



Digital Representation of Social Structures and Spatial Forms in Dunhuang Murals: A Study on the Protection and Inheritance of Cultural Heritage Based on Narrative Space Theory

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Abstract. This paper explores the digital representation of social structures and spatial forms depicted in Dunhuang murals on the basis of narrative space theory. By analysing the application of digital technology in cultural heritage protection, this study explores the limitations of traditional conservation methods and highlights how narrative space theory enables innovative, immersive, and interactive reconstructions of Dunhuang's historical and cultural context. Through digital representation, the study aims to preserve and reinterpret the rich social and spatial narratives of Dunhuang, enhancing the public's engagement and understanding of this invaluable cultural heritage.

Keywords: narrative space theory, intangible cultural heritage, tangible cultural heritage

1 Introduction

Dunhuang, the shining pearl of human civilization that integrates Eastern and Western cultures, has a rich history spanning thousands of years. The Dunhuang murals are deeply imprinted with the imprint of foreign cultural influences and traces of the collision and integration of Chinese and foreign cultures^[1]; they not only bring together broad and profound Chinese culture but also integrate Indian, Islamic, Greek and other multicultural elements to form a unique and splendid cultural landscape. Historically, many traditional buildings in China have disappeared due to wars and social unrest. However, the excavation of many murals in Dunhuang is similar to a vivid historical picture, which records in detail the rich art and culture from the Sixteen Kingdoms to the Tang and Song dynasties and provides invaluable materials for the study of Dunhuang's intangible cultural heritage. Many scholars have devoted themselves to the exploration of Dunhuang culture, and Mr. Liang Sicheng's "Buddhist Temples and Palaces in the Tang Dynasty as We Know It" opened the prelude to the study of Dunhuang architecture and Tang Dynasty architecture. Many subsequent achievements, such as

"Ancient Chinese Architecture as Seen in Dunhuang Murals" and Xiao Mo's "Dunhuang Architectural Research", have emerged, and their efforts have made indelible contributions to the cause of Dunhuang's intangible cultural heritage. Although predecessors have made remarkable achievements in the study of Dunhuang's intangible cultural heritage, several limitations remain. At present, some of the intangible cultural heritage protection paths of Dunhuang focus too much on material protection and symbol appropriation, ignoring the comprehensive inheritance of the rich connotation of intangible cultural heritage. Moreover, viewer experience is mostly a static viewing process, and there is a lack of dynamic interactive experience with the building. In fact, the connotation of intangible cultural heritage is extremely rich, covering many fields such as architectural technology, literature, calligraphy and painting, music, sculpture and landscape, etc., and the traditional way of focusing only on the protection of physical space can no longer fully cover the full meaning of intangible cultural heritage. Therefore, this paper chooses the theme of "Research on the Inheritance of Dunhuang Intangible Cultural Heritage Based on Narrative Space and Digital Technology", which focuses on the narrative space of place value and emotional experience and combines digital technology as a specific way to carry out research because narratives naturally run through various artistic fields involved in intangible cultural heritage, which can provide new perspectives and ways for intangible cultural heritage inheritance. The development of digital technology provides the possibility to overcome the limitations of traditional protection methods, and through the combination of the two methods, the effective inheritance of the "intangible", generational, and living social practices, conceptual expressions, and expressions of Dunhuang's intangible cultural heritage are expected to be realized. The purpose of this paper is to start from the social structure and spatial form seen in the Dunhuang murals and to contribute new strengths to the inheritance of Dunhuang's intangible cultural heritage through this innovative research method.

2 Introduction to Narrative Space Theory

In recent years, narrative space theory has become the focus of attention in many disciplines, and it integrates multidisciplinary knowledge such as literature and design, showing its unique charm and value. Many researchers have contributed wisdom to the development of narrative space theory. Gérard Genet^[2] (1930--2018), a representative of French structuralist narratology in the twentieth century, has laid a solid foundation for narrative space theory. Frederick Jameson^[3] of the United States explored the role of space in cultural narratives from the perspective of cultural criticism, broadened the research horizon of narrative space theory, and closely integrated theory with the social and cultural context. Previous studies have provided rich references for the development of narrative space theory, and scholars such as Zhu Taoxiang, Wang Zhongyan, and Wang Xiang have studied narrative space theory from different perspectives. The American scholar John Neill noted in *Body Form* (1985): "The communicative body that we have and are thinking about is the general medium of our world, history, culture, and political economy." ^[4] Narrative space theory aims to study how spatial elements

are used and the meanings they carry in various narrative texts. Narrative space has multifaceted value, and from the perspective of cultural inheritance, it provides innovative ideas for the inheritance of intangible cultural heritage. In the field of artistic creation, creative techniques are enriched. The narrative space covers a wide range of fields, such as literature, space design, and university curriculum systems, and shows strong vitality through the integration and practical application of multiple disciplines, bringing new development opportunities to many fields.

2.1 Core Concepts and Framework Narrative

Space theory integrates multidisciplinary knowledge to study the use of spatial elements in various narrative texts and the meanings they carry. Gérard Genet's analysis of narrative time and space makes people realize that narrative space is not simply a background setting but rather a key element that is closely connected to the narrative structure. Frederick Jameson starts from the perspective of cultural criticism and closely integrates narrative space theory with the sociocultural context. In the literature, space is not only a place where the story takes place but also has the functions of driving the plot, shaping the characters, and conveying the theme. Narrative space has multifaceted value and covers a wide range of aspects, including literature, spatial design (architecture, interior design, landscape design, etc.), and the university curriculum system.

2.2 Application in Cultural Heritage Research

From the perspective of cultural inheritance, narrative space theory provides innovative ideas for the inheritance of intangible cultural heritage. As a manifestation of behavior and spiritual civilization, intangible cultural heritage is highly consistent with the theory of narrative space. Through the participation of the audience, interactive narrative enhances the audience's embodied experience and self-emotional involvement in the storyline, and realizes the immersive experience in the narrative process based on the involvement forms of emotional immersion, empathy and cognitive concentration.^[5]This paper explores how narrative storylines affect the shaping of spatial belonging.^[6]Research on the spatial narrative strategy of digital interactive images for ancient buildings^[7]etc.In practical projects, narrative space theory has been brilliantly applied. For example, the "Awakening Dunhuang" exhibition in Shanghai uses dynamic multimedia technology to break the static exhibition form and show the construction history, religious connotation, social culture and life form of Dunhuang caves through the construction of virtual space so that visitors can gain an in-depth understanding of the historical context of Dunhuang culture. The renovation of some historical and cultural blocks also uses the theory of narrative space to tell the historical story of the block through spatial layout and landscape setting to enhance the cultural connotation and emotional value of the space.

3 The Social Structure of the Dunhuang Mural

As a treasure of human culture and art, Dunhuang murals carry a wealth of historical materials and provide a unique perspective for exploring the structure of ancient society. The study of Dunhuang murals is a research field with a wide range of rich contents, which requires comprehensive investigation in different fields such as musicology, art history, fine arts, history, and archaeology. ^[8]The social structure is a complex system, and in the context of the Dunhuang murals, it contains multiple levels and groups, and these elements are intertwined to jointly construct the basic framework of the society of the time.

Artisans are the direct executors of the creation of Dunhuang murals, Dunhuang grottoes, sculptures, etc., and they have exquisite skills that have been passed down from generation to generation. It has a rich history of blending diverse cultures such as the Central Plains, Indian Buddhism, Islam, and Greece, with artisans constantly evolving and perfecting their craft. In different historical periods, with their dedication and persistent pursuit of art, they presented the social characteristics and religious beliefs of the time through murals, architecture, sculptures and other means. These artisans come from all walks of life, some are folk artists, and some are laborers who devote themselves to creation for various reasons. Sponsors and venue suppliers have played a vital role in the development of Dunhuang murals. Patrons usually have deep financial resources, and they provide financial support for Dunhuang cultural creations for various purposes, such as religious beliefs and social reputation. The site provider provided space for the development of the Dunhuang Grottoes, the manufacture of sculptures, and the painting of murals. They formed a special partnership with the craftsmen, which not only guaranteed the smooth progress of the creation but also influenced the style and theme of the creation to a certain extent. Although times are different from today's partnerships, they essentially collaborate to achieve a specific goal. From the images of the Dunhuang murals, we can intuitively observe the conditions of the working people. Details such as their work scenes, clothing, and household utensils (see Figures 1 and 2) reflect the economic and cultural outlook of the society at that time. These images are important reflections of the value of Dunhuang murals, from which we can explore the blending of multiple cultures. The Dunhuang civilization was founded by many groups, including immigrants from the Central Plains, local ethnic minorities, and businesspeople.

In different social backgrounds and historical stages, Dunhuang has experienced many ups and downs. Since the establishment of the Western Han Dynasty, Dunhuang County has become an important hub for exchanges between the Central Plains and the Western Regions. During the Wei, Jin, Southern and Northern Dynasties, many wars occurred in the Central Plains, while Dunhuang was relatively stable, attracting many literati and craftsmen, and culture and art developed rapidly. During the Sui and Tang dynasties, the country was unified, the economy was prosperous, the Buddhist culture of Dunhuang reached its peak, and the creation of murals became increasingly exquisite. However, with historical changes, Dunhuang has faced challenges such as wars and natural disasters, and some murals have been destroyed.



Fig. 1. Cave 296 of the Mogao Grottoes (Northern Zhou) (Northern Zhou)



Fig. 2. Construction drawing of Cave 296 of the Mogao Grottoes (Northern Zhou).

In the larger historical framework, the Dunhuang civilization is at a key juncture of cultural exchanges along the Silk Road and is the crystallization of the integration of Eastern and Western cultures. Its value lies not only in its artistic excellence but also in the fact that it provides rich material material for the study of ancient societies. Dunhuang presents the characteristics of openness and inclusiveness, where different ethnic cultures interact and influence each other. Ordinary people are the creators and disseminators of culture, and their lives and beliefs are vividly reflected in the murals. The exchange of visits by diplomatic envoys promoted cultural exchanges and dissemination, and cultural elements from different countries and regions were integrated into the Dunhuang murals. The development of transportation and other infrastructure ensured the circulation of people and materials and provided support for the prosperity of Dunhuang culture. These groups and elements are interdependent and complementary

and together constitute Dunhuang's unique and diverse social structure, making it a shining pearl in the history of human civilization.

4 The Spatial form of Dunhuang Murals: Survival, Change and Value

The Dunhuang murals present a rich and diverse spatial structure, containing profound humanistic connotations, after years of circulation and changes, with extremely high research and protection value.

The spaces in the Dunhuang murals are rich and diverse, including physical space and psychological space. In terms of physical space, there are various forms of architecture, including palaces, temples, and houses, and different buildings show the style and craftsmanship of each historical period. The Tang Dynasty palace (Fig. 3) was built on a grand scale and has a symmetrical layout, reflecting the majesty and skill of the royal family. Mental spaces evoke the viewer's emotional experience through elements such as color and lines, such as the Elysium mural, which provides a sense of serenity and yearning. The Dunhuang murals of different periods have unique spatial construction techniques. Tang Dynasty murals are painted with exquisite techniques, focusing on a proportional perspective, and pavilion buildings present a sense of three-dimensionality and layering through line contours and color rendering.



Fig. 3. Cave 009 of Mogao Caves

Space is intimately linked to consciousness and human activity. Mural space is a reflection of the artist's consciousness and influences the viewer's consciousness. The painter integrates his understanding of religion and society into his creation, and the

viewer has different feelings depending on his personal background. Space and human activities are interdependent, and different spaces, such as palaces, temples, and dwellings, carry corresponding activities, reflecting social characteristics, class structures, and cultural customs. The spaces in the Dunhuang murals have unique placen, spiritual, and metaphorical meanings. The mural space inside the grotto creates a solemn atmosphere through layout, color, etc., and makes people feel the sacred power of religion. When Buddhism flourished, religious space was important; when society prospers and diversifies, the elements of secular space increased. From the perspective of human settlement theory, mural space reflects people's cognitive pursuit of the living environment. Understood from a systems perspective, the various spatial elements are interconnected to form a rich world. As an image material, Dunhuang murals provide a basis for scholars, such as Liang Sicheng, to understand ancient architecture and spatial construction and are valuable objects for the study of ancient society and culture.

With respect to the survival of the spatial form of the Dunhuang murals, some of the grottoes retain their original characteristics, such as the Buddha-like layout of some grottoes, and the symmetrical structure and proportional relationships are clearly visible, revealing the characteristics of the architectural space in the past. However, murals have also been damaged by many factors, such as natural factors such as wind, sand, and moisture, as well as human factors such as war and plunder, which have caused many exquisite spatial scenes to be mottled, and some details have disappeared. The Dunhuang mural space involves religion, culture and art, reflecting the spiritual pursuits and lifestyles of ancient people, and people's activities in the past were closely related to religious ceremonies. However, modern urban spaces are oriented toward efficiency and diversity, and people's behaviors are more diverse. From the perspective of narrative space theory, space and time are closely intertwined in the Dunhuang murals, and the stories of different eras are fused together through a unique layout, providing a basis for reproducing history and allowing us to peek into ancient society. Around the world, many monuments face conservation challenges similar to those of Dunhuang murals, and there are cases of successful restoration. The Luxor Temple in Egypt uses digital technology combined with traditional craftsmanship to restore its grandeur to a certain extent. However, some monuments have not been well restored due to technical and financial issues. The protection and restoration of the spatial structure of Dunhuang murals requires advanced technology, scientific methods and an in-depth understanding of cultural connotations. With the development of modern technology, we are responsible for protecting our precious cultural heritage and ensuring that its historical and cultural values have been passed on for a long period of time.

5 3D Modelling, VR&AR Technology Reproduction Strategy of Dunhuang Tangible and Digital Cultural Heritage Based on Narrative Space Theory

In August 2019, General Secretary Xi Jinping pointed out in his speech at the Dunhuang Academy: "It is necessary to promote the digital return of Dunhuang testaments and other cultural relics scattered abroad through high-tech means such as digitalization and

informatization, so as to realize the digital sharing of Dunhuang's cultural and artistic resources on a global scale."^[9] To a certain extent, Dunhuang digital art continues the historical background of original Dunhuang art as a geopolitical art, and is the result of the collision and exchange between original Dunhuang art and digital art with the help of digital media.^[10] The Dunhuang murals contain a wealth of architectural and cultural information, Fan Jinshi's "permanent preservation and sustainable utilization"^[11], but traditional preservation methods have limitations; it is difficult to preserve details for a long period of time, and the murals are also at risk of fading and peeling. Therefore, the digital direction is extremely necessary and beneficial. There are a number of Dunhuang digital achievements in China, and there are also IDP projects abroad^[12]. Digitization can overcome the limitations of time and space, allow more people to appreciate the charm of Dunhuang mural architecture, record information with high precision, achieve permanent preservation, and provide reliable information for research and display. From the perspective of narrative space, rather than just focusing on a single product, increasing interactive functions so that space and viewers can react to each other's dynamic activities rather than just static viewers and viewers. Starting from the social structure and spatial form, the former presents the social style of Dunhuang in ancient times, a pluralistic and international social atmosphere. The spatial form lies in the material space carrier of people's lives at the origin of Dunhuang culture and connects to the past through the similarity of space. For example, in terms of games, an adventure game is developed with the background of Dunhuang mural architecture, players can shuttle through architectural scenes of different eras, such as the palace city of the Tang Dynasty and the Wubao Mansion of the Northern Wei Dynasty, through interaction to understand the architectural culture and the connotation of humanity in the social background at that time, combined with VR and AR technology, so that the audience can be immersed in the scene and obtain an immersive experience. The museum adopts a digital approach, through modelling to present the building, craftsmen, etc., as a three-dimensional model, the audience can freely zoom and rotate on the electronic device to observe the details, combine with touch screen interactive technology, and click on the components to obtain a detailed introduction. From the perspective of montage and narrative theory, the setting of digital scenes integrates different architectural scenes to build a story-based digital experience, from the Sixteen Kingdoms to the present, allowing the audience not only to appreciate the beauty of the architecture but also to understand the historical and cultural logic behind it.

6 Conclusion

With respect to the inheritance of Dunhuang cultural heritage, traditional preservation methods have been limited in the past, and digitization has become inevitable. It can not only permanently preserve the information of murals, sculptures, buildings, etc., but also overcome the limitations of time and space through relevant materials and architectural scenarios. Digital Dunhuang art can be narrated in a way based on historical

materials, excavates cultural connotations, transforms the audience from passive acceptance to active participation, and deeply integrates into the cultural narrative, bringing new opportunities for the inheritance and dissemination of Dunhuang culture.

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