건축의 표면의 특성이 날카로운 조형의 위협성 인지에 미치는 영향에 관한 연구

신경과학 및 진화미학 기반으로

A Study on Effects of Architectural Surface Characteristics on Sharp Shape Threat Perception

Based on Neuroscience and Evolutionary Aesthetics

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Abstract

Designers express diverse opinions on how to apply sharp shapes in buildings. Sharply-changed contour of sharp shapes is one visual primitive that can be quickly extracted by people[1]. As a critical part of architectural design, architectural surface boasts of some characteristics that affect brain to recognize threat of sharp contours. In this day with diversified aesthetics, aesthetics rests with audience's visual perception and cognition of objective objects, as well as their professional knowledge, life experience, thoughts and culture. In the course of evolution, general aesthetic awareness acquired by the brain is minimally impacted by subjective factors. Under the background, this study, on neuroscience view, adopts interdisciplinary approach to explain brain's perception mechanism to threats and selective attention mechanism by applying interdisciplinary approach. Starting with analyzing five stages of aesthetic cognition, it exposes brain's preference for characteristics in line with survival instinct, such as "transparency" and "reflection", in accordance with viewpoint of evolutionary aesthetics. Aesthetic preference can be triggered by both materials, and permeability of architectural shape structures. In summary, this study aims to reveal reasons of threat perception and attraction of sharp shapes, so as to determine influence of surface characteristics on cognition and aesthetic effects of sharp shapes. It is hoped to provide scientific references and proposals for applying surface characteristics in buildings with sharp shapes.

Keyword

Sharp shapes(날카로운 조형), Architectural Surface Characteristics(건축 표면 특성), Aesthetic Judgment(미의식 판단), Threat Perception(위협성 감지)

요약

날카로움을 어떻게 건축 조형으로 활용할지에 대해 디자이너마다 다른 의견이 제시된다. 날카로운 조형의 급격한 변화는 빠르게 윤곽 특징을 추출할 수 있게 하는 시각 언어 중 하나이다. 건축 디자인의 가장 중요한 구성 요소인 표피는 날카로운 윤곽의 위협성 인지에 영향을 미친다. 오늘날 조형 양식이 다원화되면서, 미의식은 조형 객체에 대한 시각적 인지와 전문적 지식 그리고 조형을 경험한 문화에 영향을 받는 것으로 알려져 있다. 하지만 진화과정에서 획득한 두뇌의 보편 미의식은 이러한 요소에 영향을 덜 받는 것으로 알려진 것 역시 사실이다. 본 연구는 다학제적 접근을 통해, 위협에 대한 두뇌의 지각 메커니즘 및 주의 선택 메커니즘을 신경학적으로 해석하여, 미인식의 단계를 해석하는 접점으로 삼았다. '투명', '반사' 등 생존 본능에 부합하는 특성에 대한 뇌의 선호도를 진화 미학적 관점에서 설명함으로써 재질의 투명성뿐 아니라, 조형적 투과성으로 심미적 선호도를 이끌어낼 수 있게 하였다. 본 연구는 시각적으로 날카로운 조형에서 위협을 감지해 주의를 환기시키는 방법을 찾고, 표피의 특성이 날카로운 조형에 미치는 인지 및 심미적 영향을 확인하였다. 이를 통해 날카로운 조형이 가진 표면의 특성을 활용할 수 있는 과학적인 근거와 조언을 제공하였다.

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1) Liang Zhiqi&Cho Taigyoun,Neurological Research on the Effect of Visual and Emotional Characteristics of Sharpness on the Range of Formative Use -Focusing on Gothic Architecture- ,한국디자인문화학회지, vol.28, no.1 pp.267-278, p.272.

목차

1. Introduction

According to cognitive science, there is a sense of isolation in brain (Lyu Xin & Cho Taigyoun, 2019). Excellent design can be perceived by body that obtains good experience, which is not only a spatial experience, but also visual enjoyment. [2)]Nature of object outline is a basic visual cue that determines our preference for mundane objects (Moshe Bar et al. 2006). Sharp shape integrates threat and attention, and it serves as an aesthetic expression used in artistic creation. [3)]Research has shown that observers benefit from prompt capturing of potential threatening stimuli (Hansen & Hansen, 1994; Lundqvist & O¨hman, 2005), but bottom-up perceptual processing implies most of perception is acquired based on prior knowledge and expectations. [4)]The attention mechanism of brain suggests conscious awareness is limited, and focus on one thing prevents people from noticing others. [5)]Therefore, a question is proposed that when an architectural shape carries visual information with multiple stimuli characteristics, which stimuli can pass selective filtering mechanism of the brain to reduce focus on sharp shapes and divert perception of their threats? The question will be answered in this study.

Supported by theoretical knowledge of neuroscience and evolutionary aesthetics, this study mainly explores sharp shapes, and no attention is placed on color of objects. Specifically, it reveals brain's threat perception and attention generation mechanism. From perspective of five levels of aesthetic judgment, it recognizes brain's preference for modeling

2) Wei Ranran, Cho Taigyoun A Study on the Favor of Stairway Shape Based on Neuroaesthetics.한국디자인문화학회지, 2021, Vol.27,No.1,, p.239.

3) Liang Zhiqi, Cho Taigyoun,Neurological Research on the Effect of Visual and Emotional Characteristics of Sharpness on the Range of Formative Use –Focusing on Gothic Architecture– ,한국디자인문화학회지, 2022, Vol.28, No.1, p.270.

4) Lacey S, Sathian K. Multisensory object representation: insights from studies of vision and touch. Progress in brain research, 2011, Vol.191, p.169.

5) Dehaene S. [Consciousness and the brain: Deciphering how the brain codes our thoughts]. Penguin, 2014. p.61.

materials and structures according to research theory of evolutionary aesthetics. Moreover, influencing factors of threat perception are analyzed and summarized when cognitive sharp shapes are effectively transferred. This study discusses how surface characteristics of buildings affect aesthetic value of architectural shapes; how people's aesthetic evaluation and judgment of sharp shapes are influenced. This is expected to provide sufficient theoretical basis for impact of surface characteristics of sharp shapes on threat perception, and contribute more scientific guidance for improving aesthetic value of sharp shapes.

2. Threat and Attention on Sharp Shapes

2-1. Neural Mechanism of Threat Perception

Like other animals, humans change behaviors in view of threat severity. In this study, virtual predators endowed with ability to pursue, capture, and produce pain were developed, to investigate spatial urgency of threats by means of active avoidance model in which volunteers were pursued through a maze. [6]Overlapping stimulus at same site allows people to distinguish effects of attention on higher-order behaviors) from that of spatial attention. The latter strongly suppresses activities in extensive range of brain regions (Cobeta and Schulman, 2002). [7]Sharply angled jagged shoulders, elbows, and knees are often deemed to be associated with aggressive characteristics (Guthrie & Wiener. 1966. pp. 8). Therefore, angular shapes are often related with anger and aggression (Lindauer, 1990. pp. 3-4 Stefanowitsch, 2006). [8]Rapid threat detection will propel evolution (Niedenthal and Kitayama, 1994). [9]This process relies on neural circuits. When visual threat signals can be identified easily, neural circuits will be triggered fast and relatively automatically, [10]permitting brain to quickly detect threats.

A scanning device is installed in human brain that identifies any threat, and then signals body to respond. [11]In visual processing, low spatial frequency information plays a significant role in threat-related stimuli (Langner et al., 2015; Mermillod et al. 2010). More precisely, low spatial frequency transmits coarse visual information to the brain and stimulates brain nerves structure to generate emotion and reaction. Activity in prefrontal cortex is usually induced by distal threats after visual cognition; [12][13]Midbrain structures such as peritoneal gray (PAG) dominate as threats approach. [14]While visually imminent stimuli are threatening, IPS

[Table1] Threat perception processing

Stages of perceived threat	Visual perception	Distal threats	Threat approach	Imminent stimuli	
Structure of the reaction	Visual cortex (LSF)	PFC	PAG	IPS	vPM
Image					

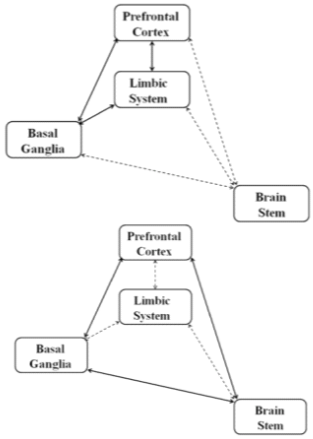
Image source : www.google.com(2022.07.19)

performances (biological movements and

(Intraparietal sulcus) and vPM (Ventral premotor

6) Mobbs D, Petrovic P, Marchant J L, et al. When fear is near: threat imminence elicits prefrontal-periaqueductal gray shifts in humans. Science, 2007, Vol.317, No.5841, p.1079.

cortex) respond strongly. [15]This suggests along with other visual areas, human vPM and IPS are particularly sensitive to threat value of body-centric encoding of visuospatial information in nearby spaces to information. It deems brainstem, basal ganglia, limbic system, and prefrontal cortex (PFC) are involved in psychiatric symptom-based threat assessment (Figure 1) [16] Threat of brainstem, basal ganglia, and limbic structures are evaluated automatically, with mostly performed unconsciously. In a word, perception of threat is not the result of subjective action through consciousness. Instead, it is objective reflection caused by relevant structures of brain to evaluate visual objects.



[Figure 1] Schematic ETAS model of SAD and MDD, indicating the actual involvement of four key brain areas based on current evidence(L).Schematic ETAS model of OCD, indicating the actual involvement of four key brain areas based on current evidence(R).

2-2. Threats and Attention in Sharp Shapes

In 2022, Liang and Cho pointed out that regardless of cognitive process, aesthetic mechanism or memory triggering mechanism, sharp shapes could not receive good feedback, but they acquired unique attribute function value. [17]Functional buildings with sharp shapes are able to become highlight, keep in short-term memory, and activate brain regions related to finding ways (James D. Rounds 1, et.al. 2020). To sum up, sharp shapes are special shapes easily identified, eye-catching, threatening and impressive (Liang & Cho. 2022. p274). Functional buildings with sharp shapes can better attract people, retain short-term memory, and activate

7) Parasuraman R, Galster S. Sensing, assessing, and augmenting threat detection: behavioral, neuroimaging, and brain stimulation evidence for the critical role of attention. Frontiers in human neuroscience, 2013, Vol.273, No.5, p.5

8) Liang Zhiqi , Cho Taigyoun, Neurological Research on the Effect of Visual and Emotional Characteristics of Sharpness on the Range of Formative Use -Focusing on Gothic Architecture- , 한국디자인문화학회지, 2022, Vol.28, No.1, p.270.

9) Larson C L, Aronoff J, Sarinopoulos I C, et al. Recognizing threat: a simple geometric shape activates neural circuitry for threat detection[J]. Journal of cognitive neuroscience, 2009, Vol.21, No.8, p.1524.

10) Ibid., p.1523.

11) Hendricks, L., et al. The effects of anger on the brain and body. National forum journal of counseling and addiction. Vol.2. No.1. 2013 ,p5

12) Mobbs D, Petrovic P, Marchant J L, et al. When fear is near: threat imminence elicits prefrontal-periaqueductal gray shifts in humans. Science, 2007, Vol.317, No.5841, p.1080.

13) Limbachia C, Morrow K, Khibovska A, et al. Controllability over stressor decreases responses in key threat-related brain areas[J]. Communications biology, 2021, Vol.4, No.1. p.2.

14) Mobbs D, Petrovic P, Marchant J L, et al. When fear is near: threat imminence elicits prefrontal-periaqueductal gray shifts in humans. Science, 2007, Vol.317, No.5841, p.1080.

15) de Borst A W, de Gelder B. Threat Detection in Nearby Space Mobilizes Human Ventral Premotor Cortex, Intraparietal Sulcus, and Amygdala[J]. Brain Sciences, 2022, Vol.12, No.3, p.10.

16) Flannelly K J. Evolutionary Threat Assessment Systems Theory, Religious Beliefs, Evolutionary Psychiatry, and Mental Health in America. Springer, Cham, 2017, Vol.1, p.134.

17) Liang Zhiqi&Cho Taigyoun,Neurological Research on the Effect of Visual and Emotional Characteristics of Sharpness on the Range of Formative Use -Focusing on Gothic Architecture- ,한국디자인문화학회지, vol.28, no.1 pp.273-274.

brain regions associated with finding ways (James D. Rounds 1, et.al. 2020).

[Table 2] Analysis of the characteristics and influence of sharp shapes

NO	1	2	3
Irritation site	Ventral access	Amygdala	Insular cortex
Stimulation process	LGN-V1neuron-VTC	Amygdala IA-BIA-other areas	Somatic sensory cortex-Short-term active memory-Cross-mode memory network
Visual/ emotional influence	Contour recognition, cognition	Attention capture	Trigger a tactile illusion
Attributes	Easy identification	Eye-catching	deep Impression
		Threatening	

In Table 1, eye-catchingness and threat are attributes caused by attention capturing. Attention refers to focusing brain resources on specific information. [18]As people awake, whatever they decide to focus on may become consciousness. [19]Shape is one basic feature that can be obtained by eyes. Whether object shape is truly perceived means if its prominent features are captured. During visual input, presentation of objects is affected by many factors, but not all factors can be visually perceived. [20]Attention on stimuli helps process targets fast and accurately; priority of a given stimulus can be altered by covertly focusing on stimulus location without changing eye or head sites (Posner, 1988). [21] James defined "attention" in 1980, who believed "selective attention" referred to separation of one thought from multiple thoughts. [22]In order to avoid information overload, brain systems adopt a selective filtering mechanism, and screening process is generally unconscious. Among innumerable potential thoughts, the one that enters brain is the best, [23]or this is so called "attention". Each time one piece of information is presented to brain, there is no option for information to enter individual consciousness. [24] According to above analysis, in unspecified circumstances, attention is usually one condition for consciousness to occur. When a sharp-shaped building is presented in a single form, only stimulation of sharp-shaped edge contour is reflected and conveyed in the brain.

3. Aesthetic Preferences Brought by Visual Stimuli

3-1. Five Levels of Aesthetic Judgment

Functional specialization is first law of brain operation (M. J. P. Flourens, 1824). It means that different regions in brain serve as various functions[25]. Specifically, different visual information such as shape, color, and movement are processed in brain regions. [26]Aesthetic

18) Dehaene S. Consciousness and the brain: Deciphering how the brain codes our thoughts. Penguin, 2014. p.12.

19) Ibid., p.12.

20) Lyu Xin,Cho Taigyoun,Explaining the Formative Consciousness from the Perspective of Cognitive Neuroscience by Using the Symmetry Structure of Cognition and Natural Objects.한국디자인문화학회, 2019, Vol.25, No.1, p.144.

21) Posner M I, Petersen S E. The attention system of the human brain[J]. Annual review of neuroscience, 1990, Vol.13, No.1, p.26.

22) Dehaene S. Consciousness and the brain: Deciphering how the brain codes our thoughts. Penguin, 2014. p.27.

23) Ibid., p.28.

24) Ibid., p.28.

25)www.wikipedia.org/wiki/Functional_specialization_(brain). [2017.10.19.Edition]. (Cit.2018.12.05).

26) Lyu Xin, Research on hierarchical aesthetics based on cognitive neuroscience,rarchical aesthetics based on cognitive neuroscience." Hongik University 박사학위논문, 2020, p.48.

[Table 3] Five Levels of Aesthetic Judgment

Level	Perceptual Levels		Element of shape Generation	Brain area	Image
1	Components		The elementary visual attributes of a shape are processed.	primary and secondary visual brain areas	
2	Shape		Attentional processes redirect information processing to prominent visual properties (e.g.color, shape, and composition)	V4 and frontal-parietal networks	
3	Form	Structures	Attentional networks modulate processing within the ventral visual stream,i.e.,experience of the stimulus, attributes and contents	temporal lobe, Ventral pathway Dorsal Pathway	
		Physical Properties			
4	Symbol		Feed-back/feed-forward processes linking attentional and attributional circuits that enhance the experience of the visual object.	Angular gyrus	
5	Thought		Emotional systems intervene in most cases	Anterior medial temporal lobe,medial and orbitofrontal cortices, and subcortical structures	

Source : Chatterjee (2004-2006)
Cela-Conde C J, Agnati L, Huston J P, et al. The neural foundations of aesthetic appreciation. Progress in neurobiology, 2011, Vol.94, No,1, pp.40-42
Lyu, Xin. "Research on hierarchical aesthetics based on cognitive neuroscience." Hongik University 박사학위논문, 2020. p.156
Image source : www.google.com 2022.07.19

responses are related to sensory, perceptual, and cognitive processes. [27]Art aesthetics reflects presentation of diverse human cognitions, which integrates functions of several brain regions. [28] "Cognitiveization" indicates special process of experience formation in cognitive processing stage. Aesthetic judgment of cognition stands for aesthetic response generated after experience formation; it is aesthetic feeling of cognitive structure of knowledge structure through visual information collection and after visual perception. [29]Aesthetics aims at describing neural and evolutionary basis of human ability to appreciate beauty and art. Such approach is neuroaesthetics, and it begins to provide insights into neurobiological basis for aesthetic appreciation. (Chatterjee, 2011; Dissanayake, 1992; Jacobsen, 2010; Miller,2000, 2001; Nadal and Pearce, in press; Ramachandran andHirstein, 1999; Skov and Vartanian, 2009; Zeki, 1999a,b). [30]Researchers only empirically investigate biological mechanisms of art, aesthetic appreciation and creation. Due to absence of an appropriate theoretical framework, the

27) Boccia M., Barbetti S., Piccardi L., Guariglia C., Ferlazzo F., Giannini A. M., Zaidel D. W., Where DoesBrain Neural Activation in Aesthetic Responses to VisualArt Occur? Meta-analytic Evidence from Neuroimaging Studies, Neuroscience & Biobehavioral Reviews, 2016, Vol.60, p.65.

28) Lyu Xin,Cho Taigyoun,Research on the Differences of Aesthetic Judgment between Visual and Cognitive Aspects Based on Evolutionary Psychology and Cognitive Neuroscience.한국디자인문화학회,2019, Vol.25,No.3. p.158.

29) Ibid., p.158.

30) Cela-Conde C J, Agnati L, Huston J P, et al. The neural foundations of aesthetic appreciation. Progress in neurobiology, 2011, Vol.94, No.1, p.40.

descriptions are anecdotal and it is difficult to understand them. Chatterjee (2011) calls it an “informative anecdote” (Chatterjee, 2011, p54)[31]. Since the research of Berlyne (1971, 1974), it is known that aesthetic appreciation is based on different psychological processes, and audience responses are subject to contextual features. In addition, particularities of participants, including variables such as society, history, culture, biology, education, and personality are believed to shape aesthetic experience.[32]

Sharp shape is a special form, and it can stimulate brain to promptly extract outline elements of building to gain attention. [33] According to above table (Table 3), visual recognition of shape takes place in stage 1 and stage 2, without aesthetic emotion. Lzq and chi proposed two application methods for sharp shapes in their research in 2022. Firstly, in view of fact that people feel positive by ordered shapes, sharp shapes are orderly arranged to enhance rhythm and complexity of architectural shapes (as shown in the figure). Second, with aid of high-density arrangement and combination, countless sharp shapes are integrated into a whole, blur edge information of sharp shapes, and hinder brain from perceiving sharp shapes (as shown in the figure) (Liang, Cho. 2022).

Through research, it has been confirmed that orderly arrangement imposes a certain influence on transferring brain’s perception of sharp threats. However, the conclusion fails to raise solutions from perspective of sharp shapes, and endows them with other shape values, to change brain’s perception of sharpness. Architectural surface, a component of buildings, is one of the most important elements, which makes buildings more significant and meaningful under fusion of structures, functions, environment and other conditions. [34]In recent years, people highly value materials and composition ways of architectural surface. [35] Under the condition that contour information of sharp shapes remains same at "Form" level, materials and structures can be changed to attract people and divert perception of sharp shape threats.

3.2 Preference for Physical Properties and Structures

For people, perception of beauty can be defined as biological instinct. On an evolutionary view, human behaviors are strongly driven by emotional response. Consequently, during long-term evolution of humans, behaviors induced by emotions must make positive contribution to survival and transmission (Orians, & Heerwagen, 1992).[36]Survival instinct is controlled by emotions produced by brain, and will be stimulated by favorable conditions.

[Table 4] Semantic Association with Natural Elements

Element	Image	Semantic association	Visual characteristic	Architecture Image
Water		Transparent	Transparency	

31) Ibid., p.40.

32) Ibid., p.41.

33) Xiao L,Fang XH, Lu YN. Shape Perception and Its Cognitive Consequences —Based on a Metaphorical Perspective, 中国心理学前沿, 2021, Vol.3, No.1, p.38.

34) Kung Chiayao, Cho Taigyoun, A Study on the Visual Characteristics and Preference for Architectural Exterior Materials. 한국디자인리서치학회, 2021. Vol.6, No,4, p.31.

35) You Yang, Cho Taigyoun. Research on Evolutionary Aesthetic and Characteristics of weave modeling in Architectural Spaces, 한국디자인리서치학회, 2022, Vol.7, No.1, p.86.

36) 윤성아, 조택연, Understanding the Order of the Natural Shape and a Public Space Design as the Universal Beauty, 한국공간디자인학회, 2011, Vol.6, No.3, pp.30-32.

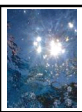
		Pure		
		Shiny	Luster	
		Glossy		
Food		Smooth	Transluc ency	
		Bright	Color	
		Moist		
		Vivid	Luster	

image source : www.google.com(2022.7.10)
source:Kung & Cho,2021,P39

Accordingly, biological instincts evolve gradually in the process of constantly pursuing stability and survival. To some extent, cognition of beauty refers to an instinctive perception, which inherits survival instinct and slowly generates corresponding perception through semantics. According to theory of evolution, factors such as “water”, “food” and “environment” are related to aesthetic stimulation; this is probably related to keywords “survival of the fittest” and “arousal of life instinct”. [37] Researchers Ulrich(1983), Kaplan and Kaplan(1989, 1995), Orians(1980), Orians and Heerwagen(1992) et al. prove that it is an instinct for organisms to seek water for survival; clean water facilitates survival. “Water” is semantically associated with adjectives - “transparent”, “pure”, “reflective”, “glossy”, “shiny”, etc. [38]Moreover, most nutrient-rich foods are characterized by crystal-clear appearance, sufficient moisture, full and bright color, [39]so, they are naturally considered to be nutritious and “suitable for survival”. In evolutionary aesthetics, a judgment can be made that humans take a shine to stimuli by “transparency”, “gloss” and “reflection”. In other words, buildings made by materials with corresponding characteristics will attract people to express aesthetic preference.

In viewpoint of Professor Michael Gazzaniga of the University of California, aesthetics is independent of acquired learning and culture. Good impressions obtained from visual objects are far from random, and instead, they are the result of millions of years of evolution integrated with development of human perception and cognitive abilities. [40]Humans have evolved for a long period, in order to adapt to living environment. During this period, experience accumulated is genetically embedded in human spirit according to theory of natural selection. Hence, humans develop ability to automatically focus on and prefer favorable factors of survival. Since then, they form priori and universal aesthetic awareness of specific images and environments (Yun, 2011). At evolutionary aesthetics level, aesthetics satisfy needs of life and senses. “Weaving” is originated from images in nature, and it reflects human’s aesthetic awareness of natural images. Woven shape symbolizes stable structures beneficial to life, and is significant for human evolution. [41]In continuous evolution, human aesthetic preference for woven shapes represents a feeling input into our genes a long time ago, or a good impression of specific shape. British geographer Jay Appleton comes up with “Prospect-refuge” theory, explaining people’s favorable impression of openness and invisibility of space. [42]Security serves as foundation for aesthetic pleasure. [43]

37) Kung Chiayao, Cho Taigyoun, A Study on the Visual Characteristics and Preference for Architectural Exterior Materials. 한국디자인리서치학회, 2021. Vol.6, No.4, p.39.

38) www.google.com 2022.06.13

39) Ibid., 2022.06.13

40) Micchael S.Gazzaniga, Park In yun Station, [왜 인간인가: 인류가 밝혀낸 인간에 대한 모든 착각과 진실], 추수밭, 2009, p.297.

41) You Y, Cho TY. Research on Evolutionary Aesthetic and Characteristics of weave modeling in Architectural Spaces, 한국디자인리서치학회, 2022, Vol.7, No.1, p.92.

42) Jay Appleton, johnwiley, sonslnc, [The experience of land scape], revedition , 1975. p.282.

43) You Yang, Cho Taigyoun. Research on Evolutionary Aesthetic and Characteristics of weave modeling in Architectural Spaces, 한국디자인리서치학회, 2022, Vol.7, No.1, p.93.

When sight line is completely blocked, people feel panic because they cannot predict and grasp objects. As a result, in the process of evolution, people prefer scenes with permeability and a little bit visibility, which is because these seem to be secure. A comparison between tables indicates that architectural surface with woven structure is permeable, but different from permeability caused by transparent materials. Woven structure displays internal structure of buildings through densely arranged pores, resulting in structural permeability.

[Table 5] Semantic Association with Natural Elements

Element	Image	Semantic association	Visual characteristic	Architecture Image
Phallus indusiatus		Grid		
Spider web		Order		
Bird's nest		Radiation		
		Cross		
		Woven		

Image source : www.google.com 2022.07.13

4. Influence of Surface Characteristics on Perception of Sharp Shape Threats

4.1 Shift of Attention Caused by Surface Characteristics of Sharp Shapes

Vision is a process (R. Arnheim, 1969), and visual perception rests with structure of brain visual system. Existing information in brain determines current perception ability levels, and also what we can and cannot see. In the sense of time trajectory, visual objects are recognized instantaneously[44] and relatively absolute[45], which implies the world people cognize is the result of interaction and unity of subjective and objective. In stage 3 of aesthetic judgment in Chapter 3.1, it shows Form Made By Shape's Spatial Relatio value of sharp shapes is to identify HSF and LSF during visual cognition process of brain through ventral and dorsal pathways. The photo below describes business school building of the University of Auckland, New Zealand. Architectural surface is composed of reflective and transparent materials that are arranged in an orderly manner. After representative value of building is covered for HSF and LSF decomposition cognition, it tells that due to visual image information brought by reflective and transparent materials, there is more and complicated building information with representative value in HSF cognition. Part of information with representative value removed is displayed in a single state of “sharp triangle”. The former, affected by that structural permeability of people’s brain preferences and material reflection bring diverse focused information, reduces attention to sharp edge information, so as to divert people’s perception of “threat” intelligence of sharp shapes. While the latter easily centers on “sharp” shape when concerned, which will lead to negative impressions such as “threat” and “insecurity”.

[Figure2] Business School Building at the University of Auckland, New Zealand(www.google.com 2022.06.07.)

4.2 Case Analysis

According to theoretical analysis of evolutionary aesthetics in Chapter 3, brain prefers

44) Evans, V, [The Structure of Time: Language, Meaning and Temporal Cognition], John Benjamins Publishing, 2003, p.153.

45) Ibid., p.247.

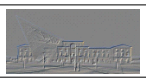
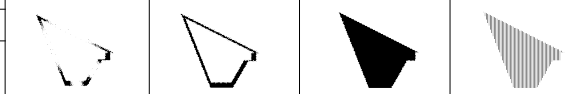
[Table 6] University of Auckland Business School building in New Zealand at different spatial frequencies

	Image		HSF		LSF
A		=		+	
B		=		+	

Image source:www.google.com 2022.06.08

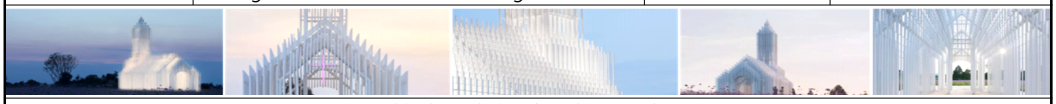
surface properties characterized by transparency, reflectivity and structural permeability, and humans feel safer in relatively open spaces (Stamps, 2005). These areas have been historically proven beneficial to survival of species because they help humans see and hide from threats (Appleton, 1975). Based on tables comparison in Chapter 3.2, structural permeability of woven buildings caters to security defined by people from the viewpoint of evolutionary aesthetics. How do architectural surface properties affect threat perception of sharp shapes? This question shall be answered from two angles: building materials and form structures. Firstly, materials should be "transparent", "reflective" and "glossy", and meet people's survival needs and aesthetic preferences. Visual intelligence is adopted to present sharp shapes under influence of multiple factors, thereby diverting brain's attention on threats. Secondly, woven structure used makes sharp shape rhythmic, enhances sense of order, and heightens shape complexity. At the same time, people visually experience "security", "warmth" and "lightness" through structure permeability so that perception of "sharp" threats is impacted. Subsequently, this study lists some popular sharp-shaped buildings in table below, followed by analytic hierarchy process of appearance design of buildings. Later, it declares when designers decorate sharp shapes with physical transparency, reflective gloss or structural permeability and other surface characteristics that cater to brain preference, they can effectively divert brain attention to sharp shape threats, and strengthen focus on styling texture and structure, causing aesthetic preferences.

[Table 7] Hierarchical Analysis of Architectural Design 1

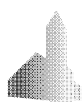
<table>
<tr><td>Building Project</td><td colspan="2">Bundeswehr Military History Museum</td><td>Completion Date</td><td>1897</td></tr>
<tr><td>Architects</td><td colspan="2">Peter zumthor</td><td>Source</td><td>Peter zumthor</td></tr>
<tr><td colspan="5">  </td></tr>
<tr><td colspan="5">Hierarchical Analysis of Architectural Design</td></tr>
<tr><td colspan="2">Visual Intelligence Analysis
LSF
  </td><td>HSF
  </td><td colspan="2" rowspan="2">  </td></tr>
<tr><td colspan="3">Structure appearance
Reflection gloss | Material transparency | Structural permeability
- | - | ●</td></tr>
<tr><td colspan="5">Designer of museum renovation project inserts an extremely sharp and pure acute-angled body into old museum building. The new angled body is composed of steel frame structure, concrete, steel grille and glass; sharp-shaped part adopts a steel wire weaving process, to create structural and translucent visual effects.</td></tr>
</table>

[Table 8] Hierarchical Analysis of Architectural Design 2

Building Project	Shadowless Church, Sichuan Province	Completion Date	2018
Architects	Shanghai Rafter Architectural Design Office	Source	www.sohu.com



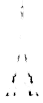
Hierarchical Analysis of Architectural Design

Visual Intelligence Analysis					
LSF	HSF				
					
Structure appearance			The whole is made of metal and composite materials. Pure white pillars are kept at almost equal distances, to jointly "scrabble up" like a church. From a distance, it looks like a solid whole, but closely, structural transparency is displayed due to pillars arrangement.		
Reflection gloss	Material transparency	Structural permeability			
-	-	●			

[Table 9] Hierarchical Analysis of Architectural Design 3

Building Project	Eiffel Tower in Paris, France	Completion Date	1887
Architects	Gustave Eiffel	Source	www.archdaily.cn

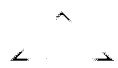
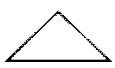
Hierarchical Analysis of Architectural Design

Visual Intelligence Analysis					
LSF	HSF				
					
Structure appearance			All standard columns and obelisks are constructed of network trusses composed of X-shaped wind-resistant diagonal braces. Eiffel Tower has a light structure because cancellous steel frame greatly reduces weight of tower body.		
Reflection gloss	Material transparency	Structural permeability			
-	-	●			

[Table 10] Hierarchical Analysis of Architectural Design 4

Building Project	Pyramid of the Louvre Museum, Paris	Completion Date	1989
Architects	IM Pei	Source	www.sohu.com

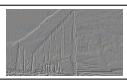
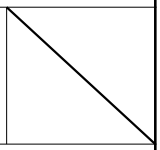
Hierarchical Analysis of Architectural Design

Visual Intelligence Analysis					
LSF	HSF				
					
Structure appearance			Structure of glass pyramid is composed of 675 pieces of diamond-shaped glass and 118 pieces of triangular glass. Clearly, glass is the most critical raw material.		
Reflection gloss	Material transparency	Structural permeability			
●	●	●			

[Table 11] Hierarchical Analysis of Architectural Design 5

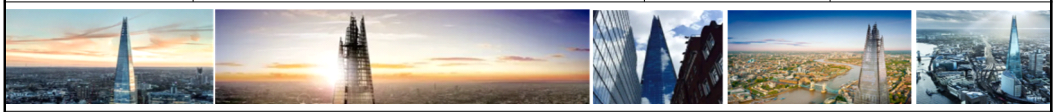
Building Project	Trollwall Restaurant and Service Centre, Norway	Completion Date	2011
Architects	Reiulf Ramstad Arkitekter (RRA)	Source	www.archdaily.cn

Hierarchical Analysis of Architectural Design

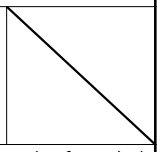
Visual Intelligence Analysis					
LSF	HSF				
					
Structure appearance			It attributes to close integration of the site with impressive precipitous cliff. The architectural style and large-scale transparent glass material convey a feeling of harmonious integration with surrounding bustling mountain sceneries.		
Reflection gloss	Material transparency	Structural permeability			
●	●	●			

[Table 12] Hierarchical Analysis of Architectural Design 6

Building Project	The Shard, London	Completion Date	2012
Architects	Renzo Piano	Source	www.sohu.com



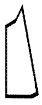
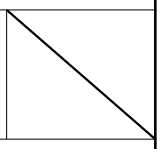
Hierarchical Analysis of Architectural Design

Visual Intelligence Analysis					
LSF	HSF				
					
Structure appearance			A highly expressive building façade is composed of angled windowpane that simultaneously reflects light. Every inch of architectural surface is covered by glass flakes that slope outward to inward, and grow upward in turn, forming a crystal-clear glass pyramid.		
Reflection gloss	Material transparency	Structural permeability			
●	●	-			

[Table 13] Hierarchical Analysis of Architectural Design 7

Building Project	The Scalpel, London	Completion Date	2012
Architects	KPF Architects	Source	www.archdaily.cn

Hierarchical Analysis of Architectural Design

Visual Intelligence Analysis					
LSF	HSF				
					
Structure appearance			There is a public plaza on the ground. The 35-storey tower is simple in shape, and partial outer contour is highlighted through highly reflective glass and bright metal materials in broken lines.		
Reflection gloss	Material transparency	Structural permeability			
●	●	-			

5. Conclusion

Based on interdisciplinary theoretical knowledge, this study analyzes how to transfer perception of sharp shape threats at property and structure levels of architectural surface. Meanwhile, it designs methods promoting aesthetic experience. According to attention mechanism feature of brain, brain's perception of threats is an objective reflection when relevant structures evaluate visual objects. Since everyone experiences differently and masts knowledge at various levels, which influences their understanding of cognition dissimilarly, bringing about diverse aesthetic preferences. Against the background, this study, with reference to evolutiology viewpoints, explores an instinct formed by the brain in continuous evolution and it is common to human to pursue survival. Affected by intuitive emotions, brain will be stimulated in light of favorable conditions.

Research of evolutionary aesthetics signifies people are easily attracted and prefer characteristics in line with people's biological instincts such as "transparency", "pureness", "reflection", "gloss", "shiny" and others. These characteristics can be displayed in architectural surface through applying transparent and reflective materials. Furthermore, physical transparency can seduce aesthetic preferences; structural permeability brought by woven structure makes people feel stable and secure, and stimulates to cultivate aesthetic awareness. In summary, it is able to transfer brain's perception of sharp shape threats by endowing sharp buildings with surface characteristics favored by brain. In addition, this study helps expand application scope of sharp shapes, and improve people's aesthetic preferences for sharp shapes. In order to maximize aesthetic value of sharp-shaped buildings, it recommends fully considering environment where buildings are located, together with coordination of surrounding facilities in building surface design.

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