

Piaget divided the children's cognitive development process into four phases: motion sensing--pre-operation--concrete operation--formal operation, and the differences between these cognitive phases should be considered in LE creation (Table 2). The children at different ages have different demands for activity place, so the landscape preference of children in different cognitive phase should be understood in LE construction, so as to form a positive space and reduce the negative space, e.g. taking the safety and vegetational coverage into consideration (Castonguay and Jutras, 2009).

Table 1. Brain plasticity-based landscape environment creation

No.	Features	Landscape environment creation	
		Landscape planning	Landscape design
1	Naturality	Vegetation coverage, green look rate, and green capacity rate	Plant diversity, community diversity, topology, and river system
2	Diversity	Diversity of space types	Diversity of landscape elements combination
3	Interestingness	Diversity of activities	Distinct theme, smell, and sensory experience
4	Informatization	Landscape lighting and smart landscape	Sound and light experience
5	Artistry	Overall artistic space	Texture, form, material and colour
6	Movability	Dynamic space and static space	Various types of motion combination
7	Comfort	Vegetation coverage and humanized facility	Microclimate control of small space

Table 2. Children cognition phases-based cognitive features and LE creation

No.	Age group	Cognitive features	Landscape environment creation
1	0-2	No language and thought; exploring the surroundings by sensing and motion	Diversity of colour, shape and touching activity
2	2-7	Emergence and development of language; representative thinking formed	Activity: game facility
3	7-11	Logic thinking, and operation capacity	Intelligence stimuli, courage inspiring
4	11-14	Making the logic operation for abstract and representative material	Exploration, culture, story and moderate adventure

Table 3. Five sense cognition-based landscape environment creation

No.	Five-sense	Landscape environment creation	
		Landscape planning	Landscape design
1	Vision	Art modelling system	Contrast, and terrain change
2	Sound	Site music system	Sound of water, plants, animals; artificial voice, air flow
3	Taste	Edible landscape and productive landscape	Planting of fruit trees, vegetables, and crops
4	Smell	Aromatic plants	Flowering plant, medicinal, and fragrance plant
5	Touch	Spatial distribution	Plants, water, facility, grass lawn, and different texture of materials

Table 4. Emotional cognition-based landscape environment creation

No.	Features	Landscape environment creation
1	Social interaction	Promote the interaction between children by cooperative landscape activity
2	Verbal communication	Cultivate the language communication by mixed landscape activity
3	Emotion accompanying	Promote the family emotions by involvement of both adults and children

Five sense cognition-based LE creation

By means of five sense experience, thought stimuli, active or passive rehabilitation activity, the landscape can expediate the physical development (Guo *et al.*, 2013). Much exposure to the higher green environment helps to effectively improve the children's vision and lower the myopia rate (Dadvand *et al.*, 2017). When the children play in the large comprehensive outdoors area with lots of trees, bushes and hilly land, the scatter-brained phenomenon scarcely occurs to the children (Mårtensson *et al.*, 2009). The parents think that the natural playground is attractive at low risk, where the vegetation and water are the most popular elements, followed by sand, stone and landform; the insects and small animals rank the third (Wang *et al.*, 2018). Therefore, in the outdoors LE construction, using the natural materials can enhance the availability of games. In the research on the children's (at 2-5 ages) changes in the playing, social behaviour, mental health and physical activity showed that the depression and antisocial behaviour significantly were lowered, while the prosocial behaviour was significantly increased (Brussoni *et al.*, 2017).

Emotional cognition-based LE creation

Autism has the three typical symptoms: social communication obstacle, verbal development barrier and language communication ability defect, which can be treated in some degree by intensifying the social communication (Xu *et al.*, 2009). In the emotion cognition theory, the autism is congenital disorder of emotion; only if the children accumulate more communication experience with others, they can acquire the knowledge of others (Zhou, 2009). The research program conducted in the outdoors sports field of children development lab in Iowa State University showed that the deployment of natural materials and other landscape elements in the current yard would cultivate the social, emotional and cognitive development of children (Herrington and Studtmann, 1998). The landscape image with visualized physical state and intellectual spatio-temporality, can well adjust the cerebral cortex and psychological state, so the outdoors landscape is helpful for the recovery of infantile autism (Hu and Tang, 2016). Besides, the harmony in the neighbourhood is related to the outdoor activity of children at different ages and gender, as a result, the government should attempt to formulate the policy improving the physical environment in the community (Aarts *et al.*, 2010.

Conclusions

The ecological function and aesthetic function of LE construction are always the key concerns of the society, but with the improvement of civilization level, more and more attention has attached to its social function, esp. the LE construction for children, which should meet the demands of leisure, recreation and exercise etc of children; besides, the more scientifically rational planning and design should be made from the perspective of cultivating brain plasticity and

cognitive capacity, so as to promote the comprehensive service function and value of landscape environment.

This paper studies the children's landscape environment creation methods by cultivating the brain plasticity and cognitive capacity: the brain plasticity can be enhanced in 7 aspects: naturality, diversity, interestingness, informatization, artistry, movability and comfort; the cognitive capacity shall be improved in such aspects as the differentiation between the cognitive phases, five senses and emotion etc.

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