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Cross-cultural design in costume: case study on totemic symbols of China and Thailand

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Cross-cultural design has emerged as a pivotal domain of significance within the context of globalization. In the field of cross-cultural design, designers are tasked with addressing user requirements and identity characteristic contexts across diverse cultural backgrounds, aiming to achieve enhanced service delivery and cultural dissemination outcomes. Nonetheless, the landscape of contemporary fashion design research exhibits a noticeable dearth in studies that effectively integrate with cross-cultural design. This study selects the iconic cultural symbols of the Chinese loong (dragon) and Thai naga as case subjects, embarking upon research that employs costume design as a medium and bridge for cross-cultural design and communication. The research methodology integrates qualitative and quantitative approaches, including field investigations, participatory research, and Analytic Hierarchy Process (AHP) analysis, thereby substantiating theoretical constructs through empirical investigation. The study proposes that cross-cultural costume design, undertaken with the purpose of cross-cultural communication, can be conceptualized as a cyclical process involving multiple encoding and decoding iterations. The research elaborates on how costume, functioning as a non-verbal language, serve as a medium for facilitating cross-cultural interactions. Furthermore, the design extraction of cultural symbols is approached through a four-tiered framework. By articulating its research perspective, methodologies, and design cases, this study contributes valuable insights to researchers and practitioners engaged in cross-cultural design and related fields.

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Introduction

Cross-cultural communication represents a common facet of contemporary society. The topic spans not only the life level of the "individual" in the context concerned but also wider levels at regional, country, national relationships and globalization. The cross-cultural communication discipline refers to the activities of communication between individuals, groups or organizations of different cultural backgrounds (Hurn et al., 2013). It is important to understand the meaning of "culture" in cross-cultural communication study. Culture can be divided into four levels: material, institutional, behavior, and mental (Davidsson, (1995); Karahanna et al., 2005; Spencer-Oatey and Franklin, 2012). The first, addressing human material production methods and products, represents tangible specific physical objects, such as clothing, food, shelter, and transportation. Hocart (1929) and Pintong (2017) agreed that material culture incorporates foods, clothing, sheltering, and medicine. Institutional culture serves as the norm built by humans to regulate their own behaviors and adjust the relationships in social practice (Higgins, 2007; Daniels, 2012). Behavior culture refers to facets of social and collective behavior, incorporating conventional etiquette and customs, folk customs, habits, and customs in social communication (White, 1959; Zhao et al., 2016). Mental culture refers to people's social psychology and social ideology, including views of value and life, esthetic taste, totem worship, religion and faith, and their literary and artistic works (Mechanic, 1986; Morgan, 2010). Taken holistically these aspects can be regarded as representing a comprehensive synthesis of the core and essence of culture. Regarding the explicit concept of culture, Geertz and Wrobel assert that the essence of the cultural concept is fundamentally semiotic (1989), and proposes that culture is not an empirical science in pursuit of definitive cultural truths, but rather an interpretive science functioning as an agent of meaning. Building upon this view, culture can be viewed as interpretable symbols or symbolic systems.

In an era of globalization, cross-cultural design emerges as a pivotal strategy for addressing the challenges of globalization and facilitating the successful integration of products and services within culturally diverse societies, to ensure that the products or services designed possess universality, acceptability, and usability on a global scale. Representing the originators of the term "Cross-cultural design," Steiner and Haas, in their work, encapsulate the design mindset and visual presentation attributes inherent in cross-cultural design, which from design thinking perspectives divide the design process into three stages known as the "Q.M.T. design process," involving Quotation, Metaphor, and Transformation (1995). the authors think Cross-cultural design is an approach to produce an esthetic style based on cultural understanding and communication, a methodology which is related to design logic and design thinking process. Based on this angle, relevant classical studies encompass Hofstede's cultural dimensions theory, which stands as one of the extensively employed theoretical frameworks in cross-cultural design (Wu, 2006). Following this theory an analysis of cultural disparities in cross-cultural product design is conducted by examining cultural variations in target users' values, behavior and design orientations. Furthermore, through a synthesis of the constituents, the theory outlines the elements essential for incorporation in cross-cultural product design.

However, in the current landscape of costume design research, there is a scarcity of studies that integrate with cross-cultural design. Most research studies have tended to focus on reproduction of esthetic forms, such as the decorative function as pattern in clothing. The themes of fashion, encapsulated in classical costume design and contemporary apparel design, and cross-cultural communication are closely connected. Carvalho (2017) argues that costume culture is moving towards a greater emphasis on the subject's identity, seeking new relationships between local and global societies, and reshaping contemporary cultural expressions through its objects of consumption. Cultural diversity can be seen as a manifestation of identity formation. Especially, in the cross-cultural costume design process, "Costume" as a non-verbal symbol, plays a symbolic role in conveying information in cross-cultural communication (Zou et al., 2022). In the context of cross-cultural costume design, designers are required to transcend the constraints of their local cultural background and gain meaningful insights into and respect for the needs, values, habits, and contexts of diverse cultural groups. This entails avoiding cultural biases and misunderstandings to ensure that design works go beyond mere "translation" or "adaptation," fostering a deep emotional connection with the target user community.

In order to investigate how to carry out cross-cultural design in the context of cross-cultural communication with costume as the carrier, this study selected the Chinese loong (another translation is "dragon") and the Thai naga (shown in Fig. 1) totem as the design objects to study this issue. A principal reason for this slection is because of costume design should reflect specific objects, functions, content or contexts, and is implemented by design languages, including patterns, colors, techniques, materials. Another reason is the loong and the naga are the most representative totem symbols of the Chinese and Thai national cultures. When thinking of China, people especially the younger generation have oft associated the country with the image of the loong totem. Correspondingly, there is also a totem with a similar appearance in Thai culture, called the naga. The two totems have similar appearance but different cultural background and connotation and can be easy confused especially for younger generations. As such they provide an opportunity for case study for exploration and research in the cross-cultural costume design domain.

Hence, this study conducted systematic research on the Chinese loong and Thai naga, and design strategies are proposed from the perspective of young generation users' perception and needs. This paper reports the process of analyzing those two totemic symbols, a summary of design strategies, and a series costume design cases.

Literature review

Cross-cultural design in fashion domain. Current research in the field of design related to cross-cultural integration is mostly focused on consumer research and cultural studies. For instance, Walker et al., which investigates cross-cultural aspects between China and the UK, providing frameworks for the contemporization of traditional craftsmanship and cultural heritage (2018). Santamaria's 'encoding and decoding' frameworks for managing cultural meanings as 'symbolic assets' in design (2023) and the role of designers as cultural intermediaries, which provide valuable reference perspectives for the research. There are also studies that are related to design practice such as Cui, Shaari (2023) that focused on several commonly used geometric patterns in fashion design. They proposed a method for symbolizing pattern designs, integrating them into a semiotic framework with categories such as 'similarity,' 'indication,' and 'reduction.' Another study explores the practice of combining Chinese and English culture in fashion design within a cross-cultural context (Zhi, 2022). While both studies effectively showcase their research processes, they rely on judgments from designers. The researchers concur with the viewpoint of Azevedo et al., which suggests a revisiting of the impacts of attire in cross-cultural design and the



Fig. 1 Representative drawings of the Chinese loong and Thai naga. (The left side picture is the image of Chinese Loong, picture available at https://www.freepik.com/premium-vector/chinese-dragon_3948771.htm. Art by 9comeback (2024), Reproduced with permission of Freepik Company, S.L. Copyright © 2010–2024 Freepik Company S.L., all rights reserved. The right side picture is the image of Thailand naga, picture available at https://www.pinterest.com/pin/231372499600636980/. Art by Pattaraporn (2024), Reproduced with permission of Pinterest Europe Ltd. copyright © Pinterest 2024, all rights reserved.).

associated relationships, they argue that recognizing cultural diversity as an expression of identity forms the foundation for comprehending design objectives (2018). It is crucial to acknowledge the unity and diversity of identities, as well as the dialectical relationship between local and regional cultures.

Ji's (2011) study was guided by Pierce's theory of the triadic relationship of signs, demonstrating the process of symbol "representamen" to "object" and then to "interpretant". In the study of Andrew (2008), the theoretical foundation relies on semiotics, drawing from the works of Barthes (1990), Saussure (Holdcroft, 1991). These studies utilize semiotic and communication theory methodologies to examine how meaning is constructed through textiles, recognizing textiles as potent "cultural signifiers". The costume is not only a communication medium, it is also a "symbol". As a form of material culture, costume has been widely analyzed. However, the physical object of clothing represents non-verbal communications and a kind of "symbol". The function of the symbol includes two aspects. The first is the intuitive sounds and images, which belong to the sensory effect while the other is conceptual design that belongs to an abstract psychological idea. How is a physical object translated into language? The same technique is used for clothing and literature to translate a physical object into language and represents "Description". The primary function of "Description" is to build on the understanding of the dissemination while readers are given free reign in the interpretation of the content. Barthes (1990) suggested that the concept of symbols includes signifier and signified. The fabric, color and structure of clothing belong to both the manner of environmental communication and the "signifier" in the symbol, while signified refers to facets such as the conceptual content, abstract thinking, and the expression of emotions. Costume has strong intuitive connection between the signifier and the sign of the symbol compared to the general symbol. Costume represents both the primary symbol and also covers a multi-level symbol system. Based on this understanding, Paivio (1991) proposed dual-coding theory and coded information into visual information and verbal information. The two systems generate a mutually corresponding relation which can improve communication.

A second technique is "Connaissance", that is, clothing can express savoir through fabrics and designs. The purpose of the description is to provide a kind of cultural concept analytically. Roland Barthes (1990) proposes three different structures for clothing, technologique, iconic and verbal, respectively. Only after certain shifters can clothing be transformed into representation. The role of shifters is to transform a kind of culture, content, or symbol into another form of expression, or from one code to another. It is a transformation approach from reality to intention, from reality to language, or from intention to language. According to Peirce's "On Signs" (1991), any symbol is composed of three elements: media related objects, object-related objects, and related interpretive objects. A sign embodies the functions of human creativity and morality and provides structural relationship between meaning and objects. This structural relationship fuses objects and meanings into a unified symbol system. The function of the symbol includes two aspects; one being the intuitive sound and the image, which belongs to the sensory effect; and the other is conceptual design relating to an abstract psychological idea.

This research proposes a hypothesis that in the context of cross-cultural design, cultural totem symbols as design objects should be based on in-depth analysis of cultural connotations. This should include explicit decorative art features and implicit cognition and knowledge, transforming valuable features with costume language. Consideration should be given to the complex relationship between human behavior, cognition, and societal culture. Emphasis needs to be given to multiple meaning connections and combinations in perception of totemic symbols formed, caused by Human-Object-Environment-Society-Culture, to enable implementation of traditional cultural elements into fashion design works.

Chinese loong and Thai naga. As totem worship, Chinese long, and Thai naga are often found in people's beliefs, festivals, and

related traditions and customs. They have high cultural status in their respective country. The language of symbol is actually the hidden expression of the culture (signified) through the symbols (signifier) (Zou and Joneurairatana, 2020). Each nation has its special cultural symbol because as the object of a primitive tribe's emotional identity and spiritual belief, totems not only become the most sacred and the best symbol in the tribe's mind but also become the link to maintain the clan members. A totem has a marking function for a nation. It is also the symbol of that nation, and the essence of the nation lies within its "symbol". National cultural symbols are perceptual symbols embedded with feelings and wishes, which can arouse the common historical memory of the members of the "national community" and enhance the psychological cohesion of the "community" (Zhang Cziráková, 2023).

In national culture, the totem is the most common way to display ancient civilization. Almost every nation or culture has a special animal or plant symbol. In the course of its development, the totem may be influenced by social system changes, cultural environment, and political evolution, and endowed with different meanings in different periods. Totem culture can be seen as the epitome of a country or a nation's culture.

The loong in China. Loong totem has also become the flag of national unity and the patron of various tribes. It was originally held as the clan insignia by Fu Hsi in ancient China, and then gradually evolved into a common belief among different tribes. Therefore, animals such as the loong (snake), became a form of universal totem worship. In the view of ancient peoples, the clan insignia could protect them, and the loong would eliminate disasters from overtaking them.

In addition, the loong is the symbol of royalty and monarchs. With the development of the social structure, the loong totem later evolved into the ruling "tool". Tribal leaders often made use of the loong image to unite and control their tribes (Ranjan and Zhou, 2011). In order to strengthen their image in the hearts of the people, emperors used to call themselves "son of the loong" (Peng, 2010), claiming to be bestowed with a mandate granted by heaven and that bestowed by the imperial throne. In later periods of feudal society (since the Qin dynasty, 221 BC), the loong pattern became a special color exclusive to the royal family. In this way, rulers used people's worship of the loong totem to "mythologize" themselves and strengthen feudal imperial rule (Van Henten, 2006). By this time the loong had become a symbol of absolute power and supreme political status.

In the loong culture in China, the inclusiveness spirit always plays an important role. The appearance of loong can be said to be strange and diverse. The body is also composed of many different animals. Inclusiveness in this point refers to creating a new object after widely absorbing and digesting, which is shown by the appearance of loong. In people's minds, the loong has always been sacred. In appearance, it is composed of nine different animals "Antlers are like a deer, head is like a camel, neck is like a snake, abdomen is like shen, scales are like fish, claws are like eagles, palms are like tigers, ears are like cattle" (Zhou, 2012). In skills, it gathers all the strengths of others and can do anything. This is why it was worshiped by people in ancient times. It was once also regarded as the medium of communication with heaven and earth to be responsible for winds and rains.

As a symbol of fortune, loong is sincerely loved and welcomed by the Chinese. In ancient periods, people would build loong and worship it. It was hoped that this would eliminate threats and bring greater care and blessings. Nowadays, loong related artefacts are very common in folklore and express auspicious and happy meanings, epitomized in wearing loong cloth, hanging loong paintings, eating loong noodles, and writing loong characters. In addition, the loong in daily life is also compared to the outstanding embodiment of wisdom. Those with outstanding talents are often referred to as "Ren Zhong loong Feng (The remarkable and outstanding person)"; a handsome son-in-law will be referred to as "Cheng loong Kuai Xu (An agreeable son-in-law is likened to an immortal on a loong)"; To congratulate those who have passed the imperial examination one would say "Yu Yue loong Men (A fish leaps over the loong gate)"; To describe a happy marriage one would say "loong Feng Ji Xiang (auspicious and delightful things)"; To express the hope for children one would say "Wang Zi Cheng loong (hope one's children will have a bright future)" (Nadezhda, 2022; Maguth and Wu, 2020).

The naga in Thailand. For thousands of years, the naga has played an important role in the history of South East Asia (Tu, P. A., 2007). The word "naga" which frequently appears in Indian and South East Asian literature is from Sanskrit and has various and confusing meanings such as "Naked", "Snake", and "Barbarian". Archeological evidence found in various places in South East Asia and specifically in Ban Chiang, Udon Thani, Thailand, provides strong support for the theory that people who used to live in the area presently referred to as South East Asia worshiped the "Snake" as a sacred animal (Chang, 2017). People were living with natural threats, surrounded by various kinds of dangers, and yet to develop understanding of natural phenomenon such as thunderstorms, earthquakes, and other forms of natural disasters. "Supernatural" and "animism" beliefs emerged to provide comfort from fear. They started to pray, worship, and sacrifice to certain spirits in an attempt to seek protection and abundance.

It is interesting to note that "snakes", were known as the most dangerous species due to their abilities which not only included deadly poison but also silent movement, the ability to go everywhere from above-ground or underground into the water or even into the air, the ability to molt (skin removal) and especially their movement that looks similar to a wave in water. Naga is also a symbol of water. In northern Thailand, the Mekong River that is deeply embedded and associated with Thai culture is called "naga". In Udon Thani in northern Thailand, people set up naga sculptures to worship the naga, make wishes, and offer incense to the naga, hoping that the naga will bless them to provide a good harvest during the year. Among all of these different meanings, "the God of Rain" which brings life (vital force), seasons, wealth, and fortune seems to be the strongest belief for those people, especially those who were residing along both sides of the Mekong riverbanks from Yunnan (South of China) down through Thailand, Laos, Cambodia, and Vietnam where the mouth of Mekong river is located (Robinson and Sinha, 2010).

A further set of paradigms is associated with this area. The Hindu gods answered all the questions of suspicion through the "Mahabharata" and the "Tri-Bhumi". This is when in the folklore of the local people, the story of "naga" became integrated into a new emerging "story" that of Naga as the protector of Buddha. According to legend, before becoming Buddha, when Sakyamuni (Siddhartha) was meditating under a Bodhi tree, Mara cast spells to interrupt the meditation of Siddhartha in fear of Siddhartha's God-realization, resulting in a furious storm between heaven and earth. Then naga was sent by Shiva to protect the Buddha, who, in order to protect the meditation of Buddha, not only fought with Mara, but also formed a colorful umbrella beside the Buddha to provide shelter for Siddhartha to continue his mediation (Moonkham (2021)). Naga has thus become the symbol of protection and is auspicious.

Most existing academic studies on this subject are about the comparisons between the Chinese loong and the western dragon

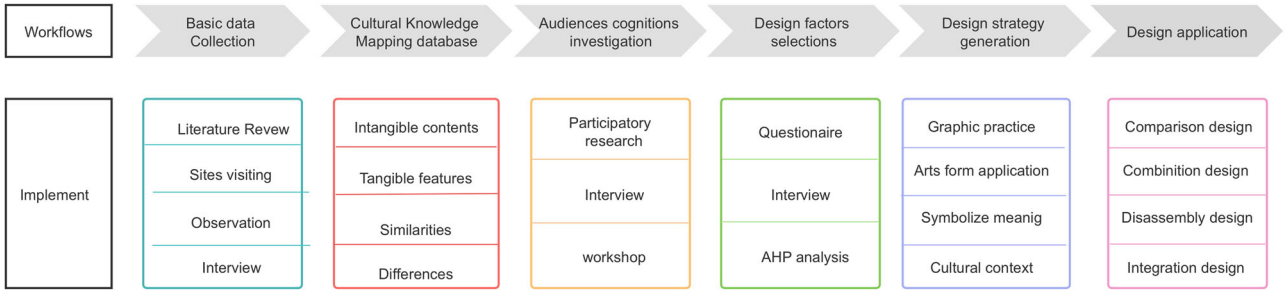


Fig. 2 Research process.

(Yuan, 2015; Maguth and Wu, 2020), while few studies compare loong and naga in depth. As both China and Thailand belong to the East, it would seem that there is not much difference between them. There are also many young Chinese and Thai people who do not know the authentic features of loong and naga and often confuse them, however, they are different and they represent the regional cultures with unique characteristics. In this paper, loong and naga, which are national cultural symbols, are selected as case studies, to show the results of the interdisciplinary study of costume design and cross-cultural communication.

From perspectives of the intersection between cross-cultural design and the fashion domain, as well as the comparative analysis between the Chinese loong and the Thai naga, this study holds significance for the interdisciplinary research encompassing fashion, culture, sociology, and design.

Research methodology and process

Research design. A cross-cultural costume design study on the Chinese dragon and the Thai naga as design objects requires an in-depth understanding of the characteristics and cultural connotations of Chinese loong and Thai naga, as well as the audience's perceptions and views of them. The specific research objectives were divided into three sub-parts:

To comprehensively analyze the tangible and intangible cultural attributes of the loong and naga, identifying any similarities, differences, or potential connections between them.

To conduct an in-depth investigation into the audience's cognition of the loong and naga, in order to identify the most appropriate design strategy that aligns with the audience's fundamental needs for cultural communication.

To propose a well-structured guidance mode for costume design, incorporating cultural symbols to facilitate successful cross-cultural communication.

The cross-cultural inheritance and design transformation research of Chinese loong and Thai naga will be conducted through the following steps: Collecting and organizing information data related to Chinese loong and Thai naga respectively, to extract their explicit visual factors and implicit semantic factors, and building a cultural knowledge mapping database of the loong and naga. The next step is to investigate audiences' background knowledge, cognition, and needs of loong and naga culture. Based on this, audiences can choose the optimal design factors from the previously established knowledge database. Design factors can then be synthesized and categorized and preference assessments conducted for target users in costume design transformation to generate a design strategy. Apparel is used as a medium, non-verbal communication to tell the story of the loong and naga. The research process is outlined in Fig. 2. The research methodology integrates qualitative and quantitative approaches, including field investigations, participatory research, and Analytic Hierarchy Process (AHP) analysis, thereby substantiating theoretical constructs through empirical investigation.

Research methods and process

Basic knowledge collection.

1. Basic knowledge about the Chinese loong and Thai naga ranging from tangible features and intangible cultural meaning and contents respectively are acquired from literature analysis. This research phase provides the fundamental knowledge and information for the next step in research. Firstly, the history and current understanding of the historical background and cultural communication between Thailand and China are summarized; secondly, a theoretical base is provided for the next research with a preliminary and overall understanding of the source and culture of loong worship and naga worship.
2. Field trips combined with site visiting and observation, field experiments, and research are conducted through embedding into the local cultural environment in depth to observe and analyze the existing artworks, such as buildings, sculptures and textiles, within the local language context and environment. Both tangible and intangible characteristics of loong and naga can be analyzed using comparison and analysis methods. The field research framework is shown in Fig. 3.

Table 1 provides a summary of the cultural contents of loong and naga arising from findings from the field investigation, observation, and analysis of a significant quantity of artwork. The researchers did field visits around Chiang Mai, Chiang Rai, Sukhothai, Phitsanulok, Udonthani in Thailand to study about Naga culture. And visitied Beijing, Fuzhou, Xiamen, Shanghai, Nanjing, Shan Xi province in China. More than 800 pieces of art works about Loong and Naga were analyzed. In order to summarize the understanding of the dissemination while readers are given free reign of the research results, they are displayed in the form of tabulated entries. The table is divided into four columns, the first column is a summary of the cultural characteristics of the loong (shown in Table 1) and naga (shown in Table 2), the second column is a detailed description, the third column is their functions as symbols, and the fourth column is how it is presented in the artwork.

Stakeholders participation. In the context of cross-cultural research, a significant challenge arises from the inherent barriers between the principal researcher's personal cultural inclinations and the nuanced cultural perspectives of the subjects under study. To circumvent potential cognitive biases introduced by designers or researchers, it is imperative to formulate a design strategy grounded in a comprehensive comprehension of the audience's cognition. This research adopted participatory research, with a combination of interviews and workshops to determine audience perceptions and opinions. Table 3 provides a summary of the research approach adopted for stakeholders engagement and analysis.

Some characteristic examples of questions and the corresponding answers from the participants were as follow.

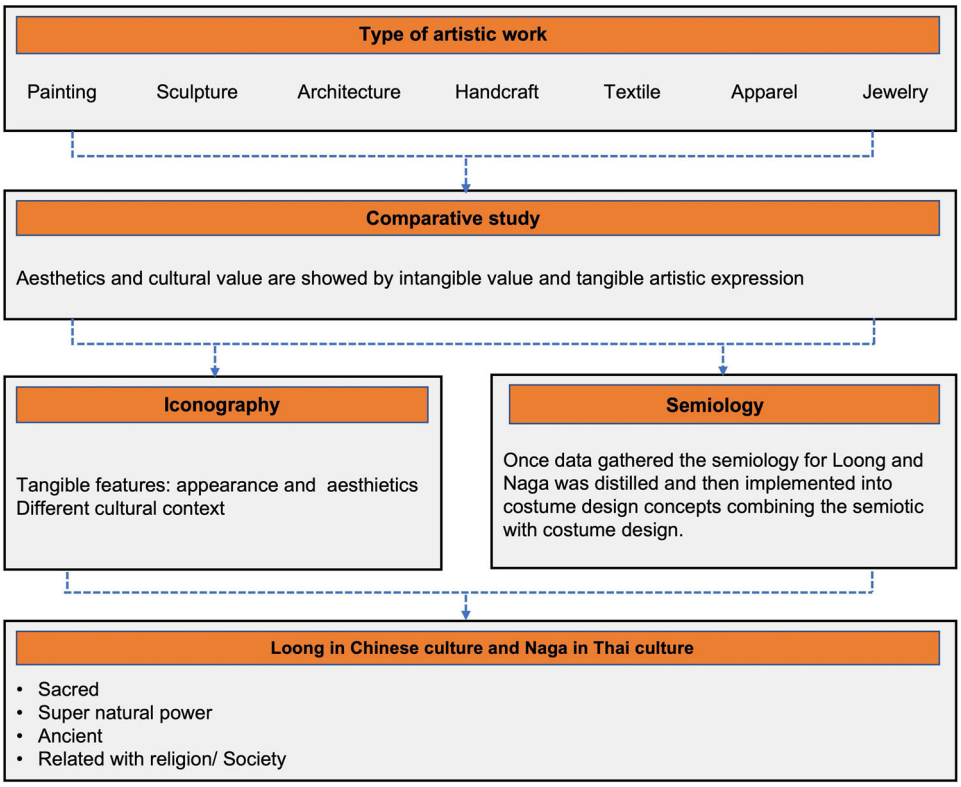


Fig. 3 Field research framework.

Table 1 Loong cultural characteristics summary.

Loong cultural characteristics	Details	Symbol	Artistic works
Sacred	Supernatural being with supernatural power	Be worshiped	The image of loong has various organs with special meaning in architecture, costume, handicrafts and sculpture
Religious beliefs	Mixture of Buddhism and Taoism	Ideology	Buddhist and Taoist temples
Chinese	Loong as the progenitor of the Chinese people	Chinese ancestry	Fabric weaving patterns, costumes, tattoos, folk literature. Similarities between loong's and human's faces
Natural phenomenon	The god of climate/rain/fire	Good agricultural harvest	Fabric patterns, architecture, handicrafts and sculptures
As the link between earth and heaven	Linking humans to heaven	Connecting with heaven, hope	Boats, funeral chariots, musical instruments, sacrifice utensils
Imperial power	In feudal dynasties, loong represented imperial power	High status and imperial power	Costumes, architecture, and sculptures in imperial palaces
National spirit	Teamwork and unity	National unity	Spiritual and identity symbol

Question: Whether they know and what they think it is when showing some pictures about Thai naga.

Answer: "*I think it's a loong, much like a loong, but looks like a snake.*"

Question: Do you know what this is and how much do you know about it (when showing some pictures about Chinese loong)?

Answer: "*This is a loong, but I do not know much about it. I became acquainted with it through Chinese TV dramas, it symbolizes the emperor. They appear and look beautiful but cruel as well.*"

Question: What do you think of the existing clothing design products that incorporate loong/naga; do you like it or not and the reasons?

Answer: "*I do not like because some of the products on the market nowadays use particularly figurative patterns as decorative elements, which look very traditional and the styles aren't very nice, and I think it should be rejuvenated and casualised, perhaps more aligned with young people's aesthetics*"

Question: In designing costumes incorporating loong and naga within a background of cross-cultural communication, what do you think should be developed?

Answer: "*I think we can't just stop at the application of patterns, I hope we can show the story of loong and naga through different design series, and learn something about the culture of loong and naga through the clothing, maybe there should be two clothing series, one series about the Chinese loong, and one series about the Thai naga*".

Table 2 Naga cultural characteristics summary.

Naga cultural characteristics	Details	Symbol	Artistic works
Sacred and holy	Supernatural being with supernatural powers	Sacred and worshiped	The image of naga has crests and various organs in architecture, sculptures, paintings, and fabrics
Religious beliefs	Protector of Buddha	Religion	Different number of heads, with Buddha image in sculptures, paintings, and fabrics
Thai	Naga as the progenitor of several races and tribes	Snake worship	Fabric weaving patterns, costumes, tattoos, and folk literates
Both good and evil	Some naga can squirt venom	Warning	Movie, literature
Natural phenomenon	The god of water and rain	Good weather and rainfall. Good agricultural harvest	Fabric patterns, architecture, handicrafts and sculptures
As the link between earth and heaven	Linking humans to heaven	Connecting with heaven	Boats, funeral chariots, musical instruments, and sacrifice utensils
Spiritual symbol	Happy life, good fortune, and auspiciousness	Protection	Fabrics, costumes, and textiles

Table 3 Stakeholders participation.

Investigation aims	1. To acquire audiences background knowledge of loong and naga: *Explicit knowledge*: Image, appearance, colors, decoration features, arts from, application occasions etc. *Implicit knowledge*: Story, spiritual, cultural meaning, etc. 2. To acquire clothing design suggestions: *Design guidance*: Design requirements, emotional needs, Inspirations of costume design, etc. *Design factors selections*: Select priority design factors for the purpose of telling the story of loong and naga.	
Investigation methods	Participatory research, unstructured individual interview, and workshop	
Investigation process design	Participant selection	- Fashion design major students - Fashion design major lectures - Fashion designer
	Number of participants	15 Chinese and 15 Thai
	Data type	Audio and text recording
	Hardware equipment	Voice recording, photograph, projector, display board, video, computer, paper, pencil, pen.
	Investigation process design	Part 1: Introduction. Introduce the following contents to the participants: What is the subject of this research; Why do this research; The importance and impact of their answers for this research; Introduce the entire process of this survey. Part 2: Stakeholders' background knowledge. The questions setting aims to check the stakeholders' knowledge and cognition of loong and naga. Process: Show the pictures of loong and naga to audiences separately, let them to describe the characteristics or their cognition of the loong and naga's tangible and intangible characters or descriptions. Part 3: Stakeholders opinion about the existing costume design of loong and naga. Questions proposed: What you think of the existing clothing design products about loong/naga symbol application, do you like it or not, and the reason? In designing costumes for loong and naga with the background of cross-cultural communication, what would you like to see about loong and naga? Part 4: Design strategy propose and participatory research process. Questions setting: As a designer, if designs costumes incorporate loong and naga symbol culture in the context of cross-cultural communication, what are the most important elements or characters that should be applied and adopted during design process? How to combine those cultural contents from question a with costume design language? What design strategy should be considered? (interview with sketching)
Data analysis method	Contents analysis, Analytic hierarchy process (AHP) method	

In comparison, the familiarity of Thai individuals with the Chinese loong symbol surpasses that of Chinese individuals with the Thai naga symbol. Both Chinese and Thai individuals exhibit a lack of awareness regarding the cultural totem symbols of the loong and naga, along with instances of cognitive misinterpretation. However, both groups acknowledge the significant cultural importance of these symbols within their respective cultural contexts, and there is a desire to acquire a deeper understanding of their significance. Regarding design requirements, it is desirable to incorporate a more comprehensive representation of cultural knowledge related to the loong and naga in clothing designs. This should encompass both explicit and implicit cultural elements. The aim is to showcase the distinctions and connections between the loong and naga symbols, thereby enhancing the portrayal of cultural depth within designs.

The next step in the research methodology was to let participants select the significant design factors. For data analysis, the Analytic Hierarchy Process (AHP) was utilized. AHP, was

originally proposed by the American operations researcher T.L. Saaty in the 1970s, and involves breaking down decision-making elements into multiple levels and factors (Yu et al., 2021). The fundamental steps of the Analytic Hierarchy Process (AHP) involve deconstructing complex decision problems into a structured hierarchy with interrelationships among its elements. Subsequently, the relative importance of criteria at the same level are compared pairwise, resulting in several judgment matrices. The next step entails calculating the relative importance weights of each element within the hierarchical criteria. Finally, by synthesizing the relative weights among criteria at different levels, the overall weights of all the criteria are determined (Russo and Camanho, 2015). Based on this weighting scheme, a comprehensive evaluation of the research problem can be conducted. The arising AHP data results are shown in Fig. 4a–c.

An analysis of the priority factors for the design transformation of the tangible characteristics of Chinese Loong and Thai naga: The raw data for the AHP (i.e., input data) are presented in Table 4. The AHP data format follows the rule that the elements on the upper right and lower left diagonal are always equal to 1, indicating that the importance of an element to itself is completely equal; and the elements on the upper right and lower left sides are reciprocals of each other; The numerical values represent the relative importance between the criteria, with higher values indicating stronger relative importance.

When using AHP for weight calculation, it is necessary to conduct a consistency check to evaluate the consistency of the weight calculation results. This involves calculating the Consistency Ratio (CR) value (CR = CI/RI). Firstly, the CI value is obtained from the calculation, given by the formula $CI = (\lambda_max - n)/(n - 1)$, where λ_max represents the maximum eigenvalue, and n is the order of the judgment matrix. Secondly, the RI value is determined based on the order of the judgment matrix. Thirdly, the CR value is calculated, and the consistency is assessed. Typically, a smaller CR value indicates better consistency in the judgment matrix. In general, if the CR value is less than 0.1, the judgment matrix passes the consistency check; however, if the CR value exceeds 0.1, it implies that the matrix lacks consistency, and appropriate adjustments should be made before further analysis. For this 7th-order judgment matrix, the computed CI value is 0.051, and the corresponding RI value from the table is 1.360. Therefore, the calculated CR value is 0.038, which is less than 0.1. This indicates that the judgment matrix in this study meets the consistency check, and the derived weights exhibit consistency (Ossadnik and Lange, 1999; Podvezko, 2009).

The research results indicate that the priority factors to be considered in the design transformation strategy of the tangible characteristics of Chinese loong and Thai naga are as follows: decoration form (33.00%)> decoration elements (18.63%)> body shape (16.43%)> movements (11.00%)> body details (8.02%)> color (7.46%)> organs (5.45%).

An analysis of the priority factors for the design transformation of the Intangible contents of Chinese loong and Thai naga: After applying the same calculation and analysis process, the results for the priority factors to be considered in the design incorporating the intangible contents of Chinese loong and Thai naga are: national philosophy (33.75%) symbol (27.95%) Beliefs (14.15%) Myth (7.66%) spiritual (9.24%) story (7.24%).

Regarding preferred design plan, the selection of respondents is as follows: Combination design of intangible meaning (25.32%) > Contrast design of intangible meaning (17.01%) >Combination design of tangible features (13.96%) > Contrast design of tangible features (10.84) > Costume design based on naga intangible meaning (9.03%) > Costume design based on loong intangible meaning (8.78%) > Costume design based on naga tangible features (7.53%) = Costume design based on loong tangible features (7.53%).

Design strategy and design application

Design strategy. To achieve effective cross-cultural communication, fashion design works should integrate the audience's cognition with the characteristics of "cultural symbols". Merely focusing on the representational meaning of symbols without delving into their deeper cultural connotations may result in a shallow understanding and ultimately lead to a failure in genuine cross-cultural communication. For a more effective symbol dissemination, a multi-layer superposition of symbols is necessary. Based on the extensive literature discussion and analysis, the principal researcher has posited that fashion design serves as a medium for fostering integrated and harmonious cross-cultural communication. In this study, the theoretical framework of "decoding and encoding," derived from Hall's cultural communication theory (2007), is adopted as the principal guiding perspective, which is then integrated with the discipline of fashion design.

Communication, viewed as an "encoding-decoding" process, involves the secondary conversion of "symbol-meaning-design" and subsequently "design-meaning." When the communicators belong to different "language systems," the "encoding-decoding" process necessitates the intervention of a "translator," which in this context is the fashion designer. Consequently, the presence of the designer introduces two consecutive "encoding-decoding" processes: The first approach involves the process of interpreting cultural symbols, encompassing symbols' cultural information, semantic information, and presentation form. Subsequently, the designer re-encodes the decoded meaning and communicates it to the audiences, constituting a re-encoding process. In this process, the transmission of cultural information occurs through the medium of clothing, achieved through various aspects such as shape language, color language, pattern language, textile or material language, and texture language. The audience engages in a secondary cultural interpretation through clothing, and their individual perceptions are further communicated back to the designer. Throughout this process, the designer assumes a dual role, serving as both the recipient of the initial communication process and the disseminator in the subsequent communication process. Figure 5 illustrates the main concepts.

After summarizing and analyzing the characteristics of the symbols, the audience's conditions, and priority factors of design strategy, the researchers divided the design strategy into four layers, shown in Fig. 6.

The initial design stage draws inspiration from the graphic design tradition of loong and naga. The design elements involve the integration of loong and naga patterns into clothing. The objective is to effectively convey the audience's understanding of loong and naga graphics. This represents the preliminary layer of the design process. The second stage of design practice emphasis is on the artistic application of loong and naga. Following an examination of artistic expressions within the fashion and textile application of their respective regions, the principal researcher employed a comparable creative approach to re-envision the loong and naga motifs, subsequently integrating them into garment design. This third design practice phase primarily focuses on elucidating the symbolic characteristics of the loong and naga as cultural symbols. This involves delving into the meanings, stories, and representations underlying these symbols. The design at this stage aims to fulfill the audience's desire to gain a deeper understanding of the implicit knowledge associated with the loong and naga. The fourth stage of design directed attention

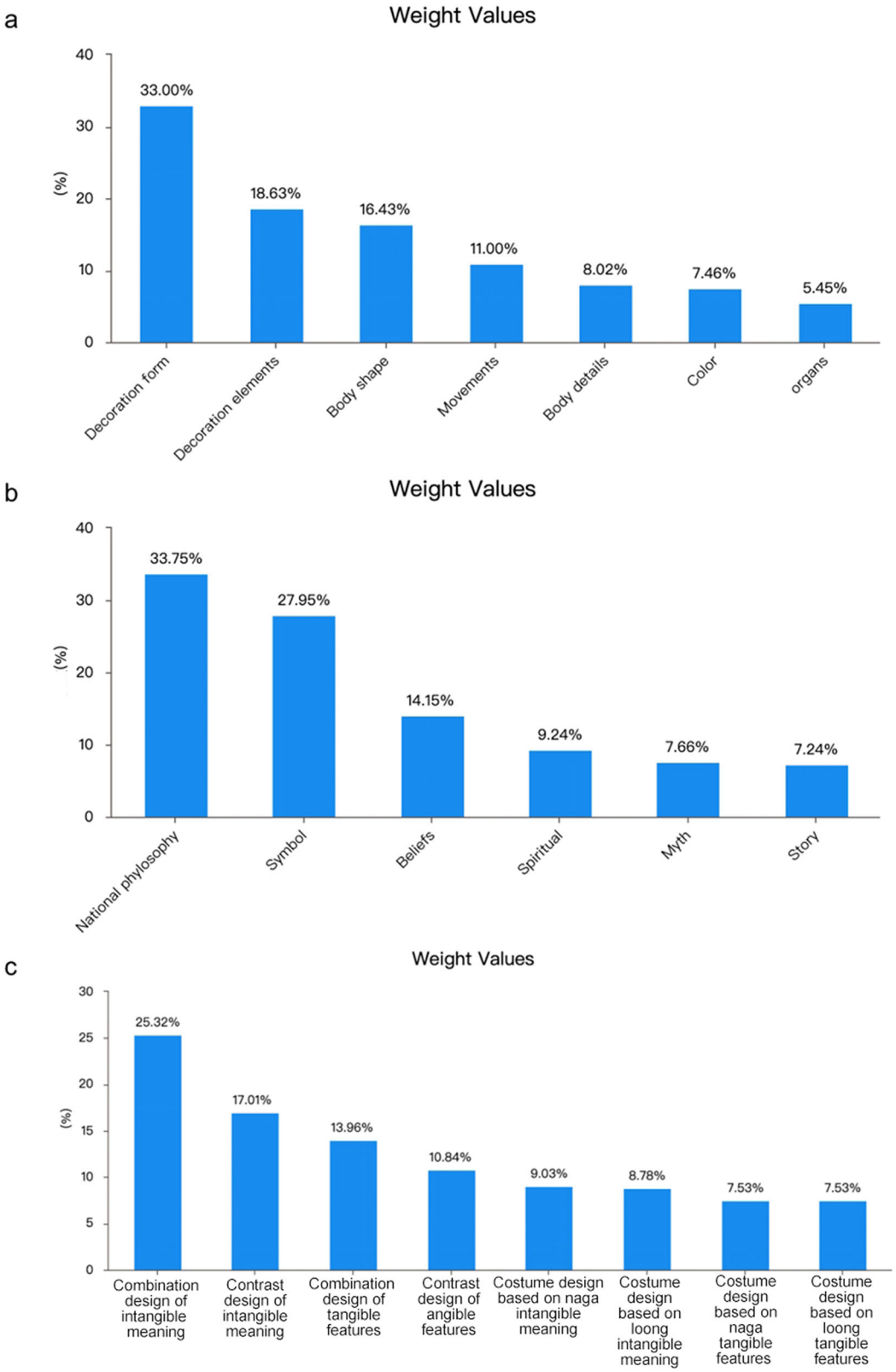


Fig. 4 Research results of AHP analysis. a AHP data results for the priority factors in the design incorporating the tangible characteristics of Chinese loong and Thai naga. **b** AHP data results for the priority factors in the design incorporating the tangible characteristics of Chinese loong and Thai naga. **c** AHP data results for the preferred design plan in the design incorporating the tangible characteristics of Chinese loong and Thai naga.

towards the shared foundation conveyed by loong and naga in their capacities as national symbols. Beyond serving as artistic symbol alone, each national emblem stands as a tangible embodiment of the ancient populace's ideologies, convictions, and reverence. Such totemic representations, often referred to as cultural symbols, genuinely encapsulate the profound philosophical essence of the nation. This culminates in the ultimate manifestation of "national culture" within the veneration of totemic symbols, simultaneously constituting the definitive substance to be conveyed in cross-cultural communication.

In essence, these four instances represent the process of "encoding." Once the design strategy is established, the primary objective of the designer's "encoding" lies in visually depicting the cultural values inherent in both cultural symbols for the audience. This visualization aids in facilitating the audience's assimilation of cultural messages and information through fashion products, thereby fostering the desired degree of comprehension.

The process of design decoding involves purposeful composition, entailing the utilization of specific decoding principles to amalgamate a distinct "cultural code" aimed at communicating with the audience through attire. This integration of loong and naga cultural insights is accomplished through the clothing's patterns, colors, structure, texture, materials, etc., effectively achieving the objective of dissemination cultural knowledge.

Table 4 AHP analysis and testing results data for design transformation of the tangible characteristics of Chinese loong and Thai naga.

AHP data

	Story	Spiritual	Myth	Beliefs	Symbol	National philosophy
Story	1.000	0.500	1.000	0.500	0.333	0.250
Spiritual	2.000	1.000	1.000	0.500	0.333	0.250
Myth	1.000	1.000	1.000	0.333	0.333	0.250
Beliefs	2.000	2.000	3.000	1.000	0.333	0.250
Symbol	3.000	3.000	3.000	3.000	1.000	1.000
National philosophy	4.000	4.000	4.000	4.000	1.000	1.000

Summary of Consistency Testing Results

Maximum Eigenvalue	CI value	RI value	CR value	Consistency Testing Result
7.306	0.051	1.360	0.038	Passed

Design results

1st design phase: graphic practice. The initial design phase focuses on the graphic design practice of loong and naga, involving the combination of their patterns on clothing. The primary purpose here is to acquaint the audience with the first image of loong and naga graphics. Adopting the "direct message" design style, the loong and naga motifs are combined and placed on the ready-to-wear designs. The design results are shown in Fig. 7.

2nd design phase: arts from application practice. This phase emphasizes the application of arts forms of loong and naga in the fashion design domain. Design results are shown in Fig. 8. This phase involves analyzing the artistic creations prevalent in the fashion and textile industries of their respective countries, the clothing design techniques used include pattern translation and the use of lines in clothing silhouettes.

This choice prompted the development of a collection of designs influenced by the contemporary utilization of the loong pattern in costume design. While retaining the established loong pattern as an ornamental component, the design of the clothing incorporated the graceful lines evocative of loong motion, contributing to its progressive evolution. The resultant collection of designs found its roots in the modern-day incorporation of the loong pattern within costume design. Given the unchanging nature of the loong pattern, this collection's design strategy involved retaining the loong pattern for decorative purposes, while concurrently integrating the

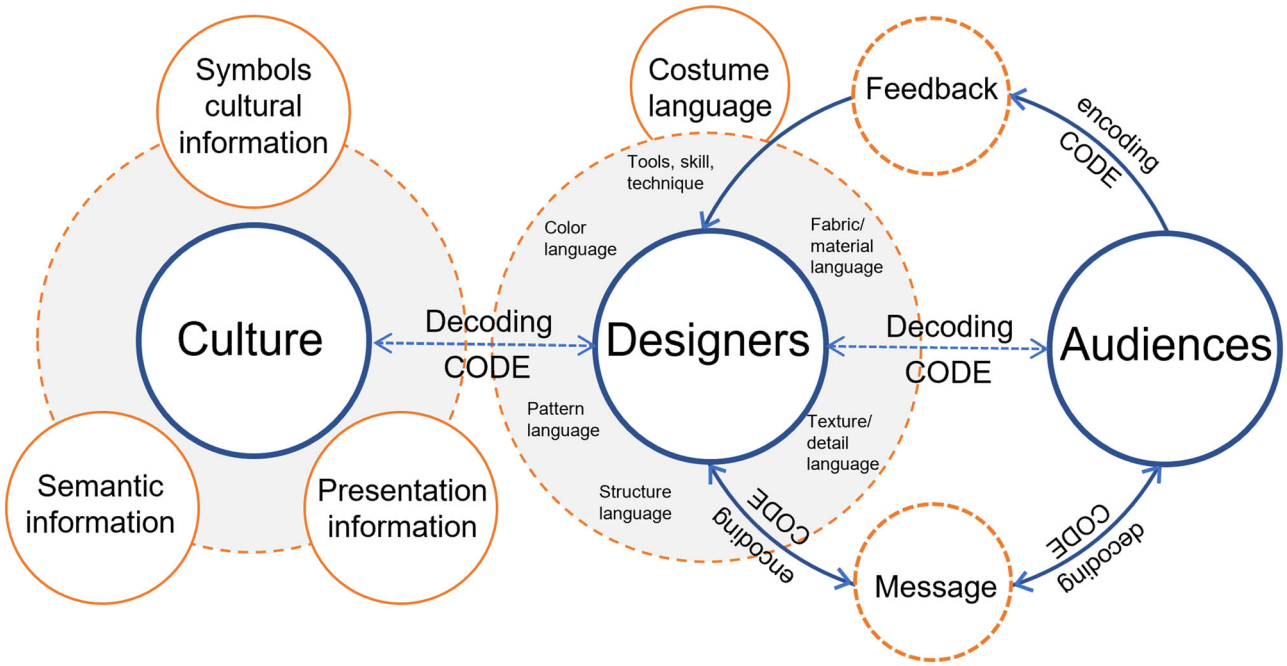


Fig. 5 "Encoding-decoding" framework in cross cultural costume design.

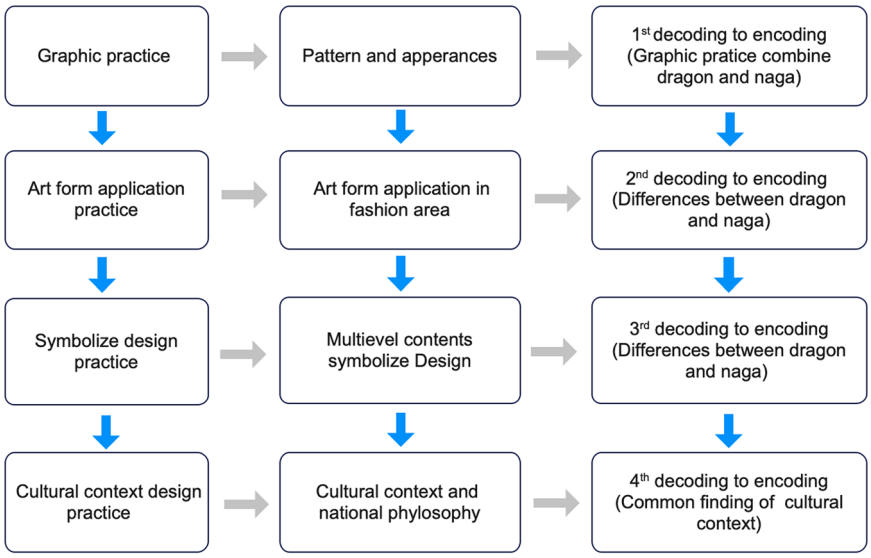


Fig. 6 Design strategy.



Fig. 7 Design results for the 1st design phase.

flowing lines representative of loong movements into the clothing's silhouette design.

The distinction between loong and naga design is notable due to the limited utilization of naga patterns in Thai costume design. In the realm of textiles, naga patterns find predominant application in products such as Paa chet, Paa sin, Paa Hom (shawls), as well as household articles such as quilt, pillows, bed sheets, and mosquito nets. By means of extensive on-site investigations and meticulous analysis, the researchers systematically categorized and scrutinized the arrangement of naga patterns. Given the distinctive nature of various textile techniques, naga patterns encompass a range of primary artistic expressions, including geometric metamorphoses, abstract artistic depictions, and figurative artistic elements (Yixin Zou and Joneurairatana, 2021). Drawing inspiration from these artistic genres, the researcher adopted a methodology of reimagining and reconfiguring naga patterns. Considering the prevalent use of naga patterns in textiles, the integration of these patterns into



Fig. 8 Design results from the 2nd design phase.

garment design materializes primarily in knitted apparel. The attire's design amalgamates an "H" shape and an "O" shape, resulting in an overall esthetic that conveys elements of contemporary fashion and youthful vibrancy.

3rd design practice: multiple layers of symbolization. In conceptual design, each component exists in an abstract and indistinct discrete state. This characteristic not only contributes to the intricacy of the design process but also allows for adaptability in the final products, thus affording designers a wide expanse of creative ideation. The conceptual design stage represents a foundational cornerstone of product innovation, and within this stage, the innovation in materials or fabrics assumes a pivotal role in realizing the precise manifestation of the conceptual design. In the realm of costume design, a multitude of avenues exist for expressing attire, including exploration of fabric design and pioneering production techniques such as material embellishments. Results from the third phase of design are shown in Fig. 9.

The differentiation between the loong and naga lies in the loong's composite form, incorporating traits from various animals alongside its serpentine aspect. Despite differing depictions of its appearance, it is widely acknowledged that the loong's portrayal involves a fusion of numerous animal attributes, including "deer antlers, camel head, snake neck, clam belly, fish scales, eagle talons, tiger paws, and ox ears." As articulated by Wen Yi-Duo (2009) in "Inquiring into Fuxi and Fuxi Culture," the loong stands as a metaphysical entity existing solely within the realm of totemic representations rather than in the natural world, as it constitutes a intricate amalgamation of distinct totemic elements. However, on a more profound level, the essence of loong culture encapsulates the spiritual significance of the traditional Chinese virtue of unity. It is apparent that the initial image of the loong symbolized the unity and resilience of the Chinese nation. Moreover, the loong is intricately linked with the feudal imperial authority in Chinese history. Now it evolves into a symbol of Chinese people. Through the study of loong culture, several pivotal design themes emerge, including Imperial authority, auspiciousness, unity, and protection.

In the context of naga worship, the naga symbolizes the deity of rain and water. The notion of the "rain deity," responsible for bestowing life, seasons, and prosperity, it also represents inhabitants residing along the banks of the Mekong River. Possessing a serpentine form, the naga may sometimes be depicted with feet and an invincible potency. Certain nagas are



Fig. 9 Design results for the 3rd design phase.

believed to possess the ability to reciprocate kindness and exhibit caution against wrongdoing. The foundation for these variations in beliefs can be traced back to their moral education encompassing concepts of virtue and malevolence. Furthermore, the naga holds the aspect of being a "guardian." The propagation of Indian religious influences into Thailand left an impact on the ruling elite, leading to a transformation in the cultural significance associated with the naga. Consequently, four pivotal thematic components emerge from the conceptual design of the naga: water, beneficial and harmful, morality, and guardian.

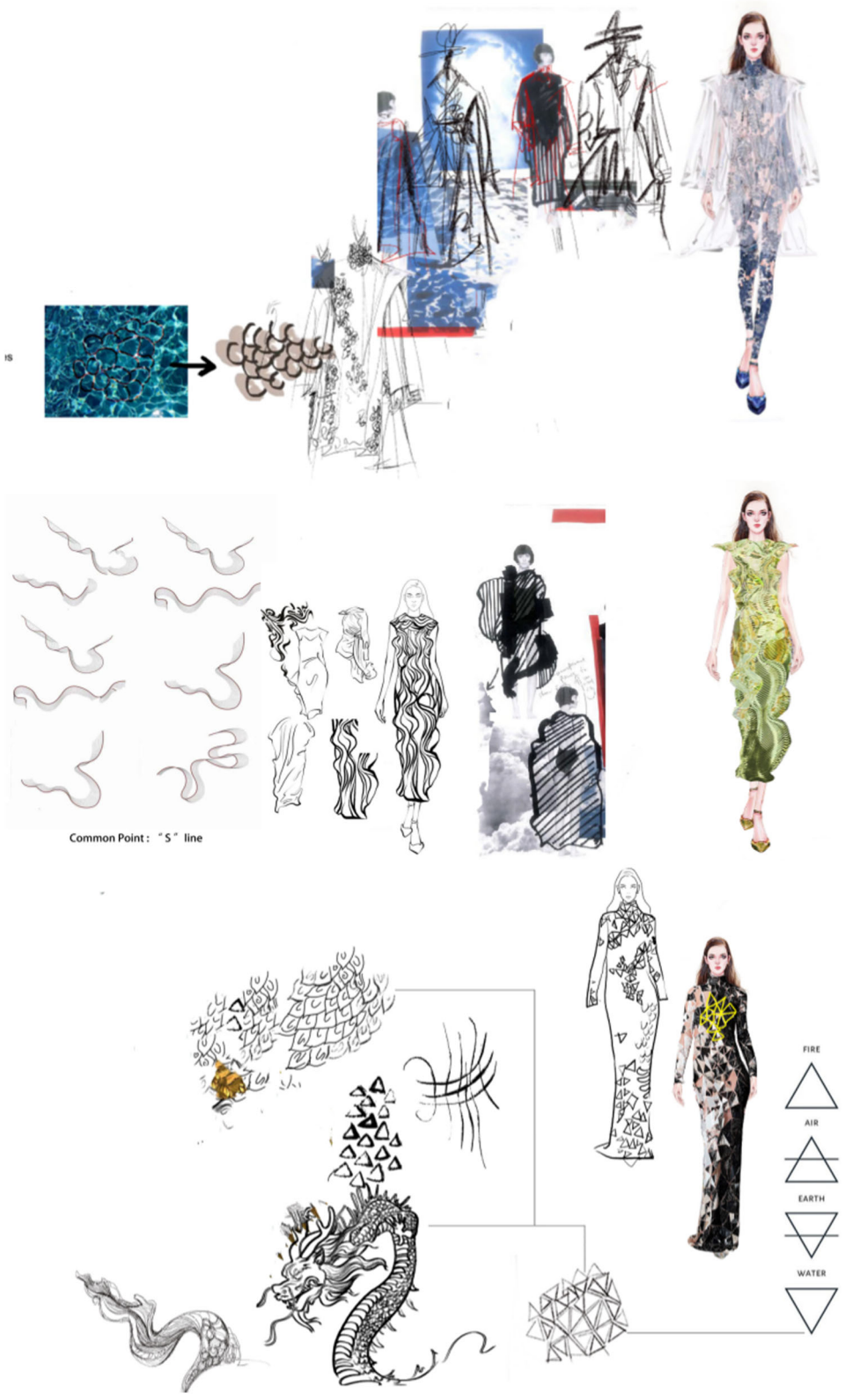


Fig. 10 Design results for the 4th design phase.

4th design practice: cultural context design. Both the loong and naga as the representatives of national cultural symbols transcend their artistic representation, encapsulating the genuine portrayal of ancient individuals' ideologies, convictions, and worship. Functioning as cultural icons, they encapsulate profound national philosophical principles, embodying the definitive embodiment of "national culture" through totemic symbol veneration, and serving as the quintessential content for cross-cultural communication. This stage encompasses the fourth instance of "encoding,"

involving the transmission of cultural messages. Arising design results are shown in Fig. 10.

Origin of life. Within Chinese and Thai cultures, the ancestral notion and practice of "snake worship" holds a significant place. Early animal veneration and mythological narratives predominantly sprang from human imagination, tailored to address emotional necessities. This amalgamation of artistic and non-artistic elements forms not only an artistic medium but also delves into philosophical realms. Totemic worship, in the form of art, enables humans to seek self-preservation by nurturing the inner spiritual wellspring essential for a nation's survival and progress. This rationale clarifies the underlying rationale for the "S-curve line" evident in the body contours of loong and naga. In this sequence of design, the researchers, in their capacity as designers, have built upon the foundational visage of loong and naga, employing the "metaphor" technique to incorporate the snake imagery into clothing.

Water wave. The myths surrounding loong and naga share common elements, notably their capability to control water and rainfall. Philosophically, the serpent has been likened to the "tree of life." Furthermore, the serpent is not solely an animal; it is also the progenitor of humanity and tribes. Water held immense significance for ancient civilizations as it nurtured life and gave rise to societies. In Thai narratives, the naga symbolizes the Mekong River (Tu, 2007). Similarly, in Chinese stories, loongs inhabit the sea and reign as sovereigns of the ocean. The design sketch amalgamates the themes of rainfall and loong's and naga's scales. A translucent PVC overcoat conveys the divinity and enigma encapsulated by these mythical beings. The ensemble holistically represents the interconnectedness of loong and naga with life and water. The sample crafting technique involves heating organza yarn to induce creases, followed by a hot-pressing process to affix it to foil and Tyvek. Varied temperatures during the heating process produce distinct wrinkle patterns in the Tyvek material.

Notions of harmony between humanity and nature. As human civilization progressed, ancient cultures have transitioned in their concept of the connection between humans and the universe, nature, and life. In Chinese culture, the concept of "relationship" aligns with the "Way" in Taoism, representing a mode of thought concerning the underlying principles running all things. Both loong and naga possess the capacity to control water and fire, embodying symbols of good agriculture harvest. Beyond this, they serve as intermediaries through which humans commune with the heaven. Loong and naga symbolically encompass the elements of water, fire, air, and earth (associated with cultivation). Over time, this symbolism evolved from "water" to encapsulate these "four elements." In philosophy, these elements form the basis of the world, underscoring the symbiotic rapport between humanity and the natural world (Macauley, 2010). Among these elements, "water" and "fire" stand as opposites, forming a harmonious interplay alongside "air" and "earth." In Chinese Taoism, a dictum encapsulates the world's functioning: "The Word begets one, one begets two, two begets three, and three begets everything. Everything carries Shade on its back and Shine in its arms, the opposites tending to harmony" (Liu, 2008). Buddhist ideology, on the other hand, posits that "all the four elements are void." Buddhism concurs that the world is constituted by four elements—earth, water, fire, and wind—integrating them with the human physique. The earth corresponds to solid materials like bones and muscles; water pertains to liquids such as blood and sweat; wind signifies human respiration and internal airflow; fire equates to temperature, denoting body heat (Jiyu, 2010). Both Taoism and Buddhism epitomize the wisdom of ancient cultures regarding the harmonious among nature, the universe, and humans.

This collection of costumes simplifies the symbols representing the four elements—"fire, water, air, and earth." All the garments convey notions of inclusiveness and equilibrium. Moreover, this series of attire employs the "metaphor" technique to convey the ancient human's imaginative comprehension of loong and naga, rooted in their profound reverence and contemplation of the natural world. The abilities attributed to loongs and nagas mirror the limited understanding ancient civilizations had of nature, coupled with their aspiration for a harmonious rapport between humanity and the natural realm.

Discussion. The four stages of design practice a stepwise evolution built upon insights arising from preceding phases. Concluding the research, the cumulative sequence of designs can be distilled into four strata of symbolic exploration, as depicted in Fig. 11. The initial stratum, termed the "Contact" layer, centers on the visual portrayal of symbols. This encompasses the graphical

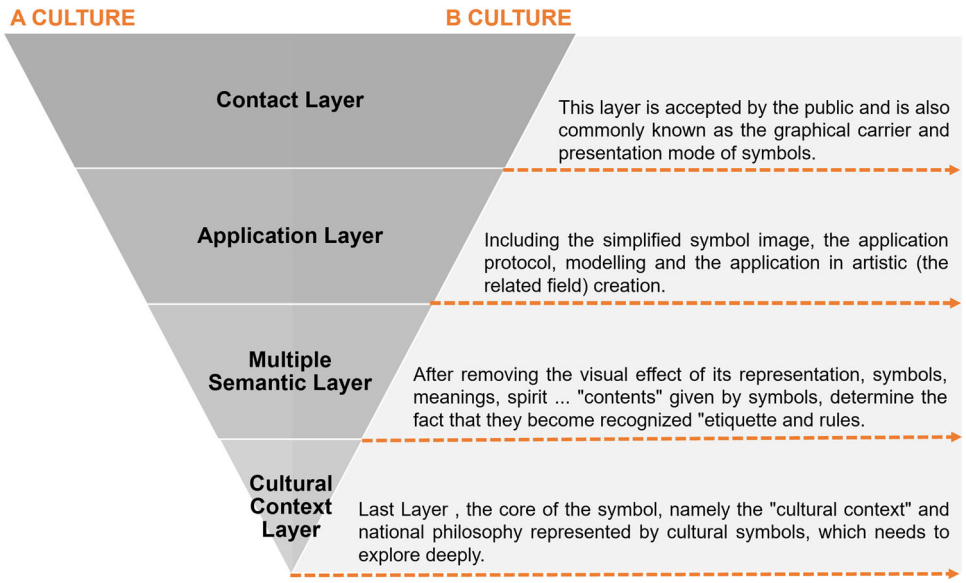


Fig. 11 Four strata of symbolic exploration.

medium and mode of presentation for these symbols, designed to be easily embraced and comprehended by the general populace. Conversely, the second phase, designated as the "arts form application" layer, delves into the pragmatic implementation of symbols. This involves streamlined symbol depictions, and their utilization across diverse artistic mediums, including fashion, painting, and sculpture. In the third layer, the "Multiple Semantic", emphasis shifts towards delving beyond the mere visual aspects of symbols. This stage involves delving into the evolutionary trajectory of symbols and their underlying profound connotations, encompassing spiritual implications, mythical narratives, and other cultural elements that grant them recognition as "etiquettes and rules." Lastly, titled the "Cultural Context Layer," delves into the core of symbol significance, which is the cultural context encompassing the represented "values" and national philosophy. This layer uncovers the factual substance underlying the evolution of symbol culture, necessitating thorough exploration and insight.

Whether conducting a unidirectional cultural symbol design exploration or engaging in a multi-faceted cross-cultural inquiry, these four strata of knowledge stand as invaluable points of reference. They offer a framework for uncovering the profound cultural implications spanning diverse dimensions.

Conclusion

This research demonstrates through design practice that a well-established fashion design research methodology will empower fashion designers to convey concealed cultural aspects while satisfying the esthetic preferences of their audience. Thus, this study represents a research case that harmoniously integrates theory, practice, and methodological exploration. In combination with conventional research methodologies, participatory research is integrated through a combination of interviews and design workshops. AHP Hierarchical Analysis was applied to perform weighting analysis of the elements in order to obtain more appropriate alternatives. This integration allows for the acquisition of objective quantitative data, subjective emotional insights, and guidance for design strategies.

Compared with Volonté (2012) and other studies on cross-cultural fashion design, this study provides new insights in theory and methodology, applying the theory of "dual coding" to cross-cultural costume design, proposing a multilevel and multifaceted interaction between the "cultural content—language of costume design" and "the designer—the audience". It also uncovers the process of interpreting ethnic totemic symbols such as the Chinese loong and Thai naga across multiple levels, progressing from representation to extension and then delving into intrinsic meaning. This study is consistent with some of the views of Farshid Nik (2020), the difference being that in addition to iconography study, this study has been expanded by incorporating semiotic theories, and proposes four levels of totemic cultural symbols a contact layer, an application layer, a multiple semantic layer and a cultural context layer, where the interpretation of symbols at each level is consistent with the views of Stamatopoulou et al. (2016) and Shelestiuk (2003) for the perception of cultural symbols, but enriches the understanding of cultural symbols from a design thinking perspective. Moreover, the utilization of distinct fabrics and materials further adds to the diversity of approaches, thereby offering valuable insights for design praxis.

There are certain limitations within this study. The current discussion lacks depth when compared to scholars in sociological or cultural studies, and the opportunity exists to incorporate Pierre Bourdieu's thinking on cultural transmission (Lizardo, 2011) and Edward T. Hall's intercultural study (1976) for a more in-depth critical theoretical study in future research. Beyond that, the paper has not investigated of the target audience's feedback about the final design works. There is also a lack of more systematic and diverse design practices regarding loong and naga. To address this gap, future research could propose a systematic design of loong and naga, such as serial development and research of products and services that are compatible with esthetics, function, perception, and value. In this process, a systematic inquiry into the audience's perspectives can be conducted. This iterative process of collecting audience feedback will culminate in a closed loop of multiple encoding and decoding cycles in order to influence people's viewpoints and perceptions from the perspective clothing as non-verbal language and realize the audience's understanding of traditional cultural symbols and respective about other cultures in diverse cultural backgrounds.

Data availability

The datasets generated or analyzed during the current study are not publicly available but are available from the corresponding author on reasonable request.

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References

9comeback (2024) Chinese Dragon. Available at https://www.freepik.com/premium-vector/chinese-dragon_3948771.htm. Accessed 25 Aug 2024

Andrew S (2008) Textile semantics: considering a communication-based reading of textiles. Textile 6(1):32–65. https://doi.org/10.2752/175183508X288680

Azevedo PZ, Giuliano CP, Waldman RL, Ruthschilling AA (2018) Estabelecendo confluências: sustentabilidade e a ética da alteridade de Emmanuel Lévinas. Mix Sustent 4(1):40–48. https://doi.org/10.29183/2447-3073.MIX2018.v4.n1.40-48

Barthes R (1990) The fashion system. Univ of California Press

Carvalho JM (2017) A cultura-mundo, respostas a uma sociedade desorientada. *Revista Estudos Filosóficos UFSJ*, (8). Available at https://www.ufsj.edu.br/portal2-repositorio/File/revistaestudosfilosoficos/res1_rev8.pdf. Accessed 23 May 2023

Chang YL (2017) Naga Art in Buddhist Temples of Mueang Chiang Mai District. In 13th International Conference on Thai Studies "Globalized Thailand? Connectivity, Conflict and Conundrums of Thai Studies" (p. 98). Available at https://www.researchgate.net/profile/Preeyarat-Chaowalitprapan-2/publication/348564364_THE_ORIGIN_MYTH_OF_NORA_A_COMPARATIVE_STUDY_OF_SOUTHERN_THAILAND_AND_MALAYSIAN_VERSIONS/links/600530bd299bf14088a2eb93/THE-ORIGIN-MYTH-OF-NORA-A-COMPARATIVE-STUDY-OF-SOUTHERN-THAILAND-AND-MALAYSIAN-VERSIONS.pdf#page=109. Accessed 11 Sep 2023

Cui C, Shaari N (2023) Exploring fashion geometric pattern design process using a semiotic method. Stud Media Commun 11(6):63–71. https://doi.org/10.11114/smc.v11i6.6095

Daniels H (2012) Institutional culture, social interaction and learning. Learn Cult Soc Interact 1(1):2–11. https://doi.org/10.1016/j.lcsi.2012.02.001

Davidsson P (1995) Culture, structure and regional levels of entrepreneurship. Entrep Reg Dev 7(1):41–62. https://doi.org/10.1080/08985629500000003

de FSM Russo R, Camanho R (2015) Criteria in AHP: a systematic review of literature. Procedia Comput Sci 55:1123–1132. https://doi.org/10.1016/j.procs.2015.07.081kl

Farshid Nik F (2020) Analysis of the semantic layers of the symbol of. Sociol Art Lit 12(1):15–43. https://doi.org/10.22059/JSAL.2020.78611

Geertz C, Wrobel F (1989) *A interpretação das culturas*. LTC — Livros Técnicos e Científicos Editora S.A

Hall ET (1976) Beyond culture. Garden City

Hall S (2007) Encoding and decoding in the television discourse. CCCS selected working papers. Routledge, pp 402–414

Higgins J (2007) Institutional culture as keyword. Rev High Educ South Afr Sel Themes 97:122

Hocart AM (1929) Lau Islands, Fiji. Bernice P. Bishop Museum, 62, p 240

Holdcroft D (1991) Saussure: signs, system and arbitrariness. Cambridge University Press

Hurn BJ, Tomalin B, Hurn BJ, Tomalin B (2013) What is cross-cultural communication? Palgrave Macmillan UK, pp 1–19

Ji HH (2011) Exploration of Pierce's semiotic thought (Doctoral dissertation, Nanjing Normal University). Avaliable at https://kns.cnki.net/kcms/detail/detail.aspx?FileName=1011187560.nh&DbName=CDFD2011. Accessed 15 Dec 2023
Jiyu R (2010) The characteristics of Chinese Buddhism. Contemp Chin Thought 41(4):38–46. https://doi.org/10.2753/CSP1097-1467410403
Karahanna E, Evaristo JR, Srite M (2005) Levels of culture and individual behavior: an investigative perspective. J Glob Inf Manag 13(2):1–20. https://doi.org/10.4018/jgim.2005040101
Liu X (2008) Daoism (I): Lao Zi and the Dao-De-Jing. The Routledge history of Chinese philosophy. Routledge, pp 221–248
Lizardo O (2011) Pierre Bourdieu as a post-cultural theorist. Cultural Sociol. 5(1):25–44. https://doi.org/10.1177/1749975510389714
Macauley D (Ed.) (2010) Elemental philosophy: earth, air, fire, and water as environmental ideas. Suny Press
Maguth BM, Wu G (2020) What is the difference between the Chinese dragon and its depiction in the west? In inquiry-based global learning in the K–12 social studies classroom. Routledge, pp 27–43
Mechanic D (1986) The concept of illness behaviour: culture, situation and personal predisposition1. Psychol Med 16(1):1–7. https://doi.org/10.1017/S0033291700002476
Moonkham P (2021) Ethnohistorical archaeology and the mythscape of the Naga in the Chiang Saen Basin, Thailand. TRaNS Trans Reg Natl Stud Southeast Asia 9(2):185–202. https://doi.org/10.1017/trn.2021.3
Morgan D (2010) Religion and material culture. The Matter of Belief
Nadezhda S (2022) NINE OFFSPRING OF CHINESE DRAGON: THE ORIGIN AND CULTURAL IMPACT. Int J Prof Sci 1:16–24. Available at http://scipro.ru/article/PS_01_2022.pdf. Accessed 25 Feb 2023
Ossadnik W, Lange O (1999) AHP-based evaluation of AHP-software. Eur J Oper Res. 118(3):578–588. https://doi.org/10.1016/S0377-2217(98)00321-X
Paivio A (1991) Dual coding theory: retrospect and current status. Can J Psychol/Rev Can Psychol 45(3):255
Pattaraporn JPJ (2024) Naga. Available at https://www.pinterest.com/pin/231372499600636980/. Accessed 25 Aug 2023
Peirce CS (1991) Peirce on signs: writings on semiotic. UNC Press Books
Peng L (2010) A study on the concept and design of hybrid character-centered the "Dragon's Nine Sons". J Integr Des Res 9(1):45–58. https://doi.org/10.21195/jidr.2010.9.1.003
Pintong S (2017) Revitalizing the fundamental elements of Thai House. Doctoral dissertation, Silpakorn University
Podvezko V (2009) Application of AHP technique. J. Bus. Econ. Manag. 2:181–189
Ranjan DKS, Zhou CC (2011) The Chinese dragon concept as a spiritual force of the masses. Sabaragamuwa Univ J 9(1). https://doi.org/10.4038/suslj.v9i1.3735
Robinson R, Sinha V (2010) South and Southeast Asia. In Religious studies. Routledge, pp 138–170
Santamaria L (2023) Seeing the invisible: revisiting the value of critical tools in design research for social change. In The Routledge companion to design research. Routledge, pp 415–428
Shelestiuk HV (2003) Semantics of symbol. Semiotica. https://doi.org/10.1515/semi.2003.026
Spencer-Oatey H, Franklin P (2012) What is culture. A compilation Quota. GlobalPAD Core Concepts 1(22):1–21
Stamatopoulou D, Cupchik GC, Amemiya T, Hilscher M, Miyahara T (2016) A background layer in aesthetic experience: cross-cultural affective symbolism. Jpn Psychol Res 58(3):233–247. https://doi.org/10.1111/jpr.12114
Steiner HJ, Haas K (1995) Cross-cultural design: communicating in the global marketplace. Available at https://lccn.loc.gov/94062071. Accessed 25 Jun 2023
Tu PA (2007) The signification of Naga in Thai architectural and sculptural ornaments. *The Asian Scholar, 4* Available at https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=085636e07c7cb880e4295583d6a4f64ae01e5e62. Accessed 7 Feb 2023
Henten JWV (1994) Dragon myth and imperial ideology in Revelation 12–13. In *Seminar papers/Society of Biblical Literature* (Vol. 130, No. 33, pp. 496–496). Scholars Press
Volonté P (2012) Social and cultural features of fashion design in Milan. Fash. Theory 16(4):399–431. https://doi.org/10.2752/175174112X13427906403723
Walker S, Evans M, Cassidy T, Jung J, Twigger Holroyd A (2018) Design roots: culturally significant designs, products, and practices. Bloomsbury Publishing
Wen Yi-Duo (2009) Fuxikao. Shanghai Ancient Books Publishing House
White LA (1959) The concept of culture. Am Anthropol 61(2):227–251
Wu M (2006) Hofstede's cultural dimensions 30 years later: a study of Taiwan and the United States. Intercult Commun Stud 15(1):33
Yixin ZOU, Yixin ZOU, Joneurairatana E (2021) A harmonious cross-culture in costume design: case study on Chinese LONG and Thai NAGA. Doctoral dissertation, Silpakorn University. Available at http://ithesis-ir.su.ac.th/dspace/handle/123456789/2983. Accessed 19 Jul 2023
Yu D, Kou G, Xu Z, Shi S (2021) Analysis of collaboration evolution in AHP research: 1982–2018. Int J Inf Technol Decis Mak 20(01):7–36. https://doi.org/10.1142/S0219622020500406
Yuan L (2015) Cultural differences of Chinese loong and Western dragon. Stud Lit Lang 10(3):40. https://doi.org/10.3968/6673
Zhang Cziráková D (2023) Descendants of the dragon: the dragon as a symbol of Chinese national identity. Asian & African Studies (13351257), 32(1). https://doi.org/10.31577/aassav.2023.32.1.04
Zhao C, Popovic V, Lu X (2016) Designing meaningful vehicle for older users: culture, technology, and experience. In: Lloyd P, Bohemia E (eds) Future focused thinking—DRS international conference 2016, 27–30 June, Brighton, United Kingdom. https://doi.org/10.21606/drs.2016.277
Zhi Y (2022) The practice of combining chinese and english culture in fashion design in cross-cultural context. Open J Soc Sci 10(1):324–354. https://doi.org/10.4236/jss.2022.101026
Zhou, H (2012) Dragon Totem in Chinese Culture and Traditions. China & the World Cultural Exchange
Zou Y, Joneurairatana E (2020) Apply of traditional cultural symbols into fashion design based on Cross-cultural communication. In E3S web of conferences, vol 179. E3S Web of Conferences, p 02081. https://doi.org/10.1051/e3sconf/202017902081
Zou Y, Joneurairatana E (2020) Fashion design based on cross-cultural communication. In Advances in physical, social & occupational ergonomics: proceedings of the AHFE 2020 virtual conferences on physical ergonomics and human factors, social & occupational ergonomics and cross-cultural decision making, July 16–20, 2020, USA. Springer International Publishing, pp 568–573
Zou Y, Pintong S, Shen T, Luh DB (2022) Evaluation and trend of fashion design research: visualization analysis based on CiteSpace. Fash. Text. 9(1):45. https://doi.org/10.1186/s40691-022-00316-6

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Author contributions

YXZ conceived the ideas, investigation design, data analyzation, interpretation of the results, drafted and edited the manuscript. CZ contributed part of conception of the study, manuscript reviewing, and revising, including the structure adjustment and figures fixing. PC performed part of conception of the study and manuscript revisions, and oversight responsibility for the research activity planning and execution. DBL provided continuous support and helped perform the analysis with constructive discussions.

Competing interests

The authors declare no competing interests.

Ethical approval

The research interview and methodology were examined, approved, and endorsed by the Science and Technology Ethics Committee of Guangdong University of Technology. The ethical approval number is GDUTXS2023238. The study meets the requirements of the National Statement on Ethical Conduct in Human Research (2007). The procedures used in this study adhere to the tents of the declaration of Helsinki.

Informed consent

Before participating in the study, all participants were required to sign the informed consent form. This informed consent form provides an overview of the study's purpose, process, and methodology, including details on the data collection method (i.e., audio-recorded interviews) and the process for data protection. It also specifies the code approved by the ethical review board for the project and provides contact information for a tutor who can be reached at any time. Only the participants who sign the informed consent form can participate in this interview.

Additional information

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