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WHY WOMEN'S POSITIVE SPATIAL EXPRESSION IS MISSING IN CHINESE FEMALE FILMS BASED ON SPATIAL PERSPECTIVE

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Abstract: Amid the progression of Chinese cinema, female films have embraced an undeniable position, yet the challenge in the development of such films persists over the century-long history of Chinese cinema. Whether in terms of female film creators or films embodying a female perspective, both find themselves in a collective state of “absence.” The proliferation of films with female themes has been notable, with select male directors now embracing a female perspective in their craft, delving into themes that resonate with the challenges confronted by women. Conversely, female directors are dedicated to conveying a distinctive female experience and illuminating feminine consciousness through their cinematic endeavors. Such films are transitioning from their initial niche status to becoming integral components of the mainstream cinematic landscape. Albeit with various positive initiatives aimed at promoting gender equality in Chinese society, female films continue to bear the imprint of patriarchy in their conception. Customarily, they merely exploit the veneer of feminine consciousness without genuinely affording women a substantial discursive space. This study circumstantiates this phenomenon by shedding light on spatial representation and expression issues in Chinese female films spanning the past decade. This research centers on the analysis of three films — *Love Education* (directed by Sylvia Chang, 2017), *Send Me to the Clouds* (directed by Teng Congcong, 2019), and *Lost in the Stars* (directed by Cui Rui and Liu Xiang, 2023) — serving as case studies to elucidate the paradox of space prevalent in Chinese female films. Comprehending and rectifying these issues are pivotal for the future creation and advancement of films within this genre. This study is firmly anchored in theoretical frameworks such as Michel Foucault’s Discipline Theory, Laura’s gaze theory, Kaplan’s feminist film theory, and Judith’s gender performativity theory. Capitalizing on these theoretical lenses, the analysis probes into the social space inhabited by women, the interplay of “gaze” and “anti-gaze” within spatial contexts, psychological spaces, and the realm of gender performativity evident in the three specifically chosen Chinese female films. The scrutiny of spatial dimensions in the examined trio of films reveals a paradox in the representation and expression of space within Chinese female films. Despite purportedly adopting a “female perspective,” a predominant trend is observed wherein these works tend to attribute negative spatial connotations to women. Such representations include themes of oppression, susceptibility to the gaze, encounters with death, fear, and confinement. These films often fall short of liberating themselves from male influence, failing to provide affirmative spatial portrayals for women or aligning closely with the contemporary socio-cultural realities faced by women. As such, they miss the mark in presenting the most authentic facets of the female experience. This study bears significance for future formulation, advancement, and breakthroughs in Chinese female films.

Keywords: Films; Female theme; Female space; Paradox of space

1 INTRODUCTION

The rapid societal transformations and evolving gender perspectives have positioned film as a pivotal medium for articulating female subjectivity, social relationships, and gender-related issues. In the 2010s, films dominated by female characters, such as *Caught in the Web* (2012), *Feng Shui* (2012), *I Am Not Madame Bovary* (2016), and *Soulmate* (2016), have emerged. Nevertheless, the market share of most of these films remains relatively limited. In 2017, the film *Angels Wear White* (2017), helmed by female filmmaker Vivian Qu, made a significant impact by earning a nomination for the Golden Lion at the Venice Film Festival. It garnered widespread acclaim both domestically and internationally, with its thematic choices and narrative perspective aligning more closely with female consciousness. Also in the same year, the film *Love Education* (2017), directed by female filmmaker Sylvia Chang, was released, portraying the pursuits and understandings of love and family across different generations of women. In 2018, a batch of low-budget films with female themes sprang up in China, exemplified by *Lost, Found* (2018). Since 2019, films within the realm of art cinema, centering on female themes, have exhibited a more diverse trajectory. Noteworthy examples encompass *Send Me to the Clouds* (2019), *Spring Tide* (2019), *Balloon* (2019), and *The Crossing* (2019), all delving into multifaceted aspects of women’s issues. Particularly remarkable is *Send Me to the Clouds*, starring Yao Chen, which directly confronts female desire and pleasure, deviating from the conventional portrayal of women enduring hardships and marking a significant advancement for mainland Chinese cinema in this genre. In 2021, during the Chinese Spring Festival holidays, *Hi, Mom* (2021) stood out in the Mandarin-language film market, historically dominated by male-centric productions. This accomplishment signals a new era for female films in the industry. Subsequently, the film *Sister* (2021) emerged as another blockbuster. In June 2023, the film *Lost in the Stars* was

released. Despite encountering various logical issues in the narrative, accentuated by numerous plot twists, the cumulative box office in mainland China raked in 3 billion yuan within 18 days of its release, securing a position in the top ten global box office rankings for 2023. Marketed with slogans such as “female perspective and female theme” and “girls help girls,” the film successfully caught the eyes of a sizable female audience. However, when scrutinizing Chinese female films as a collective entity, a homogeneous phenomenon persists, and they have yet to authentically capture the nuanced survival and mental states of women from a genuinely female perspective.

Drawing upon the preceding reflections, this paper revolves around three films, namely — *Love Education* (2017), *Send Me to the Clouds* (2019), and *Lost in the Stars* (2023) — as its primary research subjects. Concentrating on the spatial representations within these three female-themed films, it conducts a thorough analysis of the film texts, scrutinizing the portrayal of space and dissecting pivotal scenes. To commence with, this paper defines females and female-oriented films through a feminist theoretical perspective. Subsequently, it employs Foucault’s discipline theory to analyze the social spaces occupied by women in these films [1]. Further, it capitalizes on Laura’s gaze theory to scrutinize the dynamics of “gaze” and “anti-gaze” within the spatial context of the films [2]. Additionally, it applies Judith’s gender performativity theory to dissect the gender performativity of the characters within the spatial realm [3].

This study plunges into the exploration of social space, the dynamics of “gaze” and “anti-gaze,” psychological space, and the gender performativity space of characters in three films. Its objective is to tackle several questions: how do contemporary Chinese female films address the issue of female space? What are the similarities and differences in the process of spatial expression and representation in female films? Through this investigation, a noteworthy finding emerges—the deficiency or absence of expression concerning female space within this genre of films. The overarching goal of female films is to construct a meaningful structure for female discourse, endeavoring to break free from the discourse predominantly shaped by male perspectives and create a genuine space for female existence. The central question revolves around whether Chinese female films are custom-made to provide a liberated space for female discourse or if they serve as a “hollow signifier” within the patriarchal order. The term “hollow signifier” emanates from Dai’s analysis of revolutionary and agrarian-themed films in the first seventeen years after the founding of the People’s Republic of China. Dai pointed out that “on the discursive level, ‘women’ are portrayed as an invisible and suppressed identity, simultaneously representing a pivotal yet conspicuous ‘hollow signifier.’ [4]” Through this research, it was revealed that Chinese female films present female space as lacking. This paradoxical finding prompts an exploration of how to positively articulate female space, rendering it openness, inclusiveness, and diversity. This process involves fully opening up and embracing one’s true self in the gaze of the “other.” This endeavor would epitomize a crucial step for innovation and breakthroughs in Chinese female films, signifying a key to gaining new significance in the contemporary era.

This research endeavors to offer insights and references for the development of Chinese female films, aspiring to explore novel dimensions within this genre. The objective is to catalyze the creation of works that authentically capture female consciousness and depict the genuine lived experiences of women. Furthermore, this research strives to contribute fresh perspectives and approaches to the examination of spaces in Chinese female films.

2 FEMALES, SPACE, AND FILM REPRESENTATION

2.1 Female Film

The term “Woman’s Film” was coined in the 1970s by American feminist film critic Haskell [5]. In her work *From Reverence to Rape: The Treatment of Women in the Movies*, Haskell observed [5]: In the thirties and forties (1930s and 1940s), the heyday of the “woman’s film” was as regular an item in studio production as the crime melodramas or Westerns. Like any routine genre, it was subject to its highs and lows, and ranged from films that adhered safely to the formulae of escapist fantasy, films that were subversive only “between the lines” and in retrospect, and the rare few that used the conventions to undermine them. At the lowest level, as soap opera, the “woman’s film” fills a masturbatory need; it is soft-core emotional porn for the frustrated housewife. Haskell contended that a term like “woman’s film” was summarily used to dismiss certain films [5], with no further need on the part of the critic to make distinctions and explore the genre, suggesting some of the reasons for this misery. In the woman’s film, the woman—a woman—is at the center of the universe. Judith Mayne [3], a feminist film scholar at Ohio State University, delineated two categories of women’s films. The first type is tailored for female audiences, primarily catering to women’s emotional needs. This category, notably prevalent in Hollywood during the 1930s to 1950s, includes popular melodramas or “Weepies” designed to satisfy women’s emotional outlets. Interestingly, these films were largely directed by men. The second type is classified based on the creators, specifically films directed by women. Within this category, Mayne identifies four subtypes: women-centric films that dominate the system, films expressing a female mode, women-centric documentaries, and experimental films that blend avant-garde forms with feminist political perspectives.

In his work, *The Chronology of Women’s Films*, Chinese scholar Ying emphasizes that the term “women’s film” extends beyond movies directed by women or featuring women as main characters [6]. Rather, its accurate definition should encompass films, videos, DV productions, and multimedia experimental works directed by women, characterized by a distinct female perspective and explicit awareness of women’s issues. Cultural critic Dai [7], in *Invisible Women: Women and Women’s Films in Contemporary Chinese Cinema*, posits that “women’s films” are creations by women, primarily portraying women and expressing the film’s connotations from a feminist viewpoint. An ongoing debate within Chinese theoretical circles ensues around the definition of women’s films. Scholar Wei contends that in the West

[8], “women’s films” are closely tied to the feminist movement, intending to shape idealized female images by portraying women’s lives and rejecting the objectification of women. On the other hand, Wan argues that women’s films ought to be directed by women [9], revolve around women’s lives, and approach filmmaking from a female perspective. Scholars Li and Xiu contend that women’s films should exclusively focus on the concept of women’s consciousness [10], which includes advocating for gender equality, liberating female images from the male gaze, and narrating women’s own destinies, values, and psychological characteristics. However, researcher Jin contends that [11], despite ongoing definitional debates, a noticeable consensus has emerged—namely, the portrayal of women’s consciousness from a distinctly female perspective. The 1980s film *Army Nurse* (1985) marked significant progress by gradually portraying the struggles of women when their desires clashed with the responsibilities they carried. Hence, it is apparent that female desires have become a crucial aspect of portraying women’s consciousness in women’s films since the 1980s.

This study defines “female films” as works primarily centered around women, delving into their lives and destinies. These films contribute to a broadened understanding of the world from a distinctly female perspective and present novel images of women. The research is confined to the past decade, with a specific focus on films featuring female protagonists and themes revolving around women. The selected samples for this study encompass *Love Education* (2017), *Send Me to the Clouds* (2019), and *Lost in the Stars* (2023).

2.2 Space and Film

The space theory emerged in the Western world during the mid to late 20th century. According to Henry Lefebvre and Michel Foucault, space and society are closely related. Every society will produce its own space, which, in turn, implies the accommodation and cover-up of social relations. The discussion of space and gender is the basic content of feminist geography, representing the high consistency of the space theory and feminism. Massey, a British scholar, contended that “a gendered socio-spatial structure is male-dominated.” [12].

Film is a comprehensive art that integrates time and space, wherein space plays a vital role. Marcel [12], a film theorist, argued: “We can discuss the film space, which refers solely to the spatial dimensions within the film, also known as the space of plot-expansion and the space of the drama world.” In his view, “film space” is “space in the film,” and “space in the film” is “space in the drama world”. In fact, they correspond to three different levels of spatial concepts and cannot be equated. However, the three concepts can respectively correspond to the conceptual meanings of “film space,” “film narrative space,” and “story space” mentioned in this paper or can be seen as the combination of each shot space (the space recorded by the shot) in the film. It is not difficult to find that most researchers analyze the film space from the perspective of audio-visual language. Furthermore, Foucault analyzed the unique social space of prison in *Discipline And Punish* [1]. He argued that imprisonment has had two functions since the beginning of the 19th century: deprivation of personal freedom and technical transformation of individuals. Prison is a typical closed space. The French philosopher Henri especially emphasized the proposition of “space. [13]” His thinking on space is based on three dimensions of space: spatial perception, spatial imagination, and spatial experience. After absorbing the essence of Marxist philosophy, he put forward the concept of “the production of space.” The “space” in “the production of space” includes three levels, namely, spatial practice, representations of space, and representational spaces. Lefebvre defined space from different levels, such as material, social, and spiritual, rather than deconstructing it from the single lens of film art.

2.3 Space in Chinese Female Films

Influenced by literature, the study of female space in film and television arts gradually embarked on the right track. The emergence of “female films” can be considered as an image in the mirror of females’ existential dilemma in reality, which transitioned the focus of film development from females’ consciousness to their self-identity, gender diversity, and subjective needs. In the film, *Peacock*, released in 2005, Director Gu Changwei depicts the survival activities of females in a specific era through the construction of geographical, domestic, and spiritual spaces. The elder sister, Gao Weihong, is a prominent female symbol in the film. At the beginning of the film, a young woman (Gao Weihong) is seen attentively playing the accordion in a narrow and crowded corridor. Next to her, the water in the kettle on the stove has boiled for a long time, yet she only gives a sidelong glance and continues playing the accordion. The beautiful melody of the accordion is in sharp contrast with the mundanity of the surroundings. This attests to the fact that Gao is a woman who is a romantic down deep but cannot break free from the shackles of reality. The narrow and crowded corridor is transformed into a tiny kitchen, which is regarded as the living space of females. It not only reflects the triviality of family life itself but also indicates the subordinate status of females in the family. She is eager to break through the restraints but is suppressed by patriarchy. The claustrophobic space in the frame reveals the tremendous physical and mental oppression of females.

After the release of the female-themed film *Sister* in April 2021, several sensitive topics have leaped to the headlines, such as “bias for daughters,” “the eldest sister acting as a mother,” “the family of origin,” and “the brother-supporting demon,” hitting a great number of females’ pain points. The film attempts to explore females’ current living conditions, seeking the possibility of expanding their living space. However, females’ realistic dilemma still returns to its original contradictory state in the end. An Ran, the sister in the film, is forbidden by her father to wear skirts as a child. Instead of choosing her favorite major, clinical medicine, she is compelled to study nursing. Her family changes her life against

her will, only because she is a girl. The appearance design of the sister, An Ran, in the film also embodies her boyishness. With short hair and simple striped or plain short-sleeved tops, often paired with pants, a neutral and handsome “tomboy” image is presented in front of the audience. The image the sister portrays is full of masculine qualities. On the one hand, her neutral dressing style reflects her tougher and rebellious personality; on the other hand, it also implies her inability to fully display her female identity due to the influence of social and family environments. Only through the camouflage of external image can she gain recognition from the outside world. The film dissolves the subjectivity of the elder sister from the very beginning, evidenced by its title, “Sister.” While the identity of “sister” constitutes the narrative subject and narrative mode of the film, both focus on the functionality of this identity within the family. The patriarchal society constantly squeezes the living space that An Ran strives for through self-awakening, and her independence as an individual person has never been truly recognized. Moreover, the aunt in the film stands in opposition to An Ran, creating a space of “gaze” and “anti-gaze” between the two females. The aunt’s character represents three major identities: mother, wife, and elder sister. Behind these identities, one can glimpse all her responsibilities as a traditional Chinese female. Unlike An Ran, she devotes all her personal feelings to her family, enduring hardships without complaint. In *An Ran*, she sees her own shadow—a woman who wants to go to Russia but cannot fulfill her aspirations due to family obligations. Accordingly, her attitude transforms from resignedly persuading An Ran “You are the elder sister,” into “You must stand on your own feet in the future,” and “Nesting dolls don’t have to fit into the same set...” She no longer uses her own experiences and traditional moral standards to regulate her niece. However, it seems that An Ran’s final compromise still falls into the old ways of her aunt, albeit with a sense of rebellion and independence. Yin Ruoxin and You Xiaoying, the female director and screenwriter of the film, aim to shift the story’s focus to critique the notions of “male superiority” and “bias for daughters” in Chinese traditional culture. They emphasize that females have the right to pursue independence and realize self-worth. However, despite their efforts to convey concepts of “fairness” and “support” for women, their expression appears hesitant and filled with ambiguity in creation, failing to provide females space, especially real independent space. At the end of the film, An Ran ultimately succumbs to the recognition of patriarchy. She refuses to sign the adoption agreement for her younger brother and leaves the adoption family with him.

From the analysis of these two films, it is apparent that Chinese female films often fail to provide a correct identity to modern females, let alone foster a deep reflection on gender culture and consciousness. The majority of female-themed films still focus narrowly on discussing how patriarchy squeezes females’ space.

2.4 Inadequacies of Existing Research

2.4.1 Limited research on the intersection of females and space in films

Through the above-mentioned literature, it is evident that Chinese scholars’ research on female films can be roughly divided into the following three veins: Firstly, they study the development of female consciousness in female films and investigate the deeper underlying social problems. Secondly, they scrutinize female directors, aiming to showcase different female living conditions by taking a female perspective. Thirdly, they conducted research on the transformation of female figures so as to manifest the standing of females. Presently, academic researchers on female films mostly focus on the first two veins, with few studies on the space in female films and even fewer on the combination of females and space. Moreover, most of the research on film space studies camera language rather than the diversified presentation format of space, such as characters’ social and psychological space.

2.4.2 Homogeneity in the creation and research of “female films”

The creation and research of “female films” are excessively homogeneous, less diversified, and even fixated. For instance, females in Chinese films are primarily portrayed in four main archetypes: Firstly, the “Cinderella” archetype, where females are often discovered and rescued by males; Secondly, the Mulan archetype, which is often attached with a note of heroism; Thirdly, the “Pandora” archetype, portraying women as seductive and dangerous; and Lastly, the “Gaia” archetype, which often cast modern females as good mothers and devoted wives. In addition, most literature studies lay emphasis on the unflattering impressions of females being subjugated, with words like “hysteria” appearing in many descriptions of females. Besides, the non-mainstream and marginalized groups are overlooked. The existing literature tends to focus on mainstream female characters and film works while ignoring the experiences and expressions of non-mainstream and marginalized groups. This can result in insufficient research on highly skilled females from all walks of life, ethnic minority females, migrant females, sex workers, and disabled females. Future research needs to put various female figures in the crosshairs for a more comprehensive perspective.

2.4.3 Incompatibility between the theoretical research on female films and the status quo of film creation

Females have participated in film production since the birth of films, but they have been gradually excluded from the ranks of directors due to the strong male-dominated system. The emergence of feminism in the 1960s not only provided a theoretical impetus for rewriting the history of female films, but also shattered the ceiling that prevented females from participating in the film industry. Nowadays, an increasing number of female filmmakers have entered the mainstream and moved into the public view. “Taking the screening history of the ONE International Women’s Film Festival as an example, in the new production section, the proportion of female directors’ works has shown an upward trend, peaking at 78.95% compared to the initial 55.56%. Among all the films shown in the past four sessions, the total number of works produced by female directors and male directors is 52.63% and 47.37%, respectively, basically striking a balance. In the case of new films focusing on female subjects, their proportion in the screening history is also on the rise, from 42.8% and 45.7% in the first and second sessions to 50% in the fourth session.” While in the international literature,

research on Chinese female films pays more attention to the political and class nature from the perspective of traditional Chinese society and the suppressed female figures under the patriarchal system, which is mismatched with the increasing number of female filmmakers and diverse female themes.

2.4.4 Inadequate interdisciplinary cooperation

The study of females, space, and film space requires cooperation across film studies, gender studies, architecture, sociology, and cultural studies, among other disciplines. However, the current interdisciplinary cooperation is insufficient, restricting the in-depth understanding of the relationship among females, space, and film space.

2.4.5 Weak connection with viewer experience

A bunch of challenges remain to be solved through further study. These include how to build a connection between film space and viewer perception and experience, as well as how to analyze the latent space in film and the inner experiences of female subjects. Although some studies acknowledge the role of females in film production and creation, research conducted from the perspective of female viewers is underreported. Therefore, gaining insight into how female viewers perceive and interpret film space is crucial for a comprehensive understanding of the relationship between females and film space.

2.4.6 Shortage of latest theories combined with latest works

The existing literature research relies primarily on the theoretical framework of Western feminism. As time passes, the development of other theoretical perspectives and methods also plays an essential part in studying the relationship among females, space, and film space. Nonetheless, existing studies that combine the latest theory with the latest female films are exceedingly rare, resulting in a severe imbalance and mismatch between the development of female films and the application of theories.

Combining film theory, space theory, feminist theory, discourse theory, etc., this study deeply explores the space expression in Chinese female films, which involves not only the space of camera language but also the mental space of the spiritual world and the social space presented by the material world. This paper takes the space in female films as the research object and adopts the films *Love Education*, *Send Me to the Clouds*, and *Lost in the Stars* as samples to reveal the paradox existing in the creation of Chinese female films, as well as the shortage of creation regarding female space.

3 CASE STUDIES OF INFLUENTIAL FEMALE FILMS IN THE LAST DECADE

3.1 Female's Social Space

In the film *Love Education*, Zeng, the grandmother who lives in the countryside, is the original match of Yue Huiying's father, Yue Zifu. She marries him at the age of 17. After half a year, the man goes out to make a living and never comes back home again. Zeng serves her in-laws at home and remains single for decades with the so-called "chastity arch." Finally, she ends up with the body of her lover and reconciliation with herself. Zeng and Yue do not have a legal marriage contract but rather a "marriage agreement" under the traditional Chinese social system. However, because of this so-called marriage agreement, she spends her whole life secluded in the courtyard of a rural village, clinging to existence alongside the graveside in the fields. She points to her name in the family genealogy in the ancestral hall, identifying herself as a member of the Yue family for her entire life. She completes her own restraint and discipline, as well as her so-called self-mission. Traditional women are restricted by social norms, showing their obedience by sacrificing their power. Thornham [14], a professor of Media and Film Studies at the University of Sussex, UK, said in her book *Spaces of Women's Cinema* that "as critics have already retired us, these safe intervening spaces have traditionally been spaces of female imprisonment." Zeng has spent her entire life in the countryside, guarding the home she shared with Yue. For her, this is the safest and most belonging place. Ironically, it is also the space where she is imprisoned. Foucault mentioned in *Discipline and Punish* that the space inhabited by bodies under the discipline system is usually a compartmentalized unit [1]. Under the discipline of the micro-power, females' soul space is subjected to "torture," which is mainly manifested in two aspects: the lack of females' discourse power and the loss of their subject identity. The historical context of discipline is that a technology that manipulated the human body emerged at that time, which was not targeted at increasing the skills of the human body or strengthening domination over the body, but aimed at establishing a relationship. Through the mechanism, the body became more useful and obedient or more useful through increased obedience. A policy of coercing the body was formed, which was a careful manipulation of various factors, postures, and behaviors of the human body. As early as the 1990s, contemporary British social scientist and geographer Massey pointed out [15], "The attempt to confine women in the domestic sphere could be seen as both a specifically spatial control and, through that, a social." Zeng follows the discipline she perceives in this self-enclosed place in the countryside, where both the body and soul are oppressed. In the film, the "chastity arch" appears multiple times as a "symbol" in different scenes and events. It seems to remind Zeng of the self-discipline and self-control over her body, implying her determination and obsession to spend her entire life waiting for a man. The invisible feudal system seems to act as a form of discipline, monitoring or controlling her behaviors. Suter et al. make an interview with Laura Mulvey [16], to use Laura's term, this technique produces an ambiguous effect in terms of the space within the house and, by extension, the garden as well. There is a kind of prison-nest effect. In a sense, the house is a prison since the women are limited to this space, bound by the confines of house and garden, if they are not to be in the position of object (controlled), as they must be in the male external realm. On the other hand, the space of the house assumes the security, intimacy, warmth, and safety of the nest; it belongs to the women and to their ways of being; they have control

over this space, as far as possible; it is a space of refuge, possibly even of “cure.” This is precisely depicted in the movie *Love Education*. Zeng’s old house resembles a prison, where she is confined. However, she also views it as the safest space, providing deep spiritual nourishment through memories shared with her husband, Yue.

The opening scenes of the movie *Send Me to the Clouds* are filled with an oppressive social atmosphere for females. Sheng Nan, the heroine, is seen riding an elevator while eating breakfast. Behind her, a couple is reading news from the phone. Sheng hears a conversation behind her: “Twenty-seven years old is the threshold for defining leftover women.” “Twenty-seven years old?” “Yes, whether you are beautiful or not, rich or not, as long as you are over twenty-seven years old and unmarried, you are all categorized as ‘leftover women.’” “But for men, they are golden bachelors...” The opening dialogue of the film seems to be directed at Sheng Nan, hinting at her reaching the awkward age defined by society, which is unfriendly towards females. One time, Sheng unexpectedly discovers she has ovarian cancer. As female reproductive organs, ovaries are a symbol of female identity. The expectation of society towards females is to bear children, Canadian author Margaret writes in her dystopian novel *The Handmaid’s Tale* [17]: “We are for breeding purposes. We are two-legged wombs, that’s all: sacred vessels, ambulatory chalices.” Society redefines a new identity for Sheng, and her own social space is constantly being compressed. Invisible social systems and concepts discipline and define females.

The Queen’s Gambit, directed by Scott Frank. Adapted from Walter Tevis’s novel, it infused the story with strong feminist themes. In the late 1950s, young Beth Harmon was abandoned and entrusted to an orphanage in Kentucky. She has an amazing talent for chess but is addicted to sedatives provided by the government for children. Haunted by the demons of her mind, combined with the dual role of obsession, Beth becomes an impressive, highly skilled, and charismatic outcast and is determined to break the traditional boundaries established by the world of chess dominated by males. Finally, relying on her talent, she dominates the chess world and gradually grows into an international chess grandmaster. The drama depicts the protagonist’s psychological growth through each chess game, endowing females with independent and self-focused psychological space. However, in China, it is rare to see TV dramas or films that truly provide females with psychological or positive space.

3.2 The Space of “Gaze” and “Anti-Gaze”

The “gaze” theory is an important concept in Western literary theory and cultural studies in the late 20th century, referring to a kind of scrutiny or gaze with power and desire imposed by the subject on the object. Jacques proposed in his mirror stage theory that the gaze is the condition for constructing the subject [18], and individuals establish subjectivity under the gaze of others. Sartre believed that identity comes out of the gaze [19], and humans confirm their identity attributes under each other’s gaze. He pointed out that this gaze is mutual; as we gaze at others, we are also being gazed at by others. And Foucault incorporated power mechanisms into the “gaze” theory [1], considering the gaze as an acknowledgment of a certain power system and constitutes a picture of social power. Laura examined the theory of the gaze from a feminist perspective [2]. In her article *Visual Pleasure and Narrative Cinema* published in *Screen* in 1975, she contended that the scopophilic instinct (pleasure in looking at another person as an erotic object), and, in contradistinction, ego libido (forming identification processes) act as formations and mechanisms, which this cinema has played on the image of woman as (passive) raw material for the (active) gaze of man takes the argument a step further into the structure of representation, adding a further layer demanded by the ideology of the patriarchal order as it is worked out in its favorite cinematic form—illusionistic narrative film. The argument turns again to the psychoanalytic background in that woman as representation signifies castration, inducing voyeuristic or fetishistic mechanisms to circumvent her threat.

In Laura’s view, the camera is a typical embodiment of the male gaze, and the film shots symbolize the viewpoint of the male gaze [2]. In a world featured by gender inequality, the pleasure of watching is divided into male (active) and female (passive), and the oppression of females in patriarchal society is displayed through the camera. With the passage of time, female directors have persistently emerged, and the film camera has been imbued with a female perspective. For example, in the film *Love Education*, the female director Sylvia Chang focuses the camera on women of different generations. In the film *Send Me to the Clouds*, the female director, Teng Congcong, focuses the camera on the modern independent woman, Shen Nan. However, even in films shot from a female perspective, they are still not spared patriarchy in terms of character portrayals and plot settings.

In *Send Me to the Clouds*, the protagonist, Shen Nan and her mother, Liang Meizhi, are two extreme female figures, forming a sharp contrast. Liang marries Shen’s father at a young age and depends on him for her livelihood. Upon learning of her husband’s affair, she is at a loss and seeks shelter with Shen, taking her as a last resort. However, Shen does not agree with her mother’s way of life and scoffs at the “leftover women” theory. Her name, “Sheng Nan” is the most direct metaphor. In Chinese, “Sheng Nan” is a homophone for “prevailing over men,” indicating that her father, who has no sons, raises her as if she were a son to balance his psychological loss of not having a son. Since he doesn’t have a son, he hopes his daughter will be even more like a son than an actual son. There is a small detail in the film: When the father sees his daughter with injuries on her face, instead of showing concern for her, he asks, “Did you have a fight with someone? Did you win or lose?” When he hears she wins, he immediately says, “That’s good.” This conversation is more like one between a father and son rather than between a father and daughter. Sheng Nan’s capable and independent temperament is inevitably associated with her family’s expectations. Additionally, the “Sheng” in Sheng Nan’s name also resonates with the “sheng” in “leftover women.” In Internet slang, “leftover women” refers to women who have passed the generally accepted age for marriage but are still unmarried. According to the definition of

Language Situation in China, leftover women are those who are 27 years old or older, with high education and income yet still have not found an ideal marriage partner. Labeling elite women like Sheng Nan as “leftover women” is actually stigmatizing and derogatory toward women. The implied meaning behind the father’s naming of his daughter reflects a paradox and dilemma in the family’s expectations for Sheng Nan. On one hand, they hope she can “excel men” and be stronger than men. But on the other hand, they also believe that if she is stronger than men, no one will marry her. Sheng Nan appears in a neutral outfit. As a female journalist, she investigates the truth alone in the wilderness, carrying a camera on her back. She smokes, curses, and squats by the roadside to eat heartily. These images undoubtedly conceal her feminine traits, thus excluding her from the category of being gazed at by males. Instead, she begins to anti-gaze males around her. As an idealist, she detests her cheating father, looks down upon Li Ping, a nouveau riche, despises Si Mao, a colleague who embraces the money-first mindset, and unravels Liu Guangming’s hypocrisy. Such characterization is a dispelling and resistance to the male gaze, preventing Sheng Nan from being the “object” of the male gaze. The fate of women being gazed at as the “object” has changed. Anti-gaze has thus become a way or means of identity writing in Chinese female films.

The male gaze theory posits that desire is always connected with gender. Influenced by traditional patriarchy, females are gazed at by the males, which transforms them into the weaker sex being stared at. Through the operation of power, societal gender roles are constructed, turning females into objectified parties. Under the pervasive gaze of patriarchal society, the construction of females’ gender status is completed. The ubiquitous gaze becomes a confederate of discipline and power, placing females within a panopticon, impossible to conceal. Even females view themselves through the lens of males; anyone can become an enforcer of such a discipline. Sheng Nan’s mother, Liang Meizhi, represents female figures shaped by the norms of the traditional patriarchal society. In her initial appearance in the film, she is driving a pink car, with fashionable curled hair, beautifully manicured hands, and pouty lips from lip surgery. She often wears white or pink clothes, maintaining her charm well into her fifties. She tells her daughter, “You’re so capable; no wonder you can’t find a boyfriend.” As an adult female, Sheng’s mother constantly views her daughter from a male perspective, representing the “male gaze.” In the film, she and Sheng create a space of “gaze” and “anti-gaze.” Despite sharing the same sex, Sheng’s mother still views her daughter from a male perspective, which proves that a large number of females are disciplined and “taught” and do not have a genuine sense of subjectivity or independent space. Although the portrayal of Sheng Nan has broken the traditional pattern of females under the male gaze, her “anti-gaze” space can be seen as dancing with shackles. As a female, she can only engage in “anti-gaze” by covering up her femininity and adopting a neutral appearance. Thus, even though reputed as a female-themed film, *Send Me to the Clouds* still does not provide women with a completely independent space. The female subject still feels ashamed to display her feminine identity and lacks confidence in it. Only when females can examine themselves from a new perspective and engage in “anti-gaze” without the need for neutral dressing, can they truly fight against a monopolistic viewpoint.

The film *Lost in the Stars* is based on a true story. Compared to the character Li Muzi, who is killed at the beginning of the film, the prototype Wang Nuanuan seems to embody a more independent and clear-headed female cognition. On June 9, 2019, Wang Nuannuan, a Chinese woman who was in the first trimester of pregnancy at the time, fell from a cliff about 34 meters high while visiting the Pha Taem National Park in Ubon Ratchatani, Thailand. She was found by a lost tourist and taken to the hospital, where she miraculously survived after rescue efforts. The one who pushed her off the cliff was her husband, Yu Xiaodong. Yu carefully orchestrated the murder to inherit Wang’s huge fortune and defraud the insurance money. In the real case, there was no so-called “girlfriend” or “girls help girls,” but Wang herself engaged in a battle of wits with her ex-husband and initiated a self-rescue plan. Faced with no surveillance, no witnesses, and a language barrier, Wang had to comply with her ex-husband to protect herself. Later, when his guard was lowered, she informed the attending doctor of the truth and contacted a friend to visit her. The friend secretly recorded a conversation between Wang and her ex-husband, which became the only physical evidence of his crime. After being transferred to a general ward, she seized the opportunity provided by the hospital’s visitation policy to call the police immediately. During her time in the hospital, Wang not only had to endure physical pain but also to maintain a high level of courage and wisdom. This is a stark contrast to the portrayal of the wife in the film. If the film *Lost in the Stars* had portrayed the character more closely resembling Wang, it might have been more convincing and could have better showcased female space, instead of leveraging the label of feminism and claiming to speak up for females. The film depicts a story where “a male seems to be manipulated by a female,” but in reality, it still centers around males, objectifies females, and disregards the value of females’ lives.

The film *Lost in the Stars* has been promoting itself with the slogan “Girls help girls.” It portrays a sense of sisterhood, from which perspective it can be counted as a female-themed film. However, it seems that females are more objectified in this film. The wife, Li Muzi, who dies from the very beginning, is like a prop, devoid of any value in her existence. The male protagonist, He Fei, meets his wife, Li Muzi, because of diving. Li Muzi is keen on the “underwater starry sky” and stops in front of Van Gogh’s paintings, unaware of the “appreciation” of He Fei from behind. Just as a Chinese proverb says, “The mantis that is praying on a cicada is not aware of the oriole behind.” Li Muzi is treated as his “prey,” objectified as a complete money-maker. The females portrayed in this film correspond to three stereotypes of females under the male gaze: the seductive and treacherous dragon lady—fake wife, the innocent and kind “blonde”—real wife Li Muzi, and the capable and smart career woman—lawyer Chen Mai (posed by Li’s friend Shen Man). The real and fake Li Muzi represent the two extremes of the male imagination of females: the pure ethereal beauty and the seductive dragon lady. He Fei personally orchestrates the “mysterious disappearance of his wife,” viewing his wife Li Muzi from the male gaze under the patriarchy. However, as someone from the lower class, He lacks the capital to “gaze” Li. Hence,

he conceives this “murder case” to compensate for the deficiency and leap into the upper class, little knowing that Li’s friend Shen Man (namely, lawyer Chen Mai) is also planning a big play, an “anti-gaze” drama against him. The fake wife she plants beside him has a big wavy hairstyle, a red dress, and flaming red lips. In his work *Ways of Seeing* published in 1972, British art historian John proposed that visual media objectify females by presenting them in a way that serves the heterosexual male viewers’ pleasure [20]. As Laura notes [2], the effect of this is that the beauty of the woman as object and screen space coalesce; she is no longer the bearer of the guilt but a perfect product, whose body, stylized and fragmented by close-ups is the content of the film and the direct recipient of the spectator’s look. As a female, Shen Man seems to be defining women from a male perspective as well, assuming that women dressed in this way are more attractive and aggressive. Likewise, from the perspective of the director or producer of *Lost in the Stars*, such an appearance satisfies the desires of male viewers. Consequently, the image of the fake wife is not only an objectification of women from a male perspective but also from a female perspective. When Shen Man engages in “anti-gaze” behavior towards He Fei, she is also defining and objectifying females from a male perspective. As time progresses, the image of females should not be solidified into such stereotypes as “heart-breaker,” “blonde,” or “butch;” they are diverse and intelligent. At the end of the film, Shen Man visits He Fei in prison, holding the sonogram of Li Muzi, and says, “You killed the person who loved you the most in this world,” instead of “You killed my best friend.” This statement diminishes Shen Man’s subjectivity and portrays her “anti-gaze” behavior from the point of view of He Fei, representing an “anti-gaze” space within the patriarchal framework.

Whether it’s Sheng Nan in *Send Me to the Clouds* or Shen Man in *Lost in the Stars*, they both engage in “anti-gaze” behaviors towards males in the films. However, the former is based on self-empowerment, erasing feminine qualities, while the latter is anchored on objectifying females. Neither of them completely escapes the male gaze, but represent a patriarchy hidden beneath the female perspective.

3.3 Psychological Space

The compression of female space in Chinese female films leaves little space for females, while the social space under the patriarchal system further constrains their psychological space. *Love Education*, a film depicting three female generations, introduces their love lives from an incident of “moving graves,” showcasing the persistent pursuit and diverse understandings of love and family among Chinese females in different eras. As a female director, Sylvia Chang adeptly utilizes family estrangement to explore nuanced emotions in family relationships and portrays the psychological space of characters in plain storytelling, offering audiences a glimpse into an emotive realm. In the film, she also takes on the role of Yue Huiying, a retiring female teacher, whose husband, Yin Xiaoping, is a driving school instructor. While their relationship appears mundane and interdependent, they struggle with emotional communication issues. Although Mrs. Wang is their neighbor and Yin Xiaoping’s driving student, Yue Huiying harbors suspicions about his husband because of his gentleness and patience in teaching Mrs. Wang to drive. The psychological space of middle-aged females, characterized by jealousy, fear, anxiety, and a sense of crisis, is vividly depicted in this moment. Regarding the portrayal of sexuality and the body, Director Chang employs a subtle metaphorical “spring dream.” When Yue Huiying is knocked unconscious by a ball on the school playground, she drifts into a hazy reverie in the hospital, where she encounters a towering “chimney” and a vague young man extending his hand to her. As light filters through the “chimney,” her countenance reveals a coy smile and a soft sigh. The director seems to use this “spring dream” to express a middle-aged female’s deep-seated desires, but this obscure portrayal of female psychological desire space falls short of boldly unleashing female space.

Love Education features multiple scenes set within the “home.” In this household of three, the audience can perceive the fragmentation of the home, in which the layout resembles a series of compartments. A closet divides the space into three sections, with the mother, Yue Huiying, occupying the left side, the father, Yin Xiaoping, on the right, and the daughter, Weiwei, positioned in the middle of the closet. The respective locations of the three individuals within the frame correspond to their attitudes and positions: the left symbolizes the mother’s authority, the right reflects the father’s powerlessness, and Weiwei is caught in the middle dilemma. This framing technique provides a clear visual representation of the conflicts and imbalances among the family members. Additionally, the father, mother, and daughter often appear in three distinct spaces within the same frame, such as the bedroom, kitchen, and living room. This juxtaposition of spaces within a single shot conveys the director’s underlying metaphorical emotions, highlighting the conflicts between two female generations and the family imbalance. In *Love Education*, the three family members are physically separated in the home by a closet, symbolizing a psychological space of isolation and fragmentation. Weiwei’s interactions with her mother in the city are often contentious, yet when she visits her grandmother (Yue Zengshi) in the countryside, she seems to open up, lying beside her grandmother on a bed and even introducing her boyfriend. Transitioning from the city to the countryside, Weiwei’s psychological space evolves from estrangement and resistance with her mother to intimacy and initiative with her grandmother. The rural outdoor environment fosters a degree of openness for Weiwei, while the urban space seems to constrict, reflecting her closed-off inner world in the city. In *Camille*, “Nurtured by Armand’s loving and protective attention, Marguerite blossoms in this realm, freed from all social obligations. The mise-en-scène represents liberation in the extreme long shots, showing the lovers surrounded by wide-open space in contrast to the crowded, claustrophobic city spaces. The mise-en-scène here represents the liberation of nature as constrained to the tight, claustrophobic city spaces. The extreme long shot shows the lovers surrounded by wide-open space, the unreality of the sets adding to the sense of a regression to the imaginary realm, outside of the symbolism that the public spaces represent. Armand gazes lovingly at Marguerite who now, virtuous, looks coyly down.”

Natural space expands the characters' psychological space. Director Andrea Arnold mentioned in *Red Road* (2006) that "their protagonists, he writes, 'are all metaphorically imprisoned in the "squalid" city, and long for the "freedom" and "open space" of the countryside.' Against the urban context of factories, terraced streets and alleyways, canals and dockyards which dominate the films, are set brief scenes of pleasure achieved through escape into 'a countryside invested with a sense of romance'." In "Space, Place, Spectacle: Landscape and Townscape in the 'Kitchen Sink' Film (1984)", Higson explores the importance of "place" in British social realist cinema of the late 1950s and early 1960s [21], and introduces the "country/city distinction" which permeates these films. The films are thus structured according to a set of oppositions—between urban and rural, imprisonment and escape, the everydayness and romance. But Higson suggests that this "system of differences" is also implicitly mapped onto another set of oppositions [22]: between a particular British cinematic realism characterized by location shooting and an emphasis on the contemporary and social issues, and its counterpart, the escapism of Hollywood."

Send Me to the Clouds, directed by Teng Congcong, depicts the circumstances and challenges faced by independent females in modern society. It focuses on the physical and psychological health problems of modern females and narrates their efforts to bravely confront various dilemmas in life, death, emotions, family, and society. The heroine, Sheng Nan, is an independent, progressive, and aspiring single female journalist. When she is unexpectedly diagnosed with ovarian cancer and needs 300,000 yuan for surgery, she reluctantly sets aside her journalistic aspirations and takes on a task she dislikes, leading to her quest for love and self-discovery. Accompanied by her mother, Sheng Nan embarks on a journey to interview Mr. Li. On the way, they encounter an elderly woman crying over the loss of her coffin by the river, so they look directly in that direction. This moment marks the first appearance of the coffin, which recurs four times in the film. Through the characters' perspectives, the audience is compelled to confront the realities of life and death. The film was shot in Guizhou, a mountainous and scenic region in the hinterland of southwest China, featuring scenes such as Yelang Valley in Huaxi and thousands of Miao villages. Guizhou's unique karst topography creates a sense of layered space, which is suitable for depicting personal psychological space in the film. The misty slopes and Yelang Valley become mystical and literary under the gray lens, aligning well with the film title and the temperament of the heroine. Crafted by the renowned artist Song Peilun, Yelang Valley boasts stone architecture, sculptures, and pottery art, evoking a dreamy artistic ambiance that satisfies the modern imaginations of ancient Yelang. These scenes bring the audience into a mysterious realm, crafted by nature's uncanny handiwork. In the valley veiled by clouds, the atmosphere is solemn, mirroring Sheng Nan's internal struggle to release her emotions amidst the tension of life. In the late night, she shuttles among peculiar and exaggerated facial stone pillar sculptures, stretching out her arms and breathing quickly. With the camera shaking from above to shoot the ground, the entire space contains only her and the surrounding eerie sculptures, presenting a psychological space shrouded in an atmosphere of death. At this moment, the audience seems to resonate with Sheng Nan, participates in her inner world, and senses her fear of death and the unknown life, thus witnessing a helpless female facing a fearful space of death.

Lost in the Stars employs Hitchcock-style suspense filming techniques and utilizes multiple "zoom lenses" to immerse the audience in the characters' unease. The film skillfully manipulates suspense, reversal, and psychological space to control the audience's psychological orientation. Li Muzi died in the "starry sea" that she adores, isolated far from the mainland in an iron cage deep under the sea. As she removes her oxygen mask, a sense of despair envelops the audience, plunging them into a helpless, fearful, and desperate female psychological space. The film employs numerous blue, green, and yellow interplay to express the characters' inner mania and fear, which further stimulates the audience's sensory acceptance. Van Gogh's paintings symbolize the love between He Fei and Li Muzi throughout the film. The "starry sea" at the beginning of the film derives from Van Gogh's "Starry Night," which is not only their acquaintance basis but also the abyss of Li Muzi. Their marriage scene is dreamy and bright yellow in a rice field, where He Fei confesses the gambling facts to Li Muzi and swears to quit gambling. This scene comes from Van Gogh's "Wheatfield with a Reaper," symbolizing He Fei as Li Muzi's reaper. These scenic references evoke both beauty and dread, representing a psychological space of fear and death that the audience participates in.

Yue Huiying in *Love Education*, Sheng Nan in *Send Me to the Clouds*, and Li Muzi in *Lost in the Stars* are females of different ages, personalities, and social classes, but they all convey a psychological space of fear, uncertainty, and death to the audience. The directors, under the guise of female themes, fail to endow the characters with bold and positive psychological spaces.

3.4 Gender Performance Space

"Gender performativity," first introduced by Judith in her 1990 work *Gender Trouble: Feminism and the Subversion of Identity* [15], opens a future for sex and gender with diverse possibilities. It entails the ambiguity of gender roles, where individuals may embody characters of the opposite sex. In *Send Me to Clouds*, Sheng Nan's appearance is presented to the audience in a neutral style with leather jackets, Martin boots, hefty backpacks, and hats, seemingly arming herself and isolating herself from the outside world. She engages in behaviors like smoking, cursing, disregarding posture, and casually squatting by the roadside, as the director deliberately obscures her feminine vulnerabilities. It is not until later in the film that Sheng Nan removes her hat, swaps her heavy leather shoes for ordinary sneakers, and begins to release her tough exterior, gradually embracing reality and reconciling with herself. Researcher Zhou states in *Performing China: Female Stars, Performing Culture, Visual Politics* [23], "External dress not only specifies gender but also serves to subvert existing norms." Sheng Nan's neutral dress can defy the stereotype of "femininity" and break the traditional female norms. However, this portrayal lacks a sense of female subjectivity consciousness. Film researcher Wang said in

the classic Chinese film *Ghost Love* [24], the heroine's success is achieved at the expense of "her perpetual feminine lack," leading to a paradox of "silence while expressing." "She becomes absent as a female image while presenting herself as a male image, but expressing herself as a female comes at the expense of the absence of a female discourse subject." In the film, Sheng Nan's dress in "Mulan complex" seems to center on women, yet it serves to remind them that the language and behavioral norms of our history and society are not inherently natural but rather steeped in patriarchal discourse and male-centric rules. Her neutral dress makes her performance characteristics more inclined to males in language and action, which is an external subversion for gender identification, aligning with Butler's theory of gender performativity. Judith posits that the subject is a performative construction [3], which is a "subject in the process" constructed through repeated behaviors.

In *Lost in the Stars*, the fake wife is dressed in a red gown, with her hair styled in a charming wave and her lips painted a fiery red. She embodies a seductive female image, catering to the male gaze and representing the materialized feminine ideal dictated by patriarchal norms. In contrast, Li Muzi has long black hair and solid-colored dresses, especially in her back photo of the white dress at the seaside throughout the film. It seems that only this kind of dress can shape her wealthy fair female image with simplicity and kindness. Society's patriarchal discourse demands females according to male desires, placing undue emphasis on femininity and constraining them within its logic. As Alison (2009), an American socialist feminist philosopher, states, "A woman is estranged and alienated from herself." The fake wife's dress embodies the so-called sexy image with femininity under the male gaze. Judith believes that "sex" is an objective reality [25], while "gender" emerges from social and cultural constructions. She regards gender not as the inherent subject existence and "self" but as an acquired behavior result. As she said, "Gender is in no way a stable identity or locus of agency from which variable acts proceed; rather, it is an identity tenuously constituted in time—an identity instituted through a *stylized repetition of acts*. Feminist scholar Song states [26], the significance of Judith Butler's theory (1990) lies in: "By recognizing that we are performing, we can manipulate and reconstruct the power dynamics at play, and then write it into the script of this performance." The lawyer, played by the best friend Shen Man, dresses in a waistcoat suit and always appears on the scene with motorcycle and leather clothes. The waistcoat has long been a staple of male fashion, often associated with the suave and sophisticated gentlemen seen in foreign films. Shen Man's image-building seems to effectively convince He Fei, as she adapts her appearance to fit different roles and occasions.

The two distinct female films, *Send Me to the Clouds* and *Lost in the Stars*, seem to capture the female characters of "flaming red lips" under male desires. Throughout history, the notion persists that to captivate male attention, females must adhere to a sexualized dress. However, this stylized portrayal fails to truly empower females or highlight their subjectivity. The male gaze tendencies sever the complexity and three-dimensionality that females should possess as subject individuals, thus overlooking the excellence of female independence, freedom, and wisdom. Even in today's era of rapid economic development, female identities have yet to transition from concealment to full embrace, with the "Mulan complex" of independent females persisting and society still assigning specific dress to certain female types. In *Women & Films*, Kaplan (1983) discusses Motherhood in Von Sternberg's *Blonde Venus* (1932): "Eon Sternberg was one of the directors singled out by Claire Johnston as relegating women to absence. She argues that woman as a sexual and social being is actually repressed in Von Sternberg's films, so that the man can remain at the center of the world of the film, despite the fact that it ostensibly focuses on a woman: The woman as sign, then, becomes the pseudo-center of the filmic discourse. The real opposition posed by the sign is male/non-male, which Sternberg establishes by his use of masculine clothing enveloping the image of Dietrich. This masquerade indicates the absence of man, an absence which is simultaneously negated and recuperated by man. The image of women becomes merely the trace of the exclusion and repression of women." Thus, the paradox also aligns with the concept of "empty signifier" proposed by cultural critic Dai Jinhua [9]. By analyzing revolutionary films and proletarian art films in the 17 years since the founding of New China, he points out that "on the discourse level, 'female' is not only an invisible and suppressed identity but also an important and glaring 'empty signifier.'"

In *Send Me to the Clouds* and *Lost in the Stars*, females are often depicted as subdued and concealed, and their images are shaped in dialogue with patriarchal structures rather than reflecting their internal dialogue. To truly grant meaningful representation to female films, we should create more three-dimensional and positive female characters. When it comes to films with male protagonists, well-developed and three-dimensional characters are prevalent. For example, *Infernal Affairs*, adapted from *The Departed* by Martin Scorsese (Liu Weiqiang and Mai Zhaohui, 2002), is a tale about male machination struggles. With complex identities, Liu Jianming and Chen Yongren are undercover agents for the police and the underworld respectively, and they finally decide to rediscover themselves after an intense battle. Their struggle is devoid of female influence, highlighting their bravery and tenacity and portraying them as thoroughly developed and three-dimensional male characters. It contrasts sharply with the presented space depicted in male-centric films as a pseudo-female perspective. We need more films that positively depict female space, whether it is about self-growth, entrepreneurship, or value creation, to turn space into a tool of positive and powerful expression, rather than a feeble paradox.

4 CONCLUSIONS

In the evolution of the Chinese female film, from its inception to its current ascendant, it has become an independent and stable film type. Based on Foucault's discipline theory [1], Lara Mulvey's gaze theory [2], Kaplan's feminist film theory [27], and Judith's gender performativity theory [28], this paper analyzes the female social space, "gaze" and

“anti-gaze” space, psychological space, and gender performance space in three Chinese female films: *Love Education* (2017), *Send Me to the Clouds* (2019), and *Lost in the Stars* (2023). The analysis exposes certain problems and limitations of the Chinese female film in its advancement process. Most female films capitalize on “female” as the selling point and merely pay lip service to feminism without delving into female individual physical, life, and social experiences, which contradicts female subjective consciousness. Furthermore, compared with the creation of Western female films, Chinese female films lag both in theory and practice, still in the exploration stage of feminist filmmaking overall. Based on the accumulation of Chinese traditional culture, Chinese female films tend to implicitly and passively express female demands and embody a gentle “telling” with distinct local values, which differs from the “confrontation” and “subversion” of Western female films. The resistance to patriarchy in Chinese female films cannot be portrayed as intensely or even bloodily as depicted in Western female films, resulting in Chinese female films being perceived as less pure and thorough. The female image in these films often appears as a superficial symbol and a “tool” unable to escape the stereotype of females.

Female films combine feminist philosophy and interpret female issues from a female perspective. However, in many recognized female films, the filmmakers subconsciously harbor a sense of identification with females as the “second sex” and being “gazed” by males under the background of patriarchal cultural systems. While these films may possess elements of female subjective consciousness, they also harbor a hidden paradox of anti-feminism. The presentation and expression of female space often revolve around negative themes such as gaze, death, fear, depression, and concealment of self-identity in the patriarchal society, failing to truly showcase female subjectivity and initiative. Most female characters are endowed with certain identities, yet they fail to portray truly independent female characters reflective of contemporary social realities. Inadvertently, these works often fall into a self-perpetuating paradox: while seemingly addressing female themes in which female positive space should have been presented and expressed on various levels, these works ultimately fail to escape the deeply ingrained masculine perspective. Thus, the opportunity to present female spaces becomes a means of oppressing females, showcasing a lack of space rather than empowerment. Most films lack the creation of positive, active, and empowering spaces, resulting in a type of spatial paradox.

Overall, Chinese female films fall behind in both theory and practice and are still in the exploration stage. Many works neglect the real female living conditions while promoting female subjectivity and seeking liberation and independence of consciousness. Moreover, they often remain confined by traditional viewpoints, resulting in a paradox of breakthrough and discipline, coexistence and confrontation in image construction, rebellion, and body discourse. Despite advancements in the female image in Chinese female films over the past decade, accompanied by an increase in female subjective consciousness, they still find themselves in an awkward and ambiguous position. Therefore, the development of Chinese female films requires collaborative efforts from directors, screenwriters, actors, and audiences to enhance female subjective consciousness. This entails conducting comprehensive studies and reflections on both the production and theoretical aspects of female films, challenging the prevailing male-centric film culture, breaking down gender discrimination and disparities, and striving to create a harmonious and equitable atmosphere in film art and culture. This collective effort aims to cultivate a unique female consciousness in Chinese female films.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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MULTIDIMENSIONAL ANALYSIS OF CONSUMER EXPERIENCE OF CIGARETTE PRODUCTS AND IDENTIFICATION OF KEY INFLUENCING FACTORS

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Abstract: This study constructs a multi-dimensional evaluation system based on consumer behavior theory and the principles of sensory evaluation. Using the entropy weight method to determine indicator weights, and employing correlation analysis and multiple linear regression analysis, this study explores the key factors influencing consumers' experience with cigarette products. The results indicate that the overall consumer acceptance of the tested cigarette products is high. Among specific indicators, the durability of the cigarette aroma scores the highest, while the strength of the cigarette and the stimulation of the flavor are particularly prominent, and the richness of the flavor and oral comfort receive relatively lower scores. Correlation analysis shows that each dimension of experience is significantly positively correlated with consumer satisfaction, with the strength of the cigarette and the richness of the flavor displaying the highest correlation coefficients. Regression analysis identifies five key influencing factors: the richness of the flavor, the intensity of the flavor, the strength of the cigarette, the durability of the cigarette aroma, and the stimulation of the flavor, with the durability of the cigarette aroma having the most significant impact on consumer experience. Heterogeneity analysis reveals that consumers with high experience focus more on the smoothness of inhalation and the authenticity of the aroma. Young consumers are particularly sensitive to the durability of the aroma, the richness of the flavor, and the intensity of the flavor, while middle-aged consumers place greater emphasis on the authenticity of the aroma, the strength of the cigarette, and the stimulation of the flavor. This study provides decision-making support for cigarette companies in optimizing product quality and accurately meeting consumer demands.

Keywords: Cigarette products; Consumer experience; RFM model; Entropy weight method; Influencing factors

1 INTRODUCTION

In the context of rapid global economic development, the evolution of consumer behavior patterns has profoundly impacted various industries, with the cigarette industry being particularly significant [1]. According to statistics from the National Tobacco Monopoly Administration of China in 2022, China, as the largest cigarette consumption market in the world, has an annual consumption volume of 2.58 trillion cigarettes, with a noticeable trend of slowing growth rates each year [2]. On one hand, the traditional cigarette market is shifting towards health, quality, and personalized needs. Consumers are increasingly focusing on the experience and perceived value of products when selecting cigarette brands [3], indicating that cigarette manufacturers need to conduct in-depth research on consumer experience to enhance their market competitiveness. On the other hand, with the growing public health awareness and the widespread understanding of the dangers of smoking, smoking rates in some developed countries have significantly declined, prompting cigarette manufacturers to seek new avenues for market growth. A survey targeting Chinese teenagers revealed that over 60% of respondents considered multiple dimensions in their cigarette consumption decisions, mainly involving key elements such as brand image, product quality, packaging design, and flavor characteristics [4-5].

Therefore, the core strategic issue faced by cigarette companies is how to increase market share and achieve sustainable development by enhancing consumer satisfaction and brand loyalty. In light of this, the significance of this study lies in its in-depth analysis of consumer experience with cigarette products, providing quantitative decision-making support and strategic recommendations for relevant companies, helping them maintain an advantage in a highly competitive market.

Research on consumer experience originated from the development of sensory evaluation studies in the mid-20th century. Early research paradigms primarily focused on the quantitative assessment of single sensory dimensions, conducting objective evaluations of product quality through independent sensory channels such as taste, smell, and touch [6]. As research progressed, the theory of sensory evaluation became more refined, with its core idea emphasizing a comprehensive evaluation of product quality based on consumers' sensory responses [7-8]. This laid a solid theoretical foundation for subsequent studies on consumer experience.

With the continuous advancement of consumer behavior theories, scholars began to recognize the multidimensional and complex nature of consumer experiences. Research perspectives expanded beyond the evaluation of a single sensory dimension to include multiple facets of the consumer's cognitive processes, emotional responses, and behavioral expressions [9-10]. The emergence of experience economy theory further propelled the in-depth study of consumer experience. This theory highlights the central role of experiential value creation in modern business activities,

suggesting that consumers purchase not only the functional attributes of a product, but also the unique experience value it offers during use [11]. Guided by this theory, businesses began to systematically consider the perceived experiences of consumers during product use as the core basis for optimizing product design and continuous quality improvement, facilitating a strategic shift from traditional product-oriented models to modern experience-oriented approaches.

In the field of consumer experience research related to cigarette products, early scholars primarily focused on exploring evaluation methods based on single sensory dimensions [12]. Studies have shown that individual indicators such as smoothness of taste, intensity of aroma, and ease of inhalation significantly impact consumer satisfaction [13]. However, this unidimensional evaluation approach has evident limitations in comprehensively reflecting the consumer experience. As research gradually deepened, scholars began recognizing the multidimensional and complex characteristics of consumer perceptions during the cigarette consumption process. Consequently, the focus shifted towards the theoretical construction and methodological enhancement of multidimensional evaluation systems [14-15]. Recent studies have started to delve into the inherent relationships between the sensory attributes of cigarette products, emotional experiences, and cognitive evaluations, employing advanced statistical methods such as structural equation modeling and multiple regression analysis to systematically analyze the interaction patterns among various dimensions [16-17]. With the continuous development of consumer behavior research, scholars have begun to utilize more advanced and diversified research methods to explore the complex mechanisms influencing cigarette product experiences. Multivariate statistical methods, including factor analysis, cluster analysis, and discriminant analysis, have been widely applied to accurately identify key influencing factors [18-19], providing important empirical evidence and decision support for product optimization and upgrades. Additionally, some cutting-edge studies have introduced advanced physiological measurement techniques such as eye-tracking technology, electroencephalogram monitoring, and functional magnetic resonance imaging to investigate the cognitive processing mechanisms and emotional response patterns of consumers during the cigarette consumption process from a neuroscience perspective [20-21].

Despite significant progress in evaluating consumer experience with cigarette products, existing research still has three key shortcomings: First, many studies primarily employ unidimensional evaluation methods, lacking a systematic multidimensional evaluation framework. This limitation makes it difficult to comprehensively reflect the complex perceptual experiences of consumers during smoking, which involve various factors, including the physical transfer of smoke, chemical sensory stimuli, and physiological and psychological feedback. Second, most research focuses on qualitative descriptions and simple statistical analyses, lacking a scientific mechanism for determining weights and identifying key factors. This results in an inability to accurately quantify the relative importance and impact of various indicators on consumer experience. Third, existing studies exhibit relatively weak theoretical construction, lacking a systematic indicator system based on consumer behavior theory and sensory evaluation principles. Furthermore, many studies have limited sample sizes and tend to concentrate on specific regions or brands, raising questions about the generalizability and applicability of the research findings.

Based on the current research status and existing shortcomings, this study constructs a multidimensional evaluation system for consumer experience with cigarette products, encompassing ten indicators across three dimensions: the physical transfer characteristics of smoke, the perception of chemical sensory stimuli, and physiological and psychological feedback responses. Utilizing the entropy weight method and multiple linear regression analysis, the study thoroughly investigates key factors influencing consumer experience based on data from 326 valid questionnaires. The main contributions of this research are reflected in the following three aspects:

First, this study constructs a systematic multidimensional evaluation framework for consumer experience, effectively addressing the theoretical deficiencies in existing research. It provides an important theoretical foundation and practical analytical tools for the field of consumer experience studies. Second, the innovative application of the entropy weight method to scientifically determine the weights of various indicators, along with the use of multiple linear regression analysis to accurately identify key influencing factors, successfully overcomes the methodological limitations seen in previous studies. This offers a valuable methodological approach for similar research. Third, the empirical research, based on a large sample size, significantly enhances the reliability and generalizability of the findings. It provides essential decision support for optimizing product quality in the industry and accurately meeting consumer demands. Additionally, it offers scientific and reliable references for policymakers and business managers in formulating relevant development strategies.

2 CONSTRUCTION OF THE EXPERIENCE INDICATION SYSTEM

To scientifically and systematically evaluate consumers' smoking experiences and meet their increasingly refined demands for product quality and experience, this study constructs a multidimensional evaluation indicator system for cigarette experience based on existing research [22-23]. The design of this system strictly follows the principles of sensory evaluation and closely aligns with the core sensory attributes of cigarette products and the actual perception processes of consumers. The indicators are selected from three aspects: physical inhalation, chemical sensory stimulation, and physiological and psychological feedback. This approach aims to accurately identify the key indicators influencing consumer preferences and satisfaction. The specific indicator system is shown in Table 1.

Table 1 Indicator System for Cigarette Product Experience

Dimension	Indicator	Consumer Perception Significance
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Physical Transfer of Smoke	Original Aroma	The aroma that naturally emanates when the cigarette is unlit
	Smoothness of Inhalation	Reflects the consumer's experience of inhalation resistance
	Burning Style of Cigarette experienced during	The core flavor experienced during inhalation, representing the brand's taste profile brand's taste profile
Chemical Sensory Stimulation	Purity of Aroma	Reflects the consumer's assessment of the cigarette product's purity
	Duration of Aroma	The length of time the aroma lasts, indicating the perceived value of the cigarette product
	Smoothness of Flavor	The smoothness of the taste, reflecting whether there is a scratchy feeling in the throat
	Intensity of Flavor	Reflects the consumer's subjective perception of flavor impact
	Strength of Cigarette	Reflects the consumer's physiological satisfaction the consumer's aftertaste experience
Physiological and Psychological Feedback	Stimulus of Flavor	Reflects the consumer's perception of discomfort the consumer's aftertaste experience
	Comfort of the Mouth	The overall residual feeling in the mouth, reflecting the consumer's aftertaste experience

3 METHODS

3.1 Market Research Method

The market research employs a survey questionnaire method to examine consumers' experiences with a particular brand of cigarettes during the smoking process. The specific research approach involves the following steps: Randomly select several consumers with a certain level of smoking experience from the survey location. The RFM (Recency, Frequency, Monetary) model is used to filter a high-value customer group based on relevant criteria. The selected consumers are then given the opportunity to test the specified cigarettes. Participants fill out a cigarette experience questionnaire. The questionnaire content comprises two main sections: Consumers evaluate the importance of the ten dimensions of their smoking experience. And consumers provide detailed evaluations of their experiences with the test cigarettes, including their overall satisfaction and other related aspect [24]. This method ensures that the collected data is relevant and reflective of the target consumer group's preferences and sensitivities regarding cigarette products.

3.2 Weight Determination

This study utilizes the entropy weight method to calculate the weight values for the cigarette product experience indicators, thereby accurately reflecting the importance of each indicator from the consumer's perspective. The calculation steps are as follows:

Step 1: Data standardization using the range method. To eliminate dimensional relationships between the indicators and achieve comparability, the original data is standardized using the range method. The specific formula for standardization is:

$$z_{ij} = \frac{x_{ij} - \min(x_{ij})}{\max(x_{ij}) - \min(x_{ij})} \quad (1)$$

Among them, i denotes the consumer participating in the survey, j denotes the indicator, x_{ij} is the original data of the i consumer for the j indicator, and z_{ij} is its standardized value. $\max(x_{ij})$ and $\min(x_{ij})$ represent the maximum and minimum values of the j Indicator, respectively.

Step 2: Calculate the information entropy for the j indicator

$$E_j = -\frac{1}{\ln n} \sum_{i=1}^n M_{ij} \ln M_{ij} \quad (2)$$

Where $M_{ij} = z_{ij} / \sum_{i=1}^n z_{ij}$, and n is the number of consumers who filled out the questionnaire.

Step 3: Calculate the weight of the j indicator

$$W_j = \frac{1 - E_j}{\sum_{j=1}^m (1 - E_j)} \quad (3)$$

Where m is the total number of indicators in the system.

Based on the above formulas, the weights for each indicator in this paper are as follows:

Table 2 Weight Distribution of the Cigarette Product Experience Indicator System

Dimension	Indicator	Consumer Perception Significance
Physical Transfer of Smoke	Original Aroma	0.1022
	Original Aroma	
	Smoothness of Inhalation	0.0913
	Burning Style of Cigarette experienced during	0.0995
Chemical Sensory Stimulation	Purity of Aroma	0.0879
	Duration of Aroma	0.1232
	Smoothness of Flavor	0.0896
	Intensity of Flavor	0.0946
	Strength of Cigarette	0.1142
Physiological and Psychological Feedback	Stimulus of Flavor	0.1170
	Comfort of the Mouth	0.0804

3.3 Key Factor Identification

3.3.1 Correlation analysis

Correlation analysis is used to measure the strength and direction of the linear relationship between two variables. In this paper, the Pearson correlation coefficient method is adopted to examine the correlation between consumers' attention to experiential indicators and their satisfaction, as well as the significance of these correlations. The specific calculation formula is shown in Equation (4):

$$r = \frac{\sum_{i=1}^n (X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum_{i=1}^n (X_i - \bar{X})^2} \sqrt{\sum_{i=1}^n (Y_i - \bar{Y})^2}} \quad (4)$$

where r denotes the correlation coefficient, n is the number of consumers participating in the survey, X_i (Y_i) and \bar{X} (\bar{Y}) are the sample data and their respective means.

3.3.2 Multiple linear regression analysis

Multiple linear regression analysis is used to examine the relationship between respondents' overall utility evaluation of cigarette products and their evaluation results for various experiential dimensions. This helps identify the key factors influencing the perception of cigarette smoking. The specific calculation formula is as follows:

$$Y = \beta_0 + \sum_{i=1}^{10} \beta_i X_i + \varepsilon \quad (5)$$

where Y denotes the respondent's overall utility evaluation of cigarette products, X_i represents the respondent's evaluation results for each experiential dimension, β_0 is the constant term, β_i are the regression coefficients, and ε is the random error term.

4 RESULTS

4.1 Consumer Evaluation of Cigarette Product Experience

Based on the analysis of 326 valid questionnaires, this study assigns weights to each dimension according to Table 2 and computes consumer evaluations of the test cigarette's experience, with the results illustrated in Figure 1. According to the calculated results, one consumer rated the experience score between 0 and 1, indicating a poor experience with the cigarette product. Twenty-five consumers rated their overall evaluation scores between 2 and 3, suggesting a fair experience. One hundred fifty-one consumers scored their experience between 3 and 4, indicating a good experience. Lastly, one hundred forty-nine consumers rated their overall evaluation scores between 4 and 5, reflecting a high level of acceptance for the cigarette product. Overall, more than 90% of consumers evaluated their experience with the product above 3 points, indicating a strong recognition of the product among the surveyed consumers. Additionally, the mean analysis shows that the average evaluation of the testing cigarette from the 326 valid questionnaires is 3.9859, further demonstrating high consumer satisfaction with the cigarette and indicating strong market potential for the product.

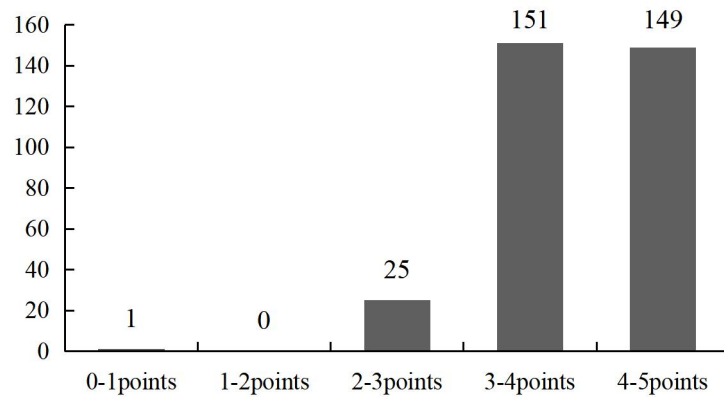


Figure 1 Evaluation of Cigarette Consumers' Experience Assessment

Next, this study further analyzes consumers' evaluation results for the experience indicators of the cigarette product, with the findings illustrated in Figure 2. According to the mean scores, four dimensions received average scores greater than 0.4, indicating that the product has gained significant recognition from testers in aspects such as “strength,” “burning style,” “persistence of aroma,” and “stimulation.” Among these, the average score for “persistence of aroma” reaches as high as 0.4922, reflecting a high level of appreciation in this area, which stands out as a notable advantage of the cigarette product. In contrast, the average scores for “smoothness of flavor” and “oral comfort” are relatively low, both below 0.35. Therefore, future improvements should focus on these two aspects to better meet consumer demands.

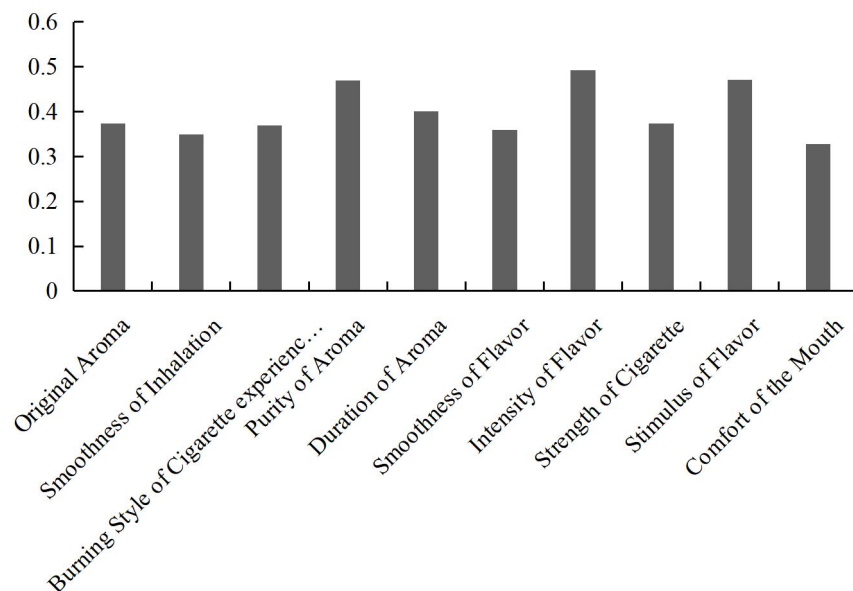


Figure 2 Mean Evaluation of Various Indicators for Cigarette Experience

In terms of the specific score distribution for each indicator, there are significant differences in the scores among the testing population (Table 3).

Regarding the “physical transmission characteristics of smoke,” respondents believe that the product excels in the aroma style when opening the box. For the “original aroma” indicator, the majority of consumers scored the cigarette product between 3 and 4 points, with 137 participants rating it, which accounts for over 60% of respondents giving a score greater than 3. This indicates a general recognition of the product's aroma intensity upon opening the box. In terms of “smoothness of inhalation,” 212 individuals rated the product's filter design above 3 points, reflecting a high level of satisfaction with the inhalation process among most consumers in this group.

For the “chemical sensory stimulation perception,” aside from the “purity of aroma” indicator, more than 100 respondents rated other indicators between 4 and 5 points, indicating satisfaction with the product's olfactory, gustatory, and integrated sensory experiences. Specifically, concerning the “burning style of the cigarette,” 261 respondents scored above 3 points, with over 30% of testers rating it between 4 and 5 points, suggesting that the core flavor of the product is well-received.

Regarding the “purity of aroma,” the majority of scores fell between 3 and 4 points, with 144 respondents indicating that they perceive the aroma purity of the product to be relatively high. However, it is noteworthy that 76 individuals rated this indicator between 2 and 3 points, suggesting that there is still room for improvement in the product's aroma purity.

In terms of “persistence of aroma,” 159 respondents and 104 respondents rated it between 3 and 4 points and 4 and 5 points, respectively, reflecting the participants' recognition of the cigarette product's aroma persistence, indicating a favorable cost-performance ratio for the product.

With regard to “smoothness of flavor,” the highest ratings were in the range of 4 to 5, with 148 respondents, accounting for more than one-third, indicating that respondents perceive the product's smoke to have a moderate smoothness in the mouth and throat, contributing to a harmonious experience. Finally, regarding “intensity of flavor,” over 80% of respondents felt that the scores for the tested product exceeded 3 points, indicating a rich flavor profile.

In terms of “physiological and psychological feedback response,” respondents' evaluations of the test product predominantly fell between 3 and 4 points, with the exception of the negative indicator “stimulation of flavor.” Specifically, regarding the “strength of the cigarette,” 155 individuals rated this indicator between 3 and 4 points, accounting for nearly 50% of all respondents. This suggests that consumers find the physiological satisfaction offered by the product to be moderate, indicating that there is still room for improvement. For the “stimulation of flavor,” over 70% of respondents rated the product below 2 points, indicating that most consumers perceive a low level of discomfort associated with the cigarette, and they are generally satisfied with its flavor profile. Regarding “oral comfort,” 151 and 107 respondents rated their experience between 3 and 4 points and 4 and 5 points, respectively. This reflects that respondents find the overall residual feeling in their mouths after experiencing the product to be quite comfortable, indicating a favorable perception of the aftertaste associated with the cigarette.

Table 3 Evaluation Results of Various Indicators for Cigarette Product Experience

Indicator	Mean	Score details for each indicator (number of people)				
		0-1	1-2	2-3	3-4	4-5
Original Aroma	0.3729	11	38	73	137	67
Smoothness of Inhalation	0.3733	4	8	102	116	96
Burning Style of Cigarette experienced during	0.4012	4	4	57	149	112
Purity of Aroma	0.3595	5	4	76	144	97
Duration of Aroma	0.4922	2	8	53	159	104
Smoothness of Flavor	0.3491	8	28	38	104	148
Intensity of Flavor	0.3699	5	7	61	152	101
Strength of Cigarette	0.4687	2	7	66	155	96
Stimulus of Flavor	0.4709	90	146	66	20	4
Comfort of the Mouth	0.3281	4	5	59	151	107

4.2 Identification of Key Influencing Factors

To identify the key determinants of perceived draw (inhalation) experience, this study first employs an indicator–utility association approach to examine the correlation between consumers' attention to each experiential attribute and its utility. Second, by specifying a utility function and estimating a linear regression model, we identify the principal drivers of the cigarette draw experience.

4.2.1 Correlation analysis

Based on 326 valid questionnaires, we first summarize respondents' overall evaluations of the test cigarette: 114 were very satisfied, 133 satisfied, 69 neutral, 6 dissatisfied, and 4 very dissatisfied. We then code these categories as numerical scores—very satisfied = 5, satisfied = 4, neutral = 3, dissatisfied = 2, and very dissatisfied = 1—and use the resulting values as the consumer utility measure for the product.

Subsequently, we apply the indicator–association analysis to examine the correlation between respondents' attention to each experiential dimension and the utility value; the results are reported in Table 4. As shown, all dimensions of cigarette quality evaluation exhibit significant positive correlations with satisfaction. In other words, consumers' attention to the “physical transmission characteristics of smoke,” “chemical sensory stimulation perception,” and “physiological and psychological feedback response” is positively associated with their satisfaction with the product. Further inspection of the correlation coefficients indicates that “strength of the cigarette” and “smoothness (mellowness) of smoke flavor” have the largest coefficients, both exceeding 0.58, implying the strongest associations with the post-draw utility level. By contrast, the coefficients for “original aroma,” “burning style of the cigarette,” and “purity of aroma” are all below 0.50, suggesting relatively weaker associations with post-draw utility.

Table 4 Results of Correlation Analysis

Dimension	Indicator	Correlation coefficient
Physical Transfer of Smoke	Original Aroma	0.398***
	Original Aroma	
	Smoothness of Inhalation	0.556***

Chemical Sensory Stimulation	Burning Style of Cigarette experienced during	0.490***
	Purity of Aroma	0.424***
	Duration of Aroma	0.533***
	Smoothness of Flavor	0.581***
	Intensity of Flavor	0.579***
Physiological and Psychological Feedback	Strength of Cigarette	0.588***
	Stimulus of Flavor	0.573***
	Comfort of the Mouth	0.516***

Note: ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively; the same applies hereafter.

4.2.2 Baseline regression results

We further estimate regressions of overall utility on respondents' ratings of each experiential dimension to identify the key determinants of the perceived draw (inhalation) experience. The results are reported in Table 5. The estimates indicate that, except for "original aroma" and "smoothness of inhalation," all coefficients are positive. Moreover, the coefficients on "persistence of aroma," "smoothness (mellowness) of smoke flavor," "intensity of flavor," "strength of the cigarette," and "stimulation of flavor" are statistically significant. This suggests that, for this cigarette product, these five dimensions constitute the principal drivers of the inhalation experience and represent the primary preference attributes guiding consumers' choice of the product.

Table 5 Key Influencing Factors of Cigarette Experience

Dimension	Indicator	Standardized coefficient	t-statistic
Physical Transfer of Smoke	Original Aroma	-0.414.	-0.97
	Original Aroma		
	Smoothness of Inhalation	-0.151	-0.22
Chemical Sensory Stimulation	Burning Style of Cigarette experienced during	1.001	1.45
	Purity of Aroma	0.400	0.86
	Duration of Aroma	1.592***	3.16
	Smoothness of Flavor	1.945***	2.77
	Intensity of Flavor	1.505**	2.49
Physiological and Psychological Feedback	Strength of Cigarette	1.074*	1.76
	Stimulus of Flavor	0.955**	2.03
	Comfort of the Mouth	1.084	1.45
Constant term		0.392*	1.77

4.2.3 Robustness checks

(1) Outlier Treatment

To ensure the robustness of the findings, we validate the baseline regression by addressing outliers. Specifically, we apply 1% winsorization at both tails to reduce the influence of extreme values. As reported in Table 6, column (1), the coefficients on the five key factors—persistence of aroma, mellowness of smoke flavor, intensity of flavor, cigarette strength, and flavor stimulation—remain positive and statistically significant, with magnitudes closely aligned with the baseline estimates. This indicates that, after mitigating the impact of outliers, the identified key influencing factors remain stable, corroborating the reliability of the conclusions.

(2) Alternative econometric specification

Given that the dependent variable, "consumer satisfaction," is bounded and may exhibit features of censoring/truncation, we further employ a Tobit model as a robustness check. The Tobit model appropriately handles dependent variables subject to lower and upper bounds, thereby avoiding the biases that ordinary least squares (OLS) can incur when applied to censored data. As shown in Table 6, column (2), the significance levels and signs of the core variables are highly consistent with the baseline regression results.

Table 6 Robustness Test

Dimension	Indicator	Outlier treatment	Tobit specification
		(1)	(2)
Physical Transfer of Smoke	Original Aroma	-0.376 (-0.90)	-0.233 (-0.38)

Chemical Sensory Stimulation	Smoothness of Inhalation	0.074 (0.11)	0.706 (0.73)
	Burning Style of Cigarette experienced during	0.871 (1.25)	1.697* (1.73)
	Purity of Aroma	0.348 (0.76)	0.738 (1.16)
	Duration of Aroma	1.527*** (3.10)	2.163*** (3.09)
	Smoothness of Flavor	1.841*** (2.66)	3.072*** (3.08)
	Intensity of Flavor	1.553** (2.56)	1.900** (2.22)
	Strength of Cigarette	1.063* (1.72)	0.849 (1.00)
	Stimulus of Flavor	1.151** (2.28)	1.348** (2.05)
	Comfort of the Mouth	0.901 (1.23)	1.663 (1.57)
	Constant term	0.390* (1.76)	-1.215*** (-3.38)

4.2.4 Heterogeneity analysis

(1) Grouping by consumer experiential level

To explore demand differences across consumers with varying levels of experiential perception, we group respondents based on their composite experiential score. Given the empirical distribution, those scoring 4 or 5 are classified as the high-experience group, while the remainder constitute the medium/low-experience group. As shown in Table 7, columns (1) and (2): For the high-experience group, “smoothness of inhalation,” “purity of aroma,” “mellowness of smoke flavor,” and “oral comfort” all exhibit significant positive effects. This indicates that high-experience consumers place greater emphasis on fine-grained quality attributes, demanding higher comfort during the draw, cleaner aroma, and a pleasant mouthfeel/aftertaste. Notably, smoothness of inhalation emerges as a core concern, reflecting their heightened sensitivity to the product’s fundamental functional attributes. By contrast, among the medium/low-experience group, the coefficients of the experiential indicators fail to reach statistical significance. This may suggest that these consumers apply more relaxed standards to experiential attributes, or that their satisfaction is more strongly influenced by other factors such as price and brand image.

(2) Grouping by consumer age

To explore the differentiated demand characteristics of consumers’ experiential perceptions of cigarette products across age cohorts, we divide the sample into three groups—youth (18–35), middle-aged (36–50), and older adults (51+)—and conduct separate regressions. As shown in Table 7, columns (3)–(5), the key experiential drivers differ markedly by age. Youth exhibit high sensitivity to core quality indicators: the coefficients on persistence of aroma, mellowness of smoke flavor, and flavor intensity are all significantly positive. This suggests that younger consumers place greater emphasis on sensory performance, with heightened requirements for aroma duration, smooth mouthfeel, and the strength of flavor impact—patterns likely tied to their pursuit of novelty and experiential quality, and a greater tendency to judge value through direct sensory cues. Middle-aged consumers display more mature and rational preference profiles. Their key drivers—purity of aroma, cigarette strength, and flavor stimulation—are all statistically significant, with cigarette strength exerting the most pronounced influence. This indicates a stronger emphasis on physiological satisfaction, potentially related to higher work pressures and a faster pace of life, alongside a concern for product stability and reliability reflected in attention to aroma purity. For older adults, none of the experiential coefficients are statistically significant. This may indicate more entrenched product preferences and lower sensitivity to fine-grained experiential attributes; alternatively, their purchase decisions may be more strongly shaped by brand loyalty, price sensitivity, or health considerations rather than purely sensory experience.

Table 7 Heterogeneity Test

Dimension	Indicator	Analysis grouped by consumer satisfaction		Analysis grouped by consumer age		
		Medium/low	High	Youth	Middle-aged	Older adult
		(1)	(2)	(3)	(4)	(5)
Physical Transfer of Smoke	Original Aroma	-0.214 (-0.29)	0.310 (0.94)	-0.031 (-0.07)	-1.337* (-1.76)	-5.658 (-1.05)

Chemical Stimulation	Sensory	Smoothness of Inhalation	0.288 (0.25)	1.127** (2.04)	-0.542 (-0.59)	1.449 (1.57)	-4.962 (-0.65)
		Burning Style of Cigarette experienced during	-0.506 (-0.45)	0.475 (0.84)	0.412 (0.51)	1.120 (0.95)	5.286 (0.73)
		Purity of Aroma	-0.035 (-0.05)	0.736* (1.83)	-0.342 (-0.63)	1.641** (2.13)	5.986 (1.00)
		Duration of Aroma	0.880 (1.25)	0.080 (0.17)	2.723*** (4.88)	0.566 (0.58)	-5.291 (-0.72)
		Smoothness of Flavor	0.662 (0.50)	1.041* (1.92)	2.436*** (2.97)	1.075 (0.92)	3.557 (0.63)
		Intensity of Flavor	-0.656 (-0.65)	0.393 (0.80)	2.205*** (3.05)	-0.274 (-0.30)	5.894 (0.75)
		Strength of Cigarette	0.812 (0.85)	0.157 (0.31)	0.323 (0.45)	3.453*** (3.27)	2.935 (0.29)
		Stimulus of Flavor	0.138 (0.15)	0.386 (1.10)	0.894 (1.56)	1.777* (1.98)	-1.982 (-0.67)
		Comfort of the Mouth	1.359 (1.01)	1.118* (1.96)	0.912 (0.95)	0.311 (0.31)	3.948 (0.59)
		Constant term		2.193*** (10.69)	0.350 (1.25)	-0.143 (-0.42)	1.339 (1.02)

5 CONCLUSIONS AND RECOMMENDATIONS

Drawing on consumer behavior theory and the principles of sensory evaluation, this study develops a multidimensional evaluation framework for the consumer experience of cigarette products, encompassing 10 indicators across three dimensions: the physical delivery characteristics of smoke, chemosensory stimulation perception, and physiological–psychological feedback responses. We determine indicator weights using the entropy weighting method and employ Pearson correlation analysis and multiple linear regression to identify the key factors influencing consumers' experiential perceptions of cigarette products.

The empirical results show that the test cigarette product achieved a high level of consumer acceptance: over 90% of consumers rated their experience above 3 points, with an average score of 3.9859. Among specific indicators, aroma persistence received the highest score; cigarette strength and flavor stimulation also performed well, whereas mellowness of smoke flavor and oral comfort scored relatively lower, indicating substantial room for improvement. Correlation analysis reveals that all experiential dimensions are significantly and positively correlated with consumer satisfaction, with the highest coefficients observed for cigarette strength and mellowness of smoke flavor. Regression analysis further identifies five key drivers—mellowness of smoke flavor, flavor intensity, cigarette strength, aroma persistence, and flavor stimulation—among which aroma persistence exerts the most significant impact on consumer experience, underscoring the importance of perceived lasting value. Heterogeneity analysis indicates that high-experience consumers place greater emphasis on fine-grained quality attributes such as smoothness of inhalation and purity of aroma; younger consumers are more sensitive to aroma persistence, mellowness, and flavor intensity; middle-aged consumers focus more on aroma purity, cigarette strength, and flavor stimulation; while older consumers' experience evaluations are relatively stable and may be more influenced by factors such as brand loyalty.

Based on the above empirical findings, this paper proposes three policy recommendations. First, optimize the configuration of core sensory indicators and build a precision-oriented system for product quality enhancement. Establish a formula-optimization mechanism centered on aroma persistence; through improvements in tobacco-leaf fermentation processes, optimization of flavoring and fragrance ratios, and innovation in filter-tip materials, extend the duration of aroma in consumer perception and enhance perceived product value. Given that cigarette strength is a key indicator of physiological satisfaction, establish a precise control system grounded in physicochemical metrics such as nicotine content and smoke nicotine yield, and configure strength differentially according to the physiological needs of distinct consumer segments. Intensify technological efforts to improve the mellowness of smoke flavor, focusing on addressing insufficient smooth mouthfeel. By optimizing the structure of tobacco raw materials, improving the cut-rag process, and adjusting rod-making parameters, reduce throat scratchiness and enhance consumer comfort. In parallel, build a sensory quality management and control system covering the entire process—from raw material procurement and production processing to quality inspection—and conduct regular consumer sensory evaluation tests to ensure stable performance on key experiential indicators.

Second, develop a multi-tiered product matrix to meet heterogeneous preference profiles for experiential attributes. The importance of specific experiential indicators varies significantly across consumer groups; firms should therefore design a tiered and categorized product-portfolio strategy. Based on flavor intensity—the core gustatory perception indicator—develop diversified product lines that span rich, light, and intermediate styles to address different needs for flavor impact. Rich-style products should reinforce intrinsic tobacco aroma and enhance flavor fullness; light-style products

should emphasize elegance and softness to reduce sensory burden; intermediate-style products should strike a balance to fit mainstream preferences. Regarding flavor stimulation, establish a classification system based on consumer tolerance and develop low-, medium-, and high-stimulation products, achieving precise control by adjusting tobacco formulations, optimizing combustion temperatures, and improving filtration technologies. Given variation in the importance of oral comfort across age and gender groups, design targeted products that emphasize aftertaste experience, employing natural plant extracts and modified filter-tip materials to improve the comfort of residual mouthfeel. Additionally, build a precision marketing system grounded in consumer profiling, using big-data analytics to identify experiential preference patterns in different market segments and to match products to demand with greater accuracy.

Finally, refine industry evaluation standards and advance the standardization of experiential assessment systems. Establish unified definitions of experiential indicators and standardized testing protocols that specify measurement standards, rating scales, and data-processing procedures, ensuring comparability and consistency of evaluation results across firms and products. Build third-party testing and certification mechanisms to regularly assess the experiential performance of mainstream market products, institute a public disclosure system for product quality information, and publish authoritative experiential evaluation reports to guide rational consumer choice. Promote the establishment of internal experiential management systems within firms, incorporating consumer experience into assessment metrics across product development, quality control, and marketing, thereby fostering a consumer-experience-oriented quality management culture. At the same time, create experiential evaluation databases and information-sharing platforms to support technological innovation and product improvement. In addition, increase R&D investment in experiential evaluation technologies, support research institutions in developing new techniques and methods in sensory evaluation, promote the shift from traditional physicochemical metrics toward a comprehensive, consumer-experience-centered evaluation paradigm, and facilitate the high-quality development of the cigarette industry.

COMPETING INTERESTS

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A DATA-DRIVEN MODEL AND METHODOLOGY FOR PREDICTING THE EFFICACY OF STRATEGIC SANCTIONS

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Abstract: The scientific rigour and precision of major strategic decisions at the national level have been demonstrated to directly impact a nation's sovereignty, economic security, and diplomatic standing. In the contemporary geopolitical landscape, characterised by the proliferation of intricate international relations, the discord between established systems and emergent demands has attained a heightened degree of visibility. This has resulted in a substantial escalation in the intricacy and ambiguity of strategic conflicts among nations. Among the various measures employed, the implementation of sanction policies directed against specific countries is of particular significance in achieving political and national security objectives. However, the factors that influence sanction policies are characterised by their multi-dimensionality and strong interdependencies (highly coupled nature). Conventional research paradigms, predicated on qualitative analysis, are progressively inadequate to satisfy the decision-making demands inherent in complex scenarios. This has given rise to a pressing need for AI technologies to construct efficient and precise analytical frameworks. The present paper proposes a deep neural network-based analytical method for the evaluation of sanction policies enacted by nations (or international organizations). The efficacy of this method is demonstrated by its ability to predict the potential outcomes of such policies, thereby providing critical information and knowledge support for the scientific formulation of national sanction strategies. The core approach involves the curation of data from extensive historical records to form quantitative indicators related to sanction policies. A deep neural network is then employed to model the intrinsic relationships between these indicators and the effects of sanctions, enabling the prediction of outcomes in new contexts and offering decision support for critical policy formulation. In conclusion, the model was trained on the Global Sanctions Database (GSDB-R3), resulting in an efficient predictive model for sanction policy effectiveness. The analysis of metrics such as accuracy and recall demonstrates the feasibility and effectiveness of the proposed method in predicting the outcomes of sanction policies.

Keywords: Artificial neural network; Strategic sanctions; Predictive analysis

1 INTRODUCTION

1.1 Research Background and Motivation

National sanctions are restrictive measures imposed by sovereign states or international organizations through targeted policies against a subject country (or its domestic entities and individuals) to achieve specific political, security, or diplomatic objectives. They are, in essence, a strategic means of exerting pressure between nations. Due to their comprehensive and profound impact, sanction policies not only directly affect various sectors of the targeted country—such as its economy, society, and livelihood—thereby triggering systemic risks, but also set off a series of chain reactions for the sanctioning parties. A case in point is the multiple rounds of sanctions imposed by Western countries on Russia in 2022, which encompassed energy, finance, investment, trade, shipping, and other domains, affecting numerous entities and individuals. As a result, Russia's revenue from oil and gas exports plummeted; several major banks were excluded from the SWIFT international payment system, hindering cross-border trade settlements for Russian enterprises and restricting the use of its foreign exchange reserves; the ruble depreciated significantly. In terms of public livelihood, the sanctions caused shortages of essential goods (e.g., medicines, electronic products), driving up domestic inflation and significantly increasing the cost of living for ordinary citizens. Therefore, accurately assessing the impact of national sanction policies is crucial for decision-makers to analyze the strategic landscape.

The scientific formulation of national sanction policies constitutes a complex systematic project. It typically requires evaluating the effects of a proposed policy after its introduction, with the core task being the prediction of its impact. Accurately forecasting the effects of one's own sanction policies can assist decision-makers in assessing the rationality of policy design, thereby facilitating optimization. Conversely, accurately predicting the effects of adversarial sanction policies enables decision-makers to better gauge the situation and devise appropriate counterstrategies.

For a long time, academic research on macro-level decision-making problems such as predicting the effects of national sanctions has relied on traditional social science methods. The core approaches include qualitative analysis and rule-based quantitative research. Qualitative analysis primarily involves historical case studies, policy document interpretation, and expert interviews—for instance, identifying key factors influencing sanctions by examining historical cases. Rule-based quantitative research, on the other hand, typically relies on domain knowledge combined with basic applied statistical models (such as logistic regression or event history analysis) to construct specific mathematical models that capture correlations between a limited set of indicators and the achievement of sanction

objectives. However, these methods have significant drawbacks: Firstly, they fail to fully exploit the knowledge embedded in massive datasets, making it difficult to integrate and analyze unstructured data such as policy documents and news announcements comprehensively. Secondly, traditional statistical analysis methods struggle to capture the intrinsic relationships among multidimensional variables within complex systems, often leading to "spurious correlations." Thirdly, they lack generalizable predictive capability; both qualitative analysis dependent on expert experience and rule-based quantitative analysis require tailor-made models and rules for specific problems, hindering their transferability to other contexts.

1.2 Research Status

In the field of economic sanction policy analysis, traditional research mainly relies on qualitative methods, such as case analysis, expert opinion integration, and policy text interpretation. For example, Ozgur discussed the types of sanctions, the relationship between the sanction - imposing party and the target party [1], and analyzed the impact of structural factors on the consequences of sanctions by studying cases of economic sanction consequences. Kerim took the 2014 Ukrainian crisis and the sanctions on Russia as examples to raise questions about the effectiveness of trade sanctions [2]. Katharina adopted the Qualitative Comparative Analysis (QCA) method and combined data from the Targeted Sanctions Consortium to study the negative externalities of UN sanctions [3].

Such research can provide a macro - level understanding of sanction policies. However, against the backdrop of today's highly integrated global economy, the combined application of sanction measures, and the multi - dimensional and complex interaction of factors influencing sanctions, their limitations have become increasingly prominent. Traditional research is unable to quantify many implicit influencing factors, such as the mediating effect of international public opinion trends and the game between domestic political forces in the target country on the impact of sanctions. Moreover, it cannot handle massive unstructured data (such as the attitude of the public towards sanctions on social networks), resulting in insufficient accuracy and forward - looking of research conclusions, which makes it difficult to adapt to the current complex and changing international political and economic situation.

In terms of AI - assisted strategic decision - making, a large number of relevant studies and application explorations have emerged. In the field of intelligent assistants, enterprises have developed decision - support tools using AI technology, which can provide managers with industry - assisted predictions, risk early warnings, and other information based on big data, greatly improving the efficiency and scientificity of enterprise strategic decision - making. Meng Xiaoyu and others studied the specific application and development direction of medical AI in the medical field by analyzing existing medical AI application cases and combining clinical data and AI technology [4]. Wang Jundong proposed a distribution network fault - assisted decision - making method based on knowledge graphs [5]. By constructing a fault dispatching knowledge graph and applying AI technology, it realizes fast, intelligent, and accurate fault handling decision - support. Chen Yao proposed an intelligent highway maintenance decision - support system that integrates new - generation information technologies such as BIM [6], big data, and AI to assist decision - makers in scientifically formulating maintenance strategies.

AI-based industry application models have been deployed in more fields, and by integrating multi-source information such as massive data, policy change updates, and user demands, they have demonstrated stronger predictive capabilities than traditional econometric models in areas including comprehensive forecasting for the electric power, energy, and medical industries, as well as assessment of industry development prospects. However, focusing on the specific topic of national sanction policies, no systematic research literature that deeply integrates AI has been retrieved so far. The existing research system on sanction policies is in urgent need of introducing the innovative analytical paradigm and powerful data processing capabilities brought by AI technology.

This study conforms to this development trend and attempts to introduce AI technology into the analysis of inter - national sanction policies. It aims to leverage the capabilities of AI technology in in - depth mining of multi - source heterogeneous data and modeling of complex relationships to make up for the shortcomings of traditional research, construct a more accurate and efficient analytical framework for sanction policies, and provide scientific support for relevant strategic decisions.

1.3 Main Contributions of This Study

The overall idea of this study is as follows: Based on the analysis of information related to inter - national and inter - organizational sanction policies formed by sorting out historical case information, the relevant information is quantified to develop characteristic indicators that can describe the sanction actions, sanction types, and sanction time. These characteristic indicators are used as inputs, and the effect of sanction policies is used as the network output to establish a multi - layer perceptron model. Through the training of the model, the accurate and efficient judgment of the effect and evolution trend of sanction policies is realized.

The main contributions of this paper are as follows:

- (1) Innovatively applying intelligent computing technology to empower research on issues in the field of social sciences, and proposing a data - driven methodological framework for studying strategic issues.
- (2) Innovatively designing an artificial neural network model and algorithm for predicting the effect of sanctions between countries or organizations, which can effectively avoid the risk of "empirical decision - making" and improve the accuracy and forward - looking of decision - making.

2 PROBLEM ANALYSIS AND DATA PREPARATION

2.1 Problem Description

At present, the global geopolitical pattern is undergoing in - depth restructuring. Inter - national sanction policies exhibit the characteristics of "multi - domain linkage" (such as combined energy and financial sanctions), "coupling of influencing factors" (interaction between economic dependence and international alliance support), and "complexity of effect evaluation" (interweaving of short - term economic shocks and long - term industrial supply chain transformation). Moreover, reliance on small-sample structured data (official statistical reports); simple analytical methods without dynamic interaction between them; and the lack of quantifiable prediction models in these methods.

Currently, research conditions include global public sanction databases, basic data processing capabilities, and algorithm frameworks. However, a full - process analytical system encompassing "data quantification - feature extraction - model prediction" has not yet been formed. The core scientific problem to be solved in this study is: How to construct a quantitative analytical framework integrating decision - support technologies based on the known characteristics of sanction policies and by utilizing existing multi - source historical data and basic technical conditions, and ultimately achieve three target effects. Firstly, the quantitative conversion rate of unstructured sanction information is effectively improved. Secondly, the constructed prediction model ensures the prediction accuracy of sanction impact indicators. Thirdly, it provides traceable and verifiable quantitative verification decision - making bases to avoid the risks of traditional empirical decision - making.

2.2 Problem Difficulties and Assumptions

Compared with general system prediction problems, the strategic sanction prediction problem has the following characteristics. The sources of sanction policy information are usually scattered across official bulletins of various countries, media news, academic research, etc., and the types of media include text, images, audio, and other forms. Data retrieval is cumbersome, acquisition is difficult, and the process of processing, integration, and analysis is complex. In addition, from the perspective of hierarchical attributes, the analysis of sanction policies belongs to the macro - strategic level, which requires an overall perspective to coordinate core goals. However, the factors affecting the final effect often involve multiple levels and have concealment. Due to the limitations of hierarchical positioning, it is difficult to conduct a comprehensive analysis of all influencing factors. How to extract effective content and key factors from the complex information to obtain evidence for the impact effect of sanctions, and thus support strategic - level macro - decision - making based on decision robots, is the direction that this study needs to explore.

2.3 Data Preparation

A wealth of information sources containing sanction policy information can be found in news media, official bulletins, and academic resources. For example, the Office of Foreign Assets Control (OFAC) of the U.S. Department of the Treasury, which is responsible for implementing sanctions, and the Council of the European Union mainly provide policy and legal texts as well as government announcements. Specialized analysis and statistical data can be obtained from global sanction data tracking websites (such as castellum.ai) and research reports released by think tanks like the Peterson Institute for International Economics. In addition, news media and social network platforms of various countries also report on the attitudes of the people in the sanction - imposing and target countries towards the sanctions. From this data, we can obtain some useful sanction information, such as the identity of the sanction - imposing party, the type of sanctions, the industries affected by the sanctions, and the duration of the sanction policies. Among these, the key initial attributes that affect the sanction decision - making process, sanction results, and effects include the duration of the sanctions, the number of countries or organizations participating in the sanctions, the type of sanction measures, the purpose of the sanctions, the entities or individuals targeted by the sanctions, the subject matter of the sanctions, and the exemption conditions for the sanctions.

The attribute values of some information are listed as follows. For the name of the sanctioned country, it may be the full name, abbreviation, or national standard code. For the sanction time, some count the number of sanction policies by year, while others count by month. For the type of sanctions, there are industrial classifications, and there is also the Harmonized Commodity Description and Coding System, an international general commodity classification and coding system presided over by the World Customs Organization (WCO).

The data sources related to sanction policies are scattered, and there are various forms of attribute identification, which bring certain difficulties to the analysis and judgment of policies and seriously affect the processing efficiency of policy analysis. This paper focuses on how to use some of the quantifiable information to predict the effect of sanctions. Based on the Global Sanctions Data Base - Release 3 (GSDB - R3), this quantifiable information includes:

- Sanction - imposing countries or organizations: Countries or organizations that take the initiative or are forced to participate in the sanctions.
- Sanctioned countries or organizations: The targets of the sanctions, which can be transnational organizations composed of a single country or multiple countries.
- Reasons for sanctions: Including the reasons for which the sanction - imposing party implements the sanction measures.
- Types of sanctions: Including restrictions on financial financing and lending, control over trade imports and

exports, and suspension of military assistance.

- Start time of sanctions: The specific year when the sanctions begin to be implemented.
- End time of sanctions: The time when the sanctions are terminated or suspended upon acceptance of the negotiation results.

There are 5 types of labels for the effect of sanctions:

- Successful sanctions: The purpose of the sanctions is achieved, such as the target party ceasing to invade other countries or accepting a truce agreement.
- Partial sanctions: A type of trade sanction, which includes comprehensive import and export sanctions or special sanctions on some industries.
- Ongoing: The sanctions are still in progress and have not had a substantial impact. For example, the sanctions on Cuba are still part of the U.S. sanction plan and have not been lifted.
- Failed sanctions: The sanctions fail to achieve the goal of stopping the target party's infringement, resulting in the failure of the sanctions.
- Negotiated settlement: Negotiations are facilitated through a third party, and the sanctioned party accepts the negotiation results, thus achieving the purpose of imposing the sanctions.

3 PROBLEM SOLVING

3.1 Technical Framework of Strategic Sanction Effect Prediction Agent

The multi - agent technology processing flow for data - driven strategic sanction effect prediction is mainly divided into two main processes: training and application, as shown in Figure 1. The sanction prediction model is trained based on historical sanction data, with iterative training conducted to learn and update model parameters and boundary constraints, and continuous approximation and fitting performed to develop a sanction prediction model that is sensitive to sanction data, based on data evidence, and achieves optimal sanction prediction results. This model can then be applied to practical policy evaluation scenarios such as sanction prediction.

In the training module, first, massive amounts of unstructured data are acquired and stored from multi - source information. Second, data preprocessing processes such as data encoding, cleaning, screening, and feature extraction are carried out. Then, the features extracted in the preprocessing stage are input into the sanction impact prediction model for iterative training, and the neural network parameters and training algorithms are continuously improved to form an effect prediction model.

In the application module, first, information about the actual sanction scenario is obtained and feature extraction is conducted. Second, real - time dynamic sanction information is imported into the sanction policy prediction Agent, and a sanction policy evaluation report is generated in accordance with the sanction prediction processing flow.

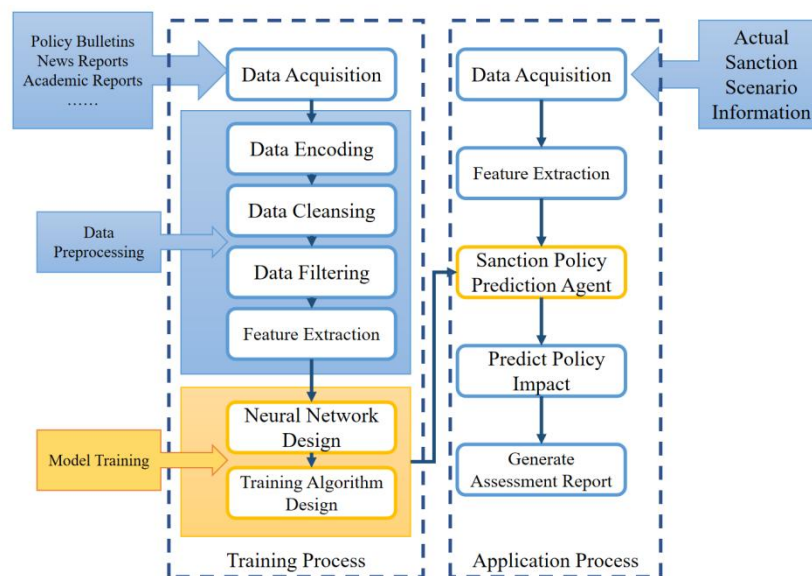


Figure 1 Technical Framework of Strategic Sanction Effect Prediction Agent

3.2 Data Preprocessing

The Global Sanctions Data Base - Release 3 (GSDB - R3) contains a total of 1325 sanction case records, including elements such as the start and end times of the sanction cases, the classification of the sanction - imposing parties, the reasons for the sanctions, the types of sanction measures, and the results of the sanctions. The original sanction data is shown in Table 1.

Table 1 Variables and Descriptions of the Original Dataset

Variables	Descriptions
case_id	Sanction case ID.
sanctioned_state	Sanctioned (target) country/region.
sanctioning_state	Sanction - imposing (initiating) country/region.
begin	Sanction start year.
end	Sanction end year. The value of 2022 may have a dual meaning for ongoing sanctions.
arms	Arms sanction indicator variable, with a value of 1 if it is an arms sanction.
military	Military assistance sanction indicator variable, with a value of 1 if it is a military assistance sanction.
trade	Trade sanction indicator variable, with a value of 1 if it is a trade sanction.
descr_trade	Type of trade sanction. "exp_compl" denotes comprehensive export sanctions; "imp_compl" denotes comprehensive import sanctions; "exp_part" denotes partial export sanctions; "imp_part" denotes partial import sanctions.
financial	Financial sanction indicator variable, with a value of 1 if it is a financial sanction.
travel	Travel sanction indicator variable, with a value of 1 if it is a travel sanction.
other	Other sanction indicator variable, with a value of 1 if it is another type of sanction.
target_mult	Multilateral target sanction indicator variable, with a value of 1 if it is a multilateral target sanction
sender_mult	Multilateral initiator sanction indicator variable, with a value of 1 if it is a multilateral initiator sanction
objective	Sanction objectives. If multiple objectives are assigned to the same case, there is no ranking among these objectives.
success	Sanction impact. If there are multiple objectives, the success sequence corresponds to the objective sequence.

Based on the analysis in Chapter 2 and the understanding of the GSDB - R3 dataset, this section focuses on designing the values of each indicator in the dataset according to the characteristics of the strategic sanction effect prediction problem. According to the original dataset, the indicators are further processed into discrete numerical variables. The indicators and their value ranges are designed as follows:

1. Sanction initiator: In the original data, the initiator is a string variable representing the country or organization that initiates the sanctions. The initiator includes at least one country or organization, and a sanction can be jointly initiated by multiple countries or organizations. In the dataset, different countries or organizations are separated by commas. This study examines the relationship between the number of initiators and the sanction effect. Therefore, after processing, this indicator is a positive integer representing the number of countries or regions participating in the sanctions.
2. Sanctioned party: Similar to the initiator, the sanctioned party is a string variable representing the country or organization being sanctioned. The sanctioned party of a sanction policy can also be multiple countries and organizations, which are separated by commas in the dataset. This study examines the relationship between the number of sanctioned countries and the sanction effect. Therefore, after processing, this indicator is a positive integer representing the number of sanctioned countries or regions.
3. Sanction start time: The original dataset uses a 4 - digit integer, with values ranging from 1949 to 2022, representing the calendar year when the sanctions begin.
4. Sanction end time: Similar to the sanction start time, the data range is from 1951 to 2022. When the end time is 2022, it may have a dual meaning, that is, the sanctions have not ended after the statistical year.
5. Sanction type: There are 6 types of sanctions, including trade, arms, military assistance, financial, travel, and others. Among them, trade is described in a separate column, distinguishing 4 subtypes of sanctions: partial import, partial export, comprehensive import, and comprehensive export, which are separated by commas. The rest are represented by 0 or 1 variables indicating the presence or absence of such sanctions. This study examines the relationship between the type of sanctions and the effect of sanctions. Therefore, after processing the trade description, the 4 trade subtypes are counted one by one, represented by 0 or 1 indicating their presence or absence, which is the same as the representation of other types of sanctions.
6. Sanction objective: The sanction objectives include territorial conflicts, policy changes, war termination, war prevention, human rights, democracy, regime change, and others, which are represented by strings. When there are multiple sanction objectives, they are separated by commas.
7. Sanction effect: In the dataset, there are 5 types of sanction effects, represented by strings: successful sanctions, partially successful sanctions, failed sanctions, acceptance of negotiation results, and ongoing sanctions. When there are multiple sanction objectives, the sanction effects correspond to the sanction objectives one by one, separated by commas. This study examines the relationship between the type of sanctions, the sanction objectives, and the sanction effects. Therefore, the sanction effects are counted one by one corresponding to the sanction objectives, and 0 or 1 is used to indicate the presence or absence of various sanction effects.

After the above data processing, the data represented by strings in the original sanction dataset are uniformly converted

into discrete data represented by integers. In addition to facilitating calculation and analysis, this will provide a basis for subsequent feature extraction and the selection of appropriate sanction prediction effect models and methods, resulting in a new dataset shown in Table 2.

Table 2 Newly Processed Dataset

Variable	Name	Value Range	Variable	Name	Value Range
X ₁	Number of sanctioned parties	1-4	X ₂	Number of sanction initiators	1-18
X ₃	Sanction start year	1949-2022	X ₄	Sanction end year	1951-2022
X ₅	Partial import sanctions	0/1	X ₆	Partial export sanctions	0/1
X ₇	Comprehensive import sanctions	0/1	X ₈	Comprehensive export sanctions	0/1
X ₉	Arms sanctions	0/1	X ₁₀	Military assistance sanctions	0/1
X ₁₁	Financial sanctions	0/1	X ₁₂	Travel sanctions	0/1
X ₁₃	Other sanctions	0/1	X ₁₄	Multilateral sanctioned parties	0/1
X ₁₅	Multilateral initiators	0/1	X ₁₆	Sanction objective: Territorial conflict	0/1
X ₁₇	Sanction objective: Human rights	0/1	X ₁₈	Sanction objective: Policy change	0/1
X ₁₉	Sanction objective: War termination	0/1	X ₂₀	Sanction objective: War prevention	0/1
X ₂₁	Sanction objective: Democracy	0/1	X ₂₂	Sanction objective: Terrorism	0/1
X ₂₃	Sanction objective: Regime change	0/1	Y ₁	Sanction result: Success	0/1
Y ₂	Sanction result: Partial success	0/1	Y ₃	Sanction result: Failure	0/1
Y ₄	Sanction result: Acceptance of negotiation results	0/1	Y ₅	Sanction result: Ongoing	0/1

3.3 Neural Network Design

In the problem of predicting the impact of sanctions, due to the participation of multiple parties in sanctions and the overlap of factors such as sanction types and purposes, it is difficult to obtain accurate prediction results using a general linear function that predicts the impact of sanctions based on these variables, making it difficult to support strategic - level macro - decision - making. Artificial intelligence neural networks have better advantages over other methods in fitting and predicting complex functions. Therefore, this study adopts a fully connected network to describe the value function for predicting the effect of sanctions.

3.3.1 Network structure

According to the characteristics of the dataset, the ANN neural network algorithm shown in Figure 2 is intended to be adopted. Data in the dataset—including sanction types, sanction times, and sanction purposes—are designed as the input layer, while data corresponding to sanction impacts serve as the output layer. The hidden layers are set to [10, 10], indicating that the neural network includes two hidden layers. The first hidden layer has 10 neurons, and the second hidden layer has 10 neurons. The number of training times is designed to be 1000.

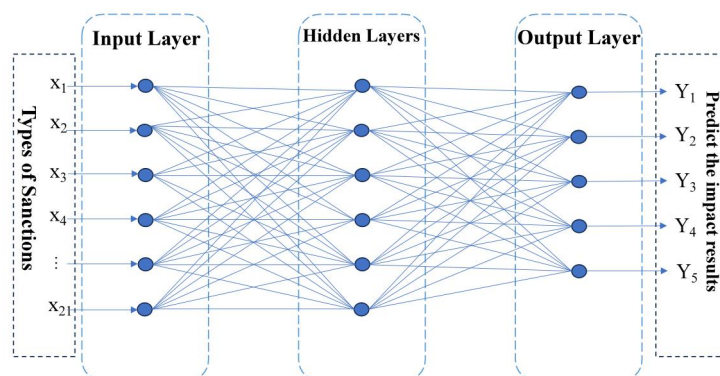


Figure 2 Design of Fully Connected Artificial Neural Network (ANN)

3.3.2 Training process

According to the attribute characteristics of global economic sanctions dataset (such as sample size, feature type and data distribution), the appropriate training method is selected from data characteristics and prediction tasks.

Predicting sanctions impact is essentially a supervised learning task. The input characteristics include sanctions involved, sanctions start and end time, sanctions type and sanctions purpose. The data of this dataset has the following characteristics: First, the number of samples is limited, and the number of major global economic sanctions events (unilateral sanctions by major powers) is small, far lower than the large-scale data sets of massive Social networks information such as images and texts; Second, the sample correlation is strong: the impact degree of sanctions is highly correlated with "sanctions intensity" (sanctions type + multilateral sanctions), "time window" (whether sanctions duration covers key time nodes), "purpose feasibility" (trade sanctions are easier to achieve than subversion), etc.; Third, there is data noise in the sample, the definition of "success rate" of some sanctions is vague (such as "partial success" is difficult to quantify), and in addition, there is no record of threat leading to success of sanctions in the original data set. The sanctions prediction neural network training algorithm is as follows:

Firstly, the data acquisition unit will collect the contents related to sanctions in government bulletins, major news media reports and major academic databases of various countries, extract the relevant sanctions time, country or region, sanctions initiator and its joint sanctions organization, and disclose the reasons for various sanctions in the information bulletin; Secondly, according to the set rules, the acquired data is distinguished from the sanction time, object, content, mode, etc., and the basic content of each piece of information is recorded according to the information elements, and corresponding labels are given; However, when incomplete information data is encountered, key information collected from other sources documenting the same sanctions case assists each other in verifying the authenticity of the sanctions incident and assessing the quality and completeness of the information; Finally, when the number of recorded sanction cases reaches a certain level, the common sanction methods, sanction targets and impact effects in the sanction cases are analyzed, the sanction rules hidden in the information are captured, and key variables with influence weights are formed, and then the data features closely related to the prediction effects of sanctions are extracted.

According to the characteristics of data features, combined with artificial neural network design specifications, the classical fully connected neural network is selected. The 21 sanction variable features after pretreatment are used as the input of neural network. Different number of hidden layer parameters are continuously tested. Through less times of testing, training data such as accuracy, recall and error distribution are recorded, and the data parameters are continuously adjusted to construct the best prediction model.

In order to obtain higher accuracy and reduce the error of sanctions prediction, regularization and boundary restriction are adopted to optimize the model, so as to obtain the convergence characteristic of function faster. With the increasing iteration times, when the error rate decreases to meet the requirements and the accuracy has high accuracy, the training is stopped, and the model will approach the actual sanctions effect function more closely and reach the optimal parameters of sanctions prediction model. The detailed sanctions prediction neural network training algorithm is shown in Algorithm 1:

Algorithm 1 Training Algorithm for Sanctions Prediction Neural Network

```

1: Randomly initialize weights  $w$  and thresholds  $\theta$ 
2: Set the error convergence threshold  $\varepsilon$ 
3: Initialize total training steps total_steps = 0
4: loop
    ▷ Training loop (until error meets requirements)
5:   total_steps  $\leftarrow$  total_steps + 1
6:   Initialize current round total error round_error = 0
7:   for each sample sample  $\in$  training set do
8:     input  $\leftarrow$  sanction types as input features
9:     target  $\leftarrow$  predicted sanction impacts as target outputs
10:     $h\_input \leftarrow \sum(w_{in \rightarrow hid} \cdot input) + \theta_{hid}$ 
11:     $h\_output \leftarrow \sigma(h\_input)$     ▷ Activation function  $\sigma$  (e.g., Sigmoid)
12:     $o\_input \leftarrow \sum(w_{hid \rightarrow out} \cdot h\_output) + \theta_{out}$ 
13:     $o\_output \leftarrow \sigma(o\_input)$ 
14:     $\delta_{out} \leftarrow (target - o\_output) \cdot \sigma'(o\_input)$ 
15:    round_error  $\leftarrow$  round_error + MSE(target, o_output)    ▷
    Accumulate mean squared error
16:     $\delta_{hid} \leftarrow (\sum(w_{hid \rightarrow out} \cdot \delta_{out})) \cdot \sigma'(h\_input)$ 
17:     $w_{hid \rightarrow out} \leftarrow w_{hid \rightarrow out} + \eta \cdot \delta_{out} \cdot h\_output$ 
18:     $\theta_{out} \leftarrow \theta_{out} + \eta \cdot \delta_{out}$ 
19:     $w_{in \rightarrow hid} \leftarrow w_{in \rightarrow hid} + \eta \cdot \delta_{hid} \cdot input$ 
20:     $\theta_{hid} \leftarrow \theta_{hid} + \eta \cdot \delta_{hid}$ 
21:   end for
22:   if round_error <  $\varepsilon$  then
23:     break    ▷ Error meets requirements, terminate training
24:   end if
25: end loop
26: Output: Training completed (total steps: total_steps)

```

The basic optimization framework selection is based on the Levenberg-Marquardt(LM) algorithm, considering that the sample size is limited and the sample size is medium. Combined with the sample size of the global economic sanctions dataset (GSDB-R3), it can handle the problem of "large difference between sanctions type and data characteristic

gradient", and the convergence speed is fast. It does not need to manually adjust parameters frequently, and is suitable for nonlinear fitting task scenarios such as sanctions impact prediction.

The core idea of LM algorithm is to balance the characteristics of Newton method and gradient descent method through damping factor, and balance the performance of the above optimization methods through the following update rules. The core formula is:

$$\xi_{k+1} = \xi_k - (\Psi^T \Psi + \lambda I)^{-1} \Psi^T e \quad (1)$$

Based on this formula, the parameters in the network can be iteratively updated, and finally the neural network can be used to predict the effect of sanctions.

3.3.3 Application process

Taking the historical sanction data set as the input of neural network, the model continuously modifies the parameters and prediction effect boundaries of neural network, and the sanctions prediction model can obtain better fitting effect through continuous iteration and upgrading. The main purpose of this paper is to design this model. Facing the complex international situation, when new sanction events occur, how to obtain the prediction effect evaluation report with high accuracy based on the sanction events obtained by data mining. Therefore, in the design and application stage, Sanction cases occurred after 2000 were taken as test set, and the training effect of cases before 2000 was tested as training set. The prediction effect obtained by applying the model was tested respectively, and the related data such as accuracy rate and recall rate were distinguished to evaluate the performance and effect of the model.

4 EXPERIMENT

In this paper, the real historical dataset is divided into training data and test data. The dataset is provided by institutions such as the LeBow College of Business at Drexel University in the United States, the Austrian Institute of Economic Research, and the Konstanz University of Applied Sciences, and is used to verify the effectiveness of the above - mentioned prediction method. The experiment is run on a personal laptop with the following main performance parameters: CPU model is 13th Gen Intel® Core™ i9 - 13900HX, memory is 32G, and graphics card is Nvidia 4080.

4.1 Experimental Scenario Design

4.1.1 Data preparation

The Global Sanctions Dataset records the statistical data of global sanction policies from 1949 to 2022. This database covers unilateral and multilateral sanctions and details attributes such as the type of sanctions, political objectives, and success level, with a total of 1325 data entries. According to the design in Chapter 3 of this paper, the original data are sorted into 21 quantitative attributes, including the sanction case ID, the sanction initiator and target, the type of sanctions, the start and end times of the sanctions, the purpose of the sanctions, and the results of the sanctions, as shown in Table 2.

4.2 Preliminary Data Analysis

4.2.1 The variation of the number of various sanction policies over time

The data are sorted in ascending order of the start time of the sanctions, and the number of various sanctions implemented each year is counted. The variation trend of the types of sanctions over time can be intuitively obtained, as shown in Figure 3.

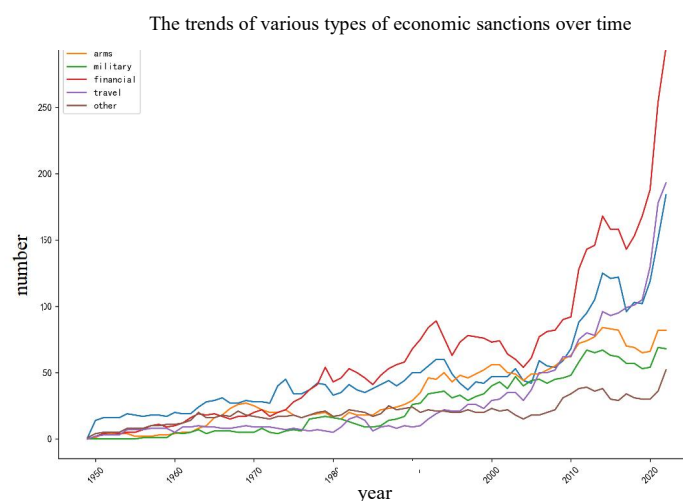


Figure 3 Trend of Various Types of Sanctions Over Time

Through the analysis of Figure 3, it can be clearly found that the number of various sanction policies shows an

increasing trend, especially after 2020, the number of sanctions has increased sharply. Among them, the number of financial and trade sanction policies has been higher than that of other types of sanctions for a long time. The growth rate of travel sanctions is relatively high, and the gap between the number of these three types of sanctions and other types is becoming larger and larger. This indicates that military sanctions are not the mainstream type of sanctions, and it reflects that non - military means of sanctions have become the mainstream in the current world development.

4.2.2 Correlation analysis between sanction types and sanction results

Based on the information in the dataset, we first analyze the correlation between sanction types, the correlation between sanction types and sanction results, and the correlation between sanction results. By calculating the correlation indicators of each statistical indicator, Figure 4 can be obtained.

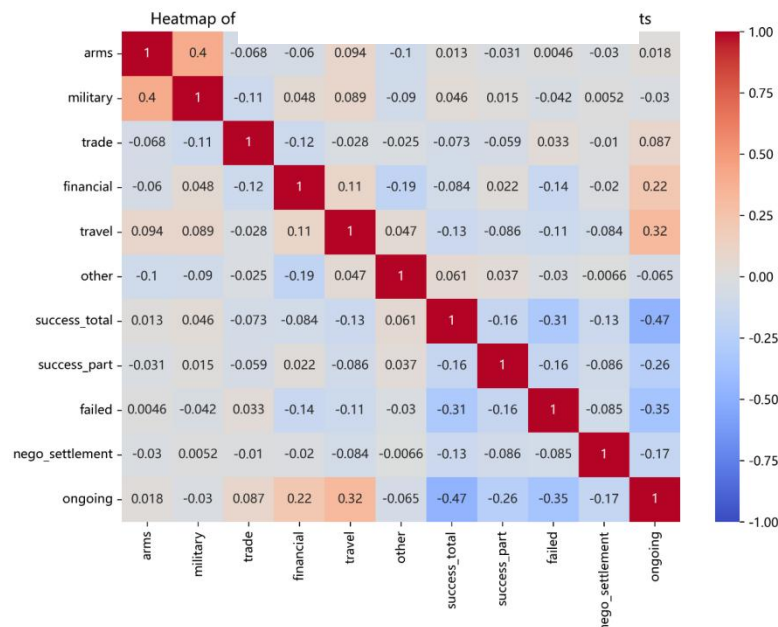


Figure 4 Correlation Heatmap of Sanction Types and Sanction Results

The absolute values of the correlations between the various attributes shown in Figure 4 are all less than 0.5, and most of them are between - 0.2 and 0.2. It is worth noting that intuitively, arms sanctions (arms) and military sanctions (military) should have a strong correlation, but the data shows that the correlation is only 0.4. There is no obvious negative correlation between cases where the sanction result is failure (failed) and those where it is success. The absolute value of the correlation between ongoing sanctions (ongoing) and other indicators is higher than 0.2 for the most attributes, but it is still difficult to summarize obvious rules through simple correlation analysis. Focusing on the sanction results of the three types of sanction policies, namely financial, trade, and travel visa sanctions, it is found that there is no obvious difference from the sanctions in other fields. Therefore, it is difficult to study the relationship between different sanction policies and sanction results only through correlation analysis.

4.2.3 Relationship between sanction measure combinations and success rate

To discuss the effect of the combined use of 6 types of sanctions, namely trade, arms, military, financial, travel visa, and other sanctions, we have drawn Figure 5. Figure 5 shows the correlation analysis between the combined use of different types of sanctions and the impact of sanctions. It can be seen from the figure that when multiple types of sanctions are used in combination, their correlation is less than 50%.

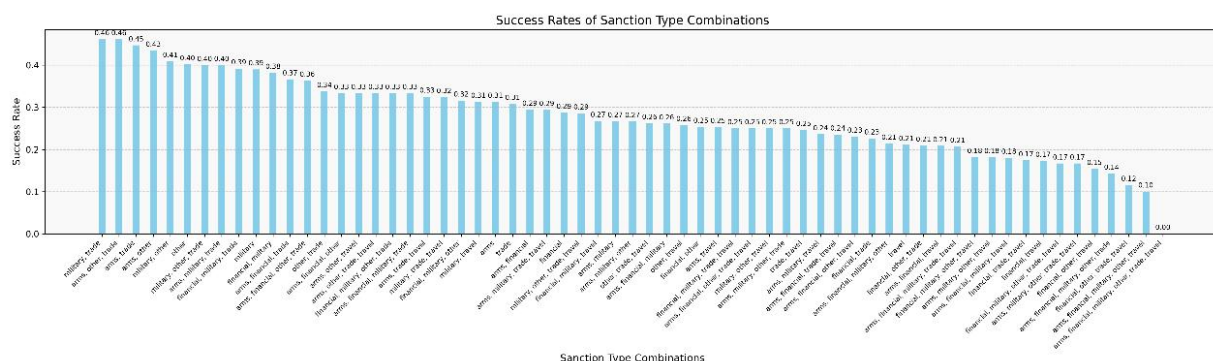


Figure 5 Correlation Between Combined Use of Sanction Types and Their Success Rates

Based on the above discussion, it is difficult to accurately judge the effect of sanctions through simple data analysis methods. Therefore, machine learning methods are introduced to predict the effect of sanctions.

4.3 Sanction Effect Prediction Based on Machine Learning

This scheme adopts a fully connected neural network to predict the effect of sanctions. To further discuss the performance of the network designed in this paper, in addition to the network structure shown in Figure 2 (referred to as ANN1 for short), a comparative experiment is also designed in this section. That is, the parameter of the output layer is set to 1, and the 5 different sanction results are judged respectively, while other network parameters remain unchanged (referred to as ANN2 for short). The accuracy of the two different neural networks in predicting the five different sanction results is counted, as shown in Table 3.

Table 3 Performance Comparison of Two Different Neural Networks

	Accuracy of Y1	Accuracy of Y2	Accuracy of Y3	Accuracy of Y4	Accuracy of Y5	Average accuracy
ANN1	0.75	0.931818	0.80303	0.939394	0.977273	0.880303
ANN2	0.704545	0.795455	0.780303	0.848485	0.931818	0.812121

It can be seen from the data in the table that the accuracy of predicting sanction results using artificial neural networks is far higher than that of traditional correlation analysis methods. Comparing the results of ANN1 and ANN2, the accuracy of ANN1 is higher than that of ANN2 in predicting each indicator, which indicates that the prediction method proposed in this paper has a good prediction effect on the whole.

True Prediction (TP) is defined as the case of correct prediction, False Positive (FP) as the case of predicting 0 as 1, and False Negative (FN) as the case of predicting 1 as 0. The numbers of FP, FN, and TP obtained from the results of the two different network structures in the experiment are counted, as shown in Table 4.

Table 4 Different Neural Networks

	ANN1	ANN2
FP	34	67
FN	45	57
TP	581	536

It can be intuitively concluded from Table 4 that ANN1 has fewer prediction errors, and is superior to the other network structure in terms of FP, FN, and TP.

Based on the above experimental results, this section also counts the number of samples in the test samples where all output parameters (Y1 - Y5) are predicted correctly. The number of prediction error indicators obtained by the two network models is counted, as shown in Table 5.

Table 5 Number of Prediction Error Indicators

Number of Prediction Error Indicators	0	1	2	3	4	5
ANN1	86	17	25	4	0	0
ANN2	59	37	24	9	3	0

A number of 0 prediction error indicators means that the prediction of the sanction result is completely correct. The results in Table 5 show that:

(1) Among the total 132 test samples, 86 are completely correctly predicted by ANN1, with a complete accuracy rate of 65.152%; only 59 are completely correctly predicted by ANN2, with a complete accuracy rate of 44.697%. This indicates that when using this method for complete prediction, ANN1 is still superior to ANN2, but there is still room for improvement in prediction accuracy.

(2) By comparing the prediction error samples of ANN1 and ANN2 one by one, it is found that except that the number of errors of ANN1 is 1 more than that of ANN2 when the number of prediction error indicators is 2, ANN1 is superior to ANN2 in other cases (the number of prediction error indicators is 1, 3, 4).

(3) By analyzing the prediction error samples of ANN1 and ANN2, it is found that in most samples, only 1 or 2 of the five output variables are predicted incorrectly, which indicates that there are very few cases of complete prediction errors. In future research, the prediction accuracy can be improved by fine - tuning the prediction model.

5 CONCLUSION AND OUTLOOK

Aiming at the problem of predicting the effect of sanctions between countries or organizations, this paper creatively proposes a data - driven effect prediction method. Firstly, after fully understanding the relevant characteristics of the

formulation of inter - national and inter - organizational sanction policies, a number of pieces of information related to the policies are sorted out. Secondly, this information is quantified, and data are used to describe the characteristics of this information. Thirdly, a neural network is designed to predict the effect of sanctions based on historical statistical data, and the feasibility and effectiveness of the method are verified through experiments.

This paper is only a preliminary attempt to apply AI technology in the field of strategic sanction effect prediction and has achieved good results. However, there are still the following directions for further exploration: (1) Design a deep neural network structure more suitable for such problems to improve the prediction accuracy. (2) Introduce more input information, such as discussing the relationship between the strength of the sanction - imposing and sanctioned parties and the sanction results, and the measures taken by the sanctioned parties to resist the sanctions.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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ETHICAL REFLECTIONS AND PATHWAYS FOR STRENGTHENING ADMINISTRATIVE ETHICS IN HIGHER EDUCATION: INSIGHTS FROM THE HARBIN UNIVERSITY AND WUHAN UNIVERSITY CASE

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Abstract: In the era of the knowledge economy, academic resources—such as research funding, project approvals, publication outlets, and institutional recognition—have become increasingly scarce and strategically valuable. The expansion of public administrative authority and the instrumentalization of academic evaluation within higher education have created conditions under which administrative discretion can be converted into private gain. Educational administration represents an activity deeply intertwined with ethics. The moral dimension of administrative action embodies commitments to fairness, justice, democracy, and responsibility. This article examines the ethical dimensions of academic corruption that arise under the influence of administrative power in Chinese higher education. Drawing on a targeted literature synthesis and detailed case analysis, the study articulates the mechanisms through which administrative actors may appropriate academic resources, the institutional vulnerabilities that enable such practices, and the normative functions of educational administrative ethics in preventing corruption. This paper explores the ethical foundations and challenges of educational administrative ethics within Chinese higher education, with a particular focus on the Wuhan University corruption case. Through theoretical and case-based analysis, the study reveals how the concentration of administrative power, the erosion of moral conscience, and institutional deficiencies jointly lead to ethical degradation. The findings suggest that administrative academic corruption is primarily driven by weakened ethical responsibility among officials, concentrated discretionary authority, and inadequate transparency and accountability systems. To address these challenges, the paper proposes an integrated set of reforms—comprising institutional redesign, strengthened ethical socialization, procedural transparency, and legal reinforcement—to realign administrator incentives with the public interest and to safeguard scholarly integrity. The research further proposes a threefold pathway for strengthening administrative ethics: legislative codification, ethical rule-making, and conscience-based education. Integrating insights from both theoretical discourse and empirical evidence, the paper contributes to a comprehensive framework for understanding and improving ethical governance in higher education.

Keywords: Educational administrative ethics; Academic corruption; Higher education governance; Administrative power; Ethical reform

1 INTRODUCTION

Education administration serves both as an exercise of power and as a moral responsibility. In the era of the knowledge economy, universities function as institutions where knowledge production, dissemination, and management are all mediated through administrative decision-making. Within China's higher education system, administrative discretion profoundly influences the allocation of academic resources, funding, and promotions. When power is concentrated and accountability mechanisms are weak, such discretion may lead to ethical lapses and even corruption.

The ethical governance of higher education is therefore not only a managerial necessity but also a moral imperative. Ethical administration ensures fairness, transparency, and justice in resource distribution while preserving the public trust essential for academic legitimacy. This study integrates theoretical analysis with a case study of Wuhan University to examine both the causes of administrative corruption and the pathways for enhancing ethical accountability in higher education governance.

2 LITERATURE REVIEW

2.1 Defining Administrative Ethics in Education

Administrative ethics refers to the moral and normative standards that guide public officials in exercising their authority. As Joo argued, administrative ethics embodies a value system connecting political morality, organizational ethics, and professional duty [1]. It serves as both a self-regulating and externally regulated mechanism that constrains power abuse and sustains legitimacy. Ethical norms within administrative systems aim to ensure fairness, integrity, and service to public interests rather than private gain.

Administrative ethics refers to the set of moral norms, duties, and institutional expectations that govern the conduct of public officials in their exercise of authority. In educational settings, such norms include commitments to fairness,

impartiality, legality, accountability, and prioritizing the welfare of students and the research community. Scholars emphasize both structural and personal dimensions of administrative ethics: the structural dimension encompasses rules, procedures, and accountability systems; the personal dimension comprises professional virtues, moral conscience, and a sense of public service [2,3]. Educational administration is characterized by a high degree of humanism, value orientation, significance, and complexity. Every administrative decision made by educational administrators is a decision made for people and about people, involving human relations and moral implications. Each decision inherently encompasses both factual and value dimensions, integrating empirical descriptions with normative judgments. In other words, it embodies the dialectic between what is and what ought to be, between administrative practice and educational ideals [4].

2.2 Features, Dimensions and Functions of Educational Administrative Ethics

Educational administrative ethics differs from other branches of applied ethics because it inherently carries an educational character. As Zhang asserted, education itself embodies ethical commitment and moral cultivation [5]; therefore, educational administration must inherently reflect fairness, justice, and democracy. Pu similarly noted that ethical consciousness must permeate all aspects of educational governance [6], linking institutional operations with social justice. scholars such as Huo have identified several features of educational administrative ethics [7]: (1) its subjects—educational administrators—are distinct in their dual roles as both moral educators and policymakers; (2) its domain—educational administration—demands both ethical efficiency and fairness; and (3) its goal—the realization of educational equity and moral integrity—extends beyond mere procedural justice.

Recent scholarship conceptualizes educational administrative ethics along multiple dimensions. Institutional ethics focus on the design and enforcement of rules that limit arbitrary discretion; public policy ethics concern the alignment of administrative action with public values and common good; and professional ethics emphasize the moral identity and duties of administrators as individuals [2,8]. These dimensions collectively contribute to three principal functions: normative guidance, preventive control, and corrective accountability. Normative guidance provides the ethical framework for decision-making; preventive control reduces the probability of misuse via transparent procedures; and corrective accountability ensures that violations are detected and sanctioned.

2.3 Administrative Power and Resource Allocation

Allocation systems—especially project-based funding and performance-driven evaluation—shape the incentives of academic actors. While project funding aims to stimulate research productivity, it inadvertently concentrates bargaining power in administrative centres that manage calls, evaluate proposals, and disburse funds. This concentration can create gatekeeping opportunities that, if unchecked, enable favoritism, nepotism, and the diversion of resources to insiders [9,10]. The literature identifies key vulnerabilities: opaque review processes, weak audit trails, conflict-of-interest gaps, and reward structures that overemphasize quantity over quality.

2.4 Forms and Drivers of Academic Corruption

Liu defined Academic corruption as the misuse of power by educational actors for personal benefit during the processes of knowledge production, dissemination, or service delivery [11]. It encompasses all unethical practices in teaching, research, and administration. The expansion of the educational market and the commodification of academic resources have amplified opportunities for misconduct, making administrative ethics a crucial safeguard of integrity and public trust [5]. Academic corruption enacted by administrators manifests in diverse forms: the misappropriation of project funds, fabrication or falsification of project deliverables, rental of project quotas, manipulation of peer review and evaluation committees, and the improper awarding of promotions or honors. These actions are driven by personal incentives (economic gain, prestige), structural opportunities (discretionary authority, weak oversight), and cultural tendencies (instrumentalism, short-term performance orientation). Importantly, many of these behaviors inhabit a legal gray area—technically lawful but ethically dubious—making purely legalistic responses insufficient [12,3].

2.5 Administrative Power and Ethical Constraints in Higher Education

Administrative power in universities is a form of public power that must serve the public interest. Montesquieu famously stated that “all power tends to corrupt, and absolute power corrupts absolutely.” Within universities, the excessive concentration of administrative authority can distort academic evaluation, financial management, and personnel decisions. Studies have shown that when administrative accountability weakens, corruption arises through rent-seeking, favoritism, or the conversion of public authority into private benefit [10,3,13].

2.6 Gaps in Current Research

Despite growing attention to research integrity, the specific ethical behavior of university administrators remains underexplored. Much of the existing literature focuses on individual researcher misconduct, while fewer studies systematically address administrative malpractice, its institutional causes, and the design of context-sensitive remedies.

There is a need for interdisciplinary approaches that combine organizational analysis, ethics, and higher education governance to generate practical solutions.

3 CASE ANALYSIS

3.1 The Harbin University Case: Administrative Corruption and Ethical Implications

This section analyzes a representative case from Harbin to illustrate how administrative discretion can be transformed into corrupt practices. The case involves a university dean who, in collusion with project leaders and external parties, inflated contract values, produced false deliverables, and siphoned funds for personal benefit. The analysis below reconstructs the *modus operandi* and situates it within institutional vulnerabilities.

The dean leveraged positional authority to influence project selection, control contract terms, and direct payments to designated accounts. Contracts ostensibly recorded legitimate academic services, but they contained inflated values with concealed overpayments. The excess funds were then channeled back to the dean through intermediaries or cash return arrangements. Over multiple cycles this scheme generated significant illicit proceeds while creating a stream of fabricated academic outputs that were falsely presented as legitimate research deliverables.

Several enabling conditions made this scheme possible: first, the absence of independent, transparent peer review for project approval; second, financial controls that permitted off-book transactions and lacked rigorous reconciliation procedures; third, cultural dynamics that tolerated or concealed improprieties for the sake of institutional reputation or reciprocal benefits. The collusion of actors across administrative and academic boundaries allowed the misdeeds to persist until external investigative mechanisms intervened.

Ethically, the case reveals a failure of professional responsibility and a departure from the fiduciary obligations of administrators. From a governance perspective, it highlights how concentrated discretion, weak internal controls, and insufficient external oversight combine to generate corruption risks. Legally, the behaviors—once uncovered—were adjudicated under anti-fraud and public funds misuse statutes, but the initial ethical breaches occurred long before legal thresholds were crossed. This temporal gap reinforces the need for proactive ethical governance rather than reactive legal remedies.

3.2 The Wuhan University Case: Administrative Corruption and Ethical Implications

Wuhan University, one of China's oldest and most prestigious institutions, became the focus of national attention in October 2009 when its Executive Vice President Chen Zhaofang and Party Secretary Long Xiaole were arrested for large-scale bribery and embezzlement involving construction projects. Investigations revealed that both officials had exploited their authority over university finances and logistics to solicit bribes, approve inflated contracts, and divert public funds.

The corruption network extended to private contractors and internal administrative departments, illustrating how systemic weaknesses allowed ethical lapses to proliferate. Despite multiple reports and warnings from faculty, early investigations failed to prevent further misconduct due to weak enforcement and internal protectionism.

Ethically, the Wuhan case exposed the erosion of administrative conscience and the subordination of public duty to personal gain. Both Chen and Long acknowledged a lack of ideological discipline and ethical reflection, attributing their downfall to moral decay and insufficient self-restraint. From a governance perspective, the case underscores the necessity of combining legal deterrence with moral education, institutional transparency, and a culture of ethical accountability.

The case triggered widespread debate in Chinese academia and prompted renewed calls for administrative reform and integrity education. It remains a cautionary example of how concentrated administrative power, when unaccompanied by ethical responsibility, can undermine both institutional legitimacy and public trust.

4 DISCUSSION: ETHICAL IMPLICATIONS AND SYSTEMIC POLICY RESPONSES

In the era of the knowledge economy, academic resources—research funding, project approvals, publication venues, and institutional prestige—have become increasingly scarce and strategically valuable. As administrative discretion expands and academic evaluation is instrumentalised, the conversion of public authority into private gain becomes a latent risk. The recent corruption scandals at Harbin University and Wuhan University exemplify how the concentration of administrative power, erosion of moral conscience, and deficient accountability mechanisms jointly precipitate ethical degradation in Chinese higher education. Drawing on the theoretical lens of educational administrative ethics and the empirical evidence presented above, this section proposes a three-dimensional governance framework that integrates legal codification, institutional redesign, and ethical socialisation to realign administrator incentives with the public interest and to safeguard scholarly integrity.

4.1 Legal and Institutional Complementarity

Justice and legality are mutually constitutive; without legal constraint, ethical aspirations risk deviation. The United States, Japan, and South Korea have enacted administrative-ethics legislation that converts moral obligations into enforceable duties. China should similarly embed explicit ethical clauses—fairness, integrity, service to the public

good—into its higher-education laws, thereby narrowing grey zones and providing a juridical basis for subsequent accountability [14,15].

4.2 Organisational Design and Checks-and-Balances

Even the most robust laws require institutional carriers. Universities should:

- (1) Constitute multi-member review panels that include ≥ 30 % external experts, rotate membership, and mandate conflict-of-interest disclosure to fragment collusive networks;
- (2) Separate budgetary approval from personnel decisions to prevent financial leverage over research allocation;
- (3) Introduce “double-key” authorisation for high-stakes decisions (e.g., talent programmes, professorial promotions), ensuring that no single actor can unilaterally determine outcomes.

4.3 Transparency, Auditing, and External Oversight

Transparency is the least-cost deterrent. Institutions must proactively publish calls for proposals, anonymised reviewer lists, funding outcomes, and aggregate performance indicators. Independent financial and procedural audits should be conducted annually, with summaries submitted to university councils, disciplinary inspection commissions, and the public. External ethics committees or ombuds offices should be empowered to receive anonymous complaints and guarantee non-retaliation, thereby increasing detection probability and reducing impunity.

4.4 Ethical Rules and Operational Standards

Abstract ethical ideals must be translated into actionable codes. Universities should promulgate an “Educational Administrator Ethics Handbook” that quantifies gift thresholds, regulates secondary employment, mandates kinship avoidance, and stipulates sanctions for data fabrication. An “ethics veto” should be institutionalised by embedding ethical compliance as a prerequisite in promotion, award, and grant decisions, thus making integrity a rewarded organisational norm.

4.5 Conscience-Based Education and Ethical Socialisation

Law and rules set the floor; conscience defines the ceiling. Administrators—who simultaneously exercise power and function as moral educators—must be incorporated into faculty ethics-training programs. Case-based deliberation, ethical-dilemma simulations, and reflective journaling can re-activate their identity as educators, ensuring that discretionary authority is exercised creatively yet consistently with fairness and the public good.

4.6 Incentive Realignment and Performance Reform

Perverse incentives rooted in “quantity worship” (grants acquired, papers published) must be corrected. Evaluation metrics should shift toward research quality, openness, reproducibility, and service to institutional governance. Administrative performance appraisals must explicitly weight ethical behaviour and governance performance at least equally with quantitative outputs, institutionalising the principle that “clean governance is itself academic achievement.”

4.7 Integrating Ethics and Law: A Three-Dimensional Framework

Legislation establishes the minimum standard (legal dimension), institutional rules operationalise compliance (institutional dimension), and culture internalises norms (cultural dimension). Only when administrators “do not wish to be corrupt” (conscience), “cannot be corrupt” (checks-and-balances), and “dare not be corrupt” (sanctions) are simultaneously activated will higher-education governance achieve moral self-sufficiency and long-term integrity.

4.8 Medium-Term Institutional Toolkit

To operationalise the above framework within two years, universities are advised to:

- a) Maintain review panels with ≥ 30 % external membership and enforce rotation after two terms;
- b) Release annual independent audit summaries and integrity reports;
- c) Launch an anonymous 24-hour reporting platform with a 48-hour investigative trigger;
- d) Implement full-cycle electronic fund-management systems ensuring complete traceability;
- e) Mandate annual conflict-of-interest disclosures for middle- to senior-level administrators and principal investigators;
- f) Allocate ≥ 20 % weight to ethical metrics in promotion, recruitment, and talent-programme evaluations;
- g) Restrict consecutive committee service to two terms to prevent network capture;
- h) Publish a “corruption-risk heat-map” that flags high-risk domains (procurement, admissions, recruitment, awards) and applies red-yellow-blue early-warning protocols.

Through the synergistic articulation of legal hardening, institutional specification, and cultural internalisation, administrative ethics in higher education can shift from ex-post punishment to ex-ante prevention and from individual

self-discipline to systemic immunity, thereby furnishing a sustainable ecosystem of justice for knowledge production and talent development.

5 CONCLUSION

Two university case illustrates that academic corruption is both a moral and institutional crisis. It originates from the imbalance between authority and responsibility and from the absence of a coherent ethical framework guiding administrative conduct. Strengthening educational administrative ethics requires an integrated approach combining legal codification, institutional rule-making, and moral cultivation. Administrative academic corruption undermines the foundational principles of higher education—fairness, openness, and the pursuit of knowledge. This paper has argued that the phenomenon is not merely a matter of individual moral failure but a systemic issue arising from concentrated discretion, weak internal controls, and misaligned incentives. Educational administrative ethics plays a critical preventative and corrective role by shaping administrators' professional identity, constraining discretionary excesses, and reinforcing organizational norms that prioritize the public interest. Effective anti-corruption strategies must be integrative—combining institutional design reforms, transparency and auditing, ethical socialization, incentive realignment, and calibrated legal protections. Future research should empirically evaluate the effectiveness of these interventions across diverse institutional contexts and explore mechanisms for scaling ethical governance in large and complex university systems.

Ultimately, the highest stage of ethical governance is the unity of morality and law—the alignment of internal conscience with external regulation. Only through this synthesis can higher education institutions restore the sanctity of education, ensure justice and fairness, and cultivate a culture of integrity that supports both academic excellence and public trust.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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DYNAMIC EVALUATION OF OPPORTUNITY INEQUALITY AND POLICY OPTIMIZATION VIA THE HST-GBM MODEL

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Abstract: In the context of China's rapid economic development and structural transformation, inequality of opportunity has become a major obstacle to upward mobility and the achievement of common prosperity. This study proposes an innovative Hybrid Spatiotemporal Gating-Boosted Model (HST-GBM), integrating LSTM, XGBoost, fixed-effects models, and gated recurrent units, to address the limitations of traditional methods in capturing nonlinear, heterogeneous, and intertemporal dynamics. Using CFPS panel data from 2010 to 2022, the study examines the evolution of opportunity inequality and its key drivers. First, the model effectively quantifies the relative impact of individual effort and environmental factors, revealing a long-term trend of declining inequality and increasing influence of personal effort. Second, the analysis shows that opportunity structures are highly responsive to policy changes, with effort-related impacts intensifying during reform windows. Finally, the study offers targeted policy recommendations that emphasize adaptive algorithms and effort-oriented approaches. Overall, this research contributes by advancing methodological innovation, enriching the theoretical understanding of dynamic inequality, and providing empirical support for policies aimed at promoting social equity and long-term stability.

Keywords: Inequality of opportunity; Common prosperity; LSTM; XGBoost; HST-GBM

1 INTRODUCTION

As China undergoes rapid economic development and social transformation, inequality of opportunity has become a pressing issue, limiting social mobility and hindering the goal of common prosperity. Despite ongoing reforms in education, income distribution and social welfare, structural disparities across urban–rural, regional and social dimensions persist. Emerging forces like the digital economy have further widened these gaps, highlighting the need for dynamic assessments of inequality and its policy implications.

Scholars have long debated the sources and mechanisms of opportunity inequality. Roemer first laid the theoretical foundation by distinguishing “circumstance” from “effort”[1], and later refined it into the more systematic “type–effort” decomposition within theories of distributive justice[2]. In the Chinese context, Zhang, Lin, and Li analyzed inequality of opportunity in basic education, showing how access and institutional arrangements shape outcomes[3]. Building on this, Chen and Zhou emphasized new forms of digital inequality, revealing how technological disparities reinforce stratification[4]. From the perspective of common prosperity, Shi, Chen, and Fang highlighted that low-income groups face structural disadvantages in opportunities, which accumulate throughout the life course[5]. Similarly, Guo and Li examined the link between educational opportunity inequality and social mobility, finding that structural disparities persist across cohorts and regions[6].

Quantitative approaches further deepened this research: Wan, Zhang, and Tang re-estimated income opportunity inequality with machine learning, showing that circumstance factors often outweigh effort in explaining disparities[7]. Complementing this, Liu and Han investigated the interplay between social mobility and educational equity, providing evidence that opportunity inequality is closely tied to income distribution and broader economic gaps[8]. Beyond income, Liu and Zhao identified new trends in educational inequality and proposed governance strategies to reduce institutional barriers and enhance fairness[9]. Finally, Xue extended the classic “ascription–achievement” model, demonstrating how effort interacts with ascriptive factors in occupational attainment, thereby signaling the need for more flexible and dynamic analytical frameworks[10].

Despite these advances, most prior studies adopt static perspectives or rely on single-model approaches like XGBoost, limiting their capacity to capture evolving structural patterns. To address this, this study employs longitudinal microdata from the China Family Panel Studies and proposes a Hybrid Spatiotemporal Gating-Boosted Model (HST-GBM). The model integrates Long Short-Term Memory networks for time-series learning, gating mechanisms for adaptive variable selection and XGBoost for enhanced prediction and interpretability. By incorporating fixed effects and spatiotemporal embeddings, it enables multi-level modelling across time and regions. Compared to traditional methods, HST-GBM improves accuracy, robustness and causal inference, though at higher computational cost.

Using this framework, the study tracks the evolution of opportunity inequality and evaluates the impact of policy reforms across various stages of reform. The main contributions are threefold: first, it develops an innovative machine learning model that overcomes the limitations of static or single-model methods; second, it identifies the dynamic mechanisms underlying opportunity inequality; and third, it provides evidence-based, policy-relevant insights to support China's pursuit of common prosperity and long-term social stability.

2 DATA PREPROCESSING AND DESCRIPTIVE STATISTICS

Before proceeding with the analysis, we first describe the data sources and then detail the preprocessing steps applied to ensure data quality and consistency.

2.1 Data Source

This study primarily utilizes data from the China Family Panel Studies, covering seven waves conducted biennially from 2010 to 2022. The CFPS is administered by the Institute of Population and Labor Economics at the Chinese Academy of Social Sciences. All relevant datasets were obtained from the official website and compiled for the corresponding years. A summary of the data is provided in Table 1.

Table 1 Overview of Data Sources

Data Name	Data Type	Data Description	Source
CFPS 2010–2022 Data	Mixed Panel Data	National longitudinal household survey data from 2010 to 2022	Institute of Population and Labor Economics, Chinese Academy of Social Sciences
China Statistical Yearbook 2010–2022	Mixed Panel Data	National statistical yearbook data from 2010 to 2022	National Bureau of Statistics of China

2.2 Data Preprocessing

Given the presence of missing values, outliers, and inconsistent formats in the dataset used for this study, these issues may negatively affect data quality and model inputs. Therefore, comprehensive data preprocessing is essential to ensure that the dataset meets analytical requirements, thereby improving the accuracy and reliability of the modeling results.

This study addresses various data issues as follows: Outlier handling was performed using the 3σ rule to remove observations beyond ± 3 standard deviations from the mean. For missing data, variables with high missing rates were excluded. Linear interpolation was applied to time-series data, while for cross-sectional data, K-nearest neighbors (KNN) clustering was used to group similar observations, and decision trees were trained within each group to predict missing values. The “years of education” variable was binned into ordered categories based on the standard duration associated with the highest degree obtained. Categorical variables were converted into numeric form using ordinal encoding for ordered variables and label encoding for binary or unordered ones. Standardization methods varied by indicator type: Min-Max was used for driving indicators, negative Min-Max for constraints, and Z-score for balance indicators. Household expenditure data were transformed into proportions of total spending. Finally, data from the China Family Panel Studies (2010–2022) were merged using household IDs, with duplicate entries containing complementary information consolidated through matching and sorting procedures. Table 2 reports the descriptive statistics.

Table 2 Summary of Descriptive Statistics

Variable	Sample Size	Mean	Std. Dev.	Min	Max
Age	43,613	43.264	14.162	10	95
Regional GDP per Capita	43,613	71,100.614	26,671.835	45,000	190,000
Education Expenditure	43,613	2,606.846	4,900.858	0	80,000
Subjective Health Score	43,613	3.091	1.299	1	5
Medical Expenditure	43,613	3,171.046	5,547.973	0	155,000
Number of Unhealthy Members in Household	43,613	0.458	0.679	0	5
Educational Attainment	43,613	2.148	1.301	0	7

3 MODEL DEVELOPMENT AND EMPIRICAL ANALYSIS

To achieve both structural interpretation and dynamic identification of opportunity inequality, this study develops a dual empirical approach that integrates indicator system construction and mechanism modeling. By distinguishing between contextual factors and individual effort variables, the study introduces the HST-GBM algorithm, which possesses strong capabilities for temporal modeling.

3.1 Model Description

This study proposes the Hybrid Spatio-Temporal Gated Boosting Model (HST-GBM) to capture the dynamics and generation mechanisms of opportunity inequality while balancing predictive performance, structural interpretability, and spatiotemporal generalization. Traditional methods like XGBoost and LightGBM are effective for static data but limited in capturing temporal dependencies and spatial heterogeneity. Conditional Inference Forests, while strong for causal analysis, face challenges in dynamic modeling and scalability. HST-GBM addresses these limitations by integrating a Long Short-Term Memory (LSTM) network for encoding temporal features, a gating mechanism for dynamic feature selection, and XGBoost for non-linear prediction. Additionally, the model incorporates panel fixed effects to account for unobserved heterogeneity and a gated residual-enhancing mechanism to adjust prediction errors.

A dynamic weight-adjustment layer ensures adaptive model fusion. Hyperparameters are fine-tuned using grid search with early stopping to optimize performance. This integrated approach provides a unified framework for multi-scale prediction of opportunity inequality, combining the strengths of deep learning and structured machine learning methods.

3.2 Construction of the Indicator System

Based on Roemer's "circumstance–effort" framework, this study classifies opportunity inequality into contextual and effort-based factors. To capture their dynamic effects, a structured indicator system is developed, with two-period lags included for both types of variables.

3.2.1 Construction of environmental indicators

This study examines how social attributes and structural conditions contribute to opportunity inequality by constructing a set of environmental indicators. Gender is defined as a constraining factor, as women often face systemic disadvantages in education, employment, and household resource allocation. Age, drawing on the life-cycle theory, is also considered a constraint due to declining access to opportunities over time. Hukou status reflects institutional stratification under China's dual urban-rural system; individuals with rural hukou face structural disadvantages in education, healthcare, and social security.

In contrast, regional GDP per capita is treated as an enabling factor, reflecting access to economic resources. Urban residence indicates relative advantages in education and employment, and is therefore also considered enabling. Household education expenditure reflects investment in human capital and contributes to reducing inequality. Self-reported health status, medical insurance coverage, and healthcare expenditure all serve as indicators of health security and are categorized as enabling factors. Finally, the number of unhealthy household members reflects health burdens that constrain opportunity structures and is treated as a constraining indicator.

3.2.2 Construction of effort-based indicators

Effort-based indicators include educational attainment and current employment status. Education reflects human capital accumulation; under social mobility theory, higher education increases access to resources and opportunities, making it an enabling factor. Employment status captures labor market integration, which not only improves economic conditions but also facilitates upward mobility, and is therefore also considered an enabling factor.

3.2.3 Weight assignment using the generalized entropy method

To quantitatively assess opportunity inequality across provinces and over time, this study adopts the Generalized Entropy Index (GEI) to decompose its structural sources. We classify the influencing factors into two dimensions: contextual (environmental) and effort-based (individual behavior), and aggregate variables within each dimension using weighted combinations. These composite indicators are then embedded into the GEI framework to measure and decompose inequality by source. The GEI allows sensitivity adjustment through a parameter α ; for this study, we use $\alpha = 1$ to balance interpretability and model tractability.

Finally, we define a combined inequality index as the weighted sum of inequality attributed to environmental and effort-based factors. The resulting structural weights indicate that contextual and individual factors contribute nearly equally to overall opportunity inequality, accounting for 50.48% and 49.52%, respectively. This suggests that both structural conditions and individual efforts jointly shape the evolution of opportunity inequality across regions and over time. The results are presented in Table 3.

Table 3 Indicator Weight Allocation

Variable Type	Weight
Environmental Indicators	50.48%
Effort-Based Indicators	49.52%

3.2.4 Construction of lagged indicators

This study uses one-period and two-period lagged variables to explore the time-lag effects of environmental and effort-based factors on opportunity inequality. Environmental variables typically have delayed effects, while the cumulative impact of effort-based factors may emerge later. A Pearson correlation heatmap (Figure 1) shows that some lagged variables are weakly correlated with their original counterparts, suggesting potential non-linear relationships and confirming the need for lagged variables in the analysis.

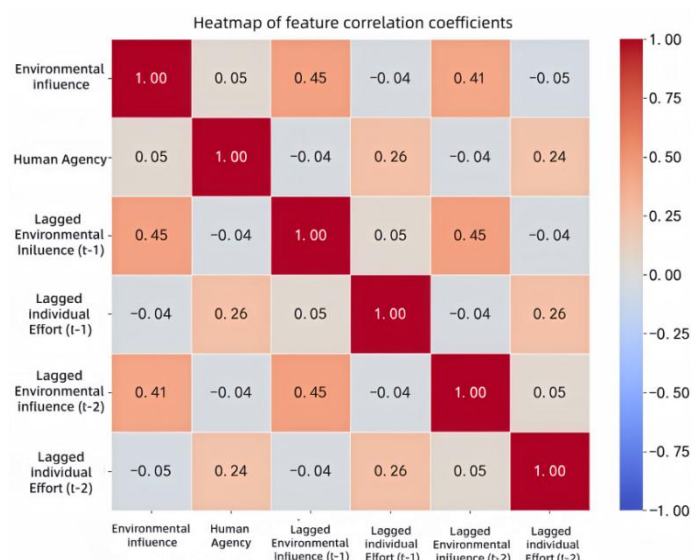


Figure 1 Heatmap of Feature Correlation Coefficients

4 EMPIRICAL ANALYSIS AND RESULTS

This section analyzes CFPS data using the HST-GBM model to examine the evolution and drivers of opportunity inequality from 2010 to 2022. It assesses the relative impacts of environmental and effort-based factors, tracks annual fluctuations and their policy roots, and identifies the causes of major changes. The findings offer empirical support for understanding inequality mechanisms and inform future policy and research.

4.1 Analysis of the Impact of Indicator Importance

This section analyzes the importance of each indicator in the model, identifying key variables that explain inequality of opportunity. By quantifying their impact, it reveals the main drivers of opportunity inequality and guides future policy interventions. The distribution of indicator importance is shown in the table 4 below.

Table 4 Distribution of Indicator Importance

Indicator	Effort Factors	Environmental Factors	Effort Lagged One Period	Effort Lagged Two Periods	Environmental Lagged One Period	Environmental Lagged Two Periods
Importance	70.26%	26.81%	0.57%	0.53%	1.14%	0.66%

The results from Table 4 show that individual effort, with a weight of 70.27%, is the dominant factor in explaining inequality of opportunity, surpassing environmental factors (26.82%). This indicates that personal investments in education and skills development play a central role in shaping opportunities. Environmental factors, though important, have a more indirect and constrained impact, influenced by demographic, geographic, and health conditions. Lagged variables show minimal impact, with diminishing effects over time. Overall, while individual effort remains crucial, environmental factors and past conditions still exert long-term influence. Policies should focus on enhancing education and skill development while optimizing environmental conditions to create a more inclusive society and reduce opportunity inequality.

4.2 Trend Analysis of Equality of Opportunity

According to the results of the model analysis (as shown in Figure 2), the level of equality of opportunity in China exhibited a clear upward trend from 2010 to 2022, with the mean value rising from 0.418 in 2010 to 0.494 in 2022. This change indicates substantial progress in promoting fair opportunities across social groups during this period. Notably, significant fluctuations in 2014 and 2018 suggest that policy shifts and socioeconomic factors had a phased impact on the state of equality.

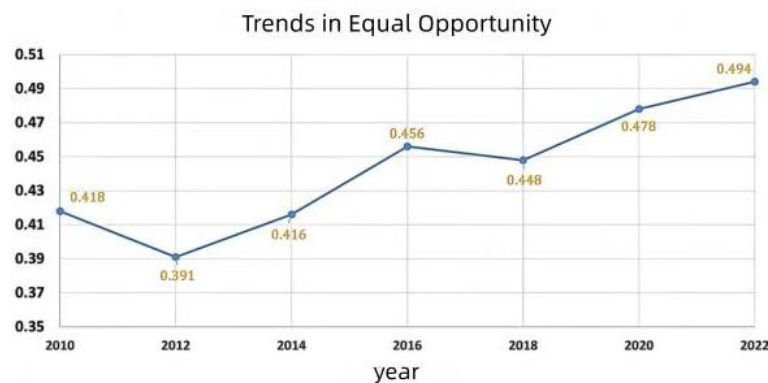


Figure 2 Trends in Equal Opportunity

These findings suggest that over the past decade, inequality of opportunity in China has been significantly reduced, reflecting the effectiveness of government policies. In particular, reforms in education, improvements in the social security system, and adjustments in income distribution have facilitated a more equitable allocation of social resources, gradually narrowing opportunity gaps between different social groups. This progress has not only enhanced social equity but also expanded the space for upward mobility across society.

4.3 Rate of Change Analysis

This section analyzes the rate of change in inequality of opportunity and its key influencing factors—namely, environmental conditions and individual effort—to reveal temporal trends and the dynamic effects of each variable over time (as shown in Figure 3). Rate of change analysis offers a more intuitive view of the relative speed and direction of variation among different variables, thereby deepening the understanding of the long-term mechanisms driving opportunity inequality. By calculating the annual change rates of each feature, the study further identifies both the phased and directional characteristics of their influence on inequality of opportunity.

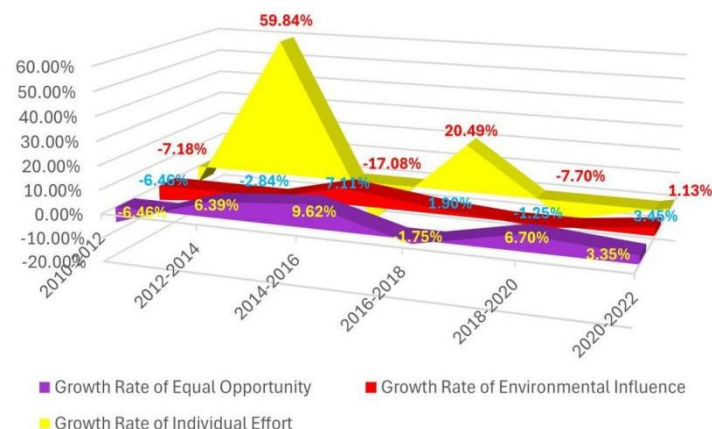


Figure 3 Three-Dimensional Line Plot of Change Rates Across Key Variables

The rate of change in opportunity equality has fluctuated over time, with notable increases during 2014–2016 (9.62%) and 2018–2020 (6.70%), likely reflecting major policy reforms—especially the deep structural changes in 2014. In contrast, the 2020–2022 period (3.35%) showed more moderate growth, suggesting stabilization in policy impact. Environmental factors remained relatively stable, indicating that deep-rooted structural conditions like family background and hukou continue to influence opportunity access. This points to a more mature policy system that mitigates but has not yet fully transformed structural inequality.

In contrast, individual effort showed significant variation, peaking in 2012–2014 (59.84%) and 2016–2018 (20.49%), highlighting the increasing role of personal initiative—particularly in education and employment—in shaping opportunity. These shifts underline the effectiveness of policy incentives in enhancing individual motivation and social mobility.

Overall, from 2010 to 2022, opportunity inequality in China has declined steadily. Effort has become the primary driver of improved access, while environmental influences have weakened but persist. The evolving opportunity structure reflects the combined effects of policy reform, institutional support, and personal agency.

5 CONCLUSION

This study constructs a Hybrid Spatiotemporal Gating-Boosted Model (HST-GBM) to address the complexity of variable interactions and nonlinear structures in high-dimensional data. Empirical findings reveal a significant shift in the drivers of opportunity inequality in China between 2010 and 2022, with individual effort surpassing environmental factors as the dominant influence. This shift reflects the growing effectiveness of institutional reforms and policy interventions in enhancing the role of personal initiative. The overall level of opportunity inequality has declined steadily—especially after 2014—while change rate analysis highlights the system’s high responsiveness to policy, with individual effort increasing notably in certain years and environmental effects remaining relatively stable.

Based on these findings, it is recommended to expand the application of adaptive models like HST-GBM in public policy evaluation to improve the analysis of complex social dynamics. Policymakers should continue to promote effort-oriented strategies by improving access to education, strengthening vocational training, and supporting human capital development. In parallel, reforms aimed at education equity, basic public service equalization, and urban–rural integration should be advanced to reduce structural disparities. Lastly, a responsive policy feedback system should be developed to monitor evolving effects of key variables and enable timely, targeted policy adjustments for enhanced social equity.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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THE LINMO–CHUANGZUO BIDIRECTIONAL TRANSFORMATION MECHANISM IN CHINESE LANDSCAPE PAINTING

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Abstract: This article investigates how *shan shui* (Chinese landscape painting) realizes a bidirectional transformation between *linmo* (copying after the masters) and *chuangzuo* (creative work), and reassesses its contemporary value. Adopting a qualitative pathway of concept archaeology, paradigm restatement, and operationalization, it constructs a Double-Loop, Four-Stage (DLFS) mechanism. The outer loop—*qufa* (appropriating a canon), *jiefu* (explicating its logic), *yunfa* (deploying it under a new brief), and *chufa* (issuing one’s method)—clarifies the progression from paradigmatic models to individualized procedure; the inner loop—*mo* (copy), *xi* (analyze), *bian* (vary), and *zheng* (validate)—models cyclical calibration in practice. Three operational modules are advanced: Canon–Nature Cross-Validation (*linben–ziran huzheng*), “Three-Distances” Spatial Analysis (*san yuan*: *pingyuan*, *gaoyuan*, *shenyuan*), and Poetic Scene-Making (*shixing zaojing*). These correspond to three soft criteria—structural legitimacy, spatial navigability, and semantic governance. Two case studies demonstrate that, without breaching canonical principles (*lifa*), minimal and interrogable adjustments can reliably effect the passage “from copying to creation,” while creation feeds back to improve copying—thus substantiating the loop. Grounded in Song-period paradigms, the model’s extension to Yuan–Ming–Qing and contemporary ink requires an adapter layer for material, subject, and venue, and cross-media application presupposes structural mapping.

Keywords: Bidirectional transformation between copying (*linmo*) and creation (*chuangzuo*); Double-Loop; Four-Stage (DLFS) model; Canon–nature cross-validation; Three-distances spatial analysis; poetic scene-making

1 INTRODUCTION

Amid an art ecology reshaped by globalization and digital technologies, debates persist over how Chinese landscape painting (*shan shui*) can continue to generate meaning within the tension between “tradition” and “modernity.” Two persistent misreadings are especially consequential: equating *linmo* with mere replication, and construing *chuangzuo* as a rupture from tradition. Together they obscure the generative logic centered on *li-fa–chengshi–qiyun* and fail to explain the practical trajectory by which artists move “from copying into creation” and, conversely, allow creation to improve copying. What is needed is an operational mechanism that addresses both technical transmission and contemporary expression. To facilitate interdisciplinary and cross-sectoral discourse and theoretical research in Chinese painting, concurrently with the maintenance of its disciplinary rigor and authentic tradition, thereby constructing a more open and sustainable ecology for artistic practice[1].

This study proposes a teaching-and-practice-oriented model of the bidirectional transformation between copying and creation, structured as a Double-Loop, Four-Stage (DLFS) mechanism. The outer loop—*qufa* (appropriating a canon), *jiefu* (explicating its logic), *yunfa* (deploying it under a new brief), and *chufa* (issuing one’s method)—articulates the progression from paradigmatic models to personal method. The inner loop—*mo* (copy), *xi* (analyze), *bian* (vary), and *zheng* (validate)—describes cyclical calibration in practice. The purpose of traditional scholarship is not merely to reveal the existence of a fully-realized past, but to revitalize culture through a deepened understanding of its historical artistic life[2]. Within this framework, *linmo* is defined as embodied modeling of procedural conventions and principles, aiming to establish robust hand–eye–mind–body coordination and transferable schemata; *chuangzuo* is defined as problem-oriented recomposition and contextual response, restructuring form around a stated theme and situation while remaining within established principles. The two are driven by a back-and-forth cycle of back-copying (*huimo*), paired reading (*duidu*), and cross-validation (*huzheng*), which converts procedural skill into propositional understanding and feeds back into operational refinement.

To render the mechanism actionable and testable, the paper operationalizes it through three modules—Canon–Nature Cross-Validation (*linben–ziran huzheng*), Three-Distances Spatial Analysis (*san yuan*), and a Poetic Scene-Making chain (*shixing zaojing*). These translate spatial structure, micro–macro rhythmic consonance, and the *ti–yi–jing* semantic governance into explicit procedures. Methodologically, the paper adopts lightweight evidence boards (historical/modern pairings plus process segments) as minimal evidentiary units that privilege discussability, traceability, and transferability over statistical generalization.

2 TERMINOLOGY AND PROBLEM DOMAIN

This study defines *linmo* as an embodied mode of learning characterized by the coordination of hand–eye–mind–body. Its aim is not the replication of images but the schematic modeling and calibrated command of *chengshi–lifa–qiyun*: taking *fa* (operative method) as the core to establish transferable operational schemata (e.g., the coordinated control of pressure, wet–dry, density, and rhythm); constraining them by *li* (principle) so that *shi* (force–lines) and structure remain coherent; and judging by *qiyun* (vital resonance) to align technique and intention. In this sense[3], *linmo* functions as training that is replicable, interpretable, and transferable, rather than as static tracing.

Chuangzuo is understood as problem-oriented recomposition and contextual response grounded in existing conventions and principles. Its generative process follows the *ti–yi–jing* chain: the theme (*ti*) sets the semantic direction; an image repertoire (*yi*) mediates between affect/concept and form; and the scene (*jing*) materializes in decisions on compositional hierarchy, reserve, brush-and-ink rhythm, and material texture. “*Chufa*” (issuing one’s method) does not mean novelty *ex nihilo*; it denotes raising both problem-responsiveness and stylistic distinctiveness without violating the logic of *lifa*.

“Transformation” here is not linear inheritance but a cycle of generation, verification, and regeneration. The paper models this with a Double-Loop, Four-Stage (DLFS) mechanism: the outer loop—*qufa–jiefu–yunfa–chufa*—describes the progression from selecting exemplars and unpacking paradigms to contextual recomposition and personal method; the inner loop—*mo–xi–bian–zheng*—effects practical calibration, culminating in back-copying (*huimo*), paired reading (*duidu*), and cross-validation (*huzheng*) between canon and nature, and between image repertoire and formal resolution. Together they form a feedback system that carries one from copying into creation and, conversely, allows creation to feed back into copying, raising procedural skill to propositional understanding and refining operation in turn.

As to scope, the study takes Song-period *shan shui* as its normative reference and constructs the mechanism within a framework that is principle-interpretable, convention-operable, and semantics-testable. Extensions to Yuan–Ming–Qing and to contemporary ink’s cross-media practices are addressed through the subsequent sections on operational modules and value reassessment, with the aim of providing a generative mechanism that remains consonant with classical logic while affording contemporary explanatory power, with the ultimate artistic pursuit to create works that embody the inner world of contemporary people and capture the defining characteristics of our zeitgeist[4].

3 MECHANISM: THE LOGIC OF THE DOUBLE-LOOP, FOUR-STAGE MODEL

This section models the generation and calibration of the *linmo–chuangzuo* relation through the Double-Loop, Four-Stage (DLFS) framework. The outer loop—*qufa–jiefu–yunfa–chufa*—organizes the progression from canonical paradigms to a personal method: *qufa* simultaneously fixes a learning object and a problem object (Song-period paradigms to carry method, a present thematic brief to define the task), thereby delimiting the usable techniques and structural constraints; *jiefu* restates the paradigm in a discussable structural language that privileges structure–rhythm–semantics rather than surface style; *yunfa* recomposes under the governance of the theme, rearranging position, relations, passages, and reserves while adapting to material and viewing conditions; *chufa* does not prize drastic divergence from tradition but, without violating *lifa*, raises the explanatory force of the *ti–yi–jing* chain and the consistency of one’s personal handling.

The inner loop—*mo–xi–bian–zheng*—performs cyclical calibration at the level of practice. *Mo* establishes *fenshunkan* (a felt sense of measure) through embodied execution, bringing pressure, wet–dry, speed, and density/rhythm under control; *xi* interprets the work with the *li–fa–xiang* frame and the *san yuan* viewing mechanism, examining whether the viewing path is navigable, force–lines and hierarchy are coordinated, and local rhythms accord with macro-segments; *bian* targets mismatches by structural or sectional adjustment (resetting turning points, reallocating reserve “channels,” tightening contrast gradients); *zheng* closes decisions with back-copying—paired reading—cross-validation: back-copying to recalibrate measure, paired reading against historical/modern fragments to check structural homology, and cross-validation against nature to confirm correspondences among form, force, and breath. Each round of *zheng* feeds back to revise the focus and thresholds of the outer loop, improving the stability and warrant of subsequent *yunfa–chufa*.

To avoid abstraction and over-quantification, the workflow is condensed into an operational protocol: first structure (force–lines–hierarchy–density), then rhythm (micro–macro consonance), then thematic review (align *ti*, *yi*, and *jing*), closing and extending by back-copying, paired reading, and cross-validation. Three soft criteria guide qualitative judgment: structural consistency (force–lines do not contradict the viewing path; hierarchy and density elucidate one another); local–global consonance (tight/loose handling at the stroke level accords with expansion/contraction at the segment level); and theme–scene congruence (the required mood/atmosphere is realized through composition, reserve, ink value, and edge character). Recognizability appears in relatively stable preferences for contrast configuration, reserve strategy, and force–line orientation, together with logical coherence and clarity of response across differing briefs.

Typical failure modes include the absence of *lifa*, visual resemblance masking structural distortion, and information overload producing a “collage effect.” A three-step remediation is proposed: reset structure by redrawing the viewing path, force–lines, and hierarchy with minimal lines; return to back-copying to recalibrate wet–dry, light–heavy, slow–fast; and re-strike the theme by using the theme keywords as the final check, micro-adjusting reserve channels and segment rhythm to land the semantics. With the outer loop’s process organization interlocked with the inner loop’s calibration, the bidirectional passage “from copying into creation, and from creation back into copying” gains a clear operational pathway and reproducible standards of judgment.

4 MECHANISTIC CLUES IN CLASSICAL PAINTING DISCOURSE: QUALITATIVE CONCEPT ARCHAEOLOGY AND PARADIGM RESTATEMENT

Taking a qualitative approach, this section treats classical painting discourse as a “living archive.” Through concept extraction and relational mapping, dispersed terms are restated as a contemporary structural vocabulary and set of operational principles to serve the bidirectional *linmo–chuangzuo* mechanism. Materials include the “Three Distances” (*san yuan*), Xie He’s “Six Laws,” Dong Qichang’s debate on the Southern and Northern Schools, and such phrases as *yizai bixian* and *tihua shi*. The goal is not panoramic historiography but the distillation of actionable structures and criteria.

First, the “Three Distances” yield a structural proposition for spatial organization: the triad viewing path—hierarchy—force-line constitutes a stable invariant for *shan shui*[5]. *Pingyuan* correlates with lateral reach and concentrated reserves; *gaoyuan* with vertical lift, upper sparseness and lower density; *shenyuan* with an ingress created by occlusion—channel—overlap. When the viewing path is disciplined by force-lines and layers/densities unfold accordingly, the image gains navigability; otherwise one encounters “near pressing, far blocked” or “broken force, scattered breath.” Copying should first calibrate structure; creation should remain constrained by it, avoiding local effect-piling that compromises global operation.

Second, *gufa yongbi* points to the criterion of micro–macro rhythmic isomorphism. The “bone-force” of line depends not only on center-/side-brush handling but, more decisively, on whether local rhythms of press–lift–turn accord with the global segmental stretch–relax–stretch (as articulated in *Bifa ji*). When aligned, *qiyun* is continuous; when misaligned, local passages “steal the show” and fracture the whole. Hence, in copying one first secures rhythmic consonance as an ethic; in creation, any variation proceeds without breaking that isomorphism, keeping “bone” (structure) and “breath” (operation) mutually implicated.

Third, semantic governance is articulated by the *ti–yi–jing* chain: the theme sets direction, an image repertoire mediates, and the scene is realized through composition, reserve, ink values, and edge character. If *jing* departs from *ti*, semantics stalls; if imagery is thin, form cannot focus. The pivot from copying to creation, therefore, lies in theme review: each formal adjustment must answer why it draws closer to the stated theme and atmosphere. Copying, too, should proceed under a hypothetical theme to avoid copying for its own sake, and thus look past the superficial appearance of things to grasp the underlying reality[6].

With respect to paths to method (*chufa*), a modern restatement of Dong Qichang’s schema suggests two strategies: law-stable, detail-variation and structural rewiring under isomorphic law-abiding. The former seeks “small newness” via fine-tuning rhythm, reserve, and light–dark within a given structure and textural repertoire; the latter reorganizes force-lines and segment layout at the structural level without violating spatial and force-line legitimacy, producing marked yet reasonable variation. Early training should emphasize the first to stabilize law; mature work may adopt the second to open structural innovation. In both, the baseline is structural coherence and continuous operation.

The “Six Laws” also establish a tiering of invariants versus adjustables: *qiyun guantong*, *gufa yongbi*, and *jingying weizhi* belong to the invariant tier—the conditions under which a work “stands up”; *yingwu xiangxing*, *suilei fucai* (ink/color), and *chuanyi moxie* form the adjustable tier, to be recomposed according to theme and context. Accordingly, the division of labor between *linmo* and *chuangzuo* becomes clear: the former targets stable command of invariants and felt operation; the latter performs problem-focused recomposition at the adjustable tier to achieve semantic response and stylistic recognition. Tradition thus ceases to be a style repository and functions instead as a methodological fulcrum within a layered guard–change structure.

For contemporary translation, three rules apply. Structural priority: in any cross-media shift, secure the viewing path, hierarchy, and force-lines before texture and effect, avoiding “strong twigs, weak trunk.” Semantic primacy: every formal decision must explain how it serves the theme; otherwise it is an invalid adjustment. Looped cross-validation: sustain a round trip among canon, nature, and creation—return to the canon to check method when technique stalls; return to nature to test principle once the canon is digested—so that a stable path emerges through the cycle of back-copying—paired reading—cross-validation.

In sum, the classical discourse—qualitatively restated—yields a set of structural cues (viewing path—hierarchy—force-line) and a criterion system (rhythmic isomorphism, thematic governance, guard–change layering) that can be embedded directly into the mechanism. These provide the grammatical base and checkpoints for the subsequent operational modules—Canon–Nature Cross-Validation, Three-Distances Spatial Analysis, and the Poetic Scene-Making chain.

5 OPERATIONALIZATION: THREE MODULES AND PRINCIPLES FOR IMPLEMENTATION

To translate the foregoing structural cues and criteria into executable method, the bidirectional *linmo–chuangzuo* mechanism is operationalized as three mutually supporting modules, with the back-copying—paired reading—cross-validation cycle as the throughline. The general orientation is to use a discussable, demonstrable, and transferable operational idiom that yields stable practice both in the classroom and in the studio.

5.1 Canon–Nature Cross-Validation

This module establishes the legitimacy baseline for spatial structure and brush-and-ink operation. The workflow proceeds as follows: first, a directed copying after Song canons to build tactile and operative command of viewing

path—hierarchy—force-line; second, onsite sketching or reliable images as natural referents to test how form—force—breath correspond to observed phenomena, differentiating what is transferable from what requires contextual adjustment[7]; third, a return to the canon for back-copying that internalizes observations as micro-adjustments of wet–dry, light–heavy, slow–fast, and the placement of reserves. Qualitative checkpoints include: whether the eye travels unimpeded under the guidance of force-lines; whether hierarchy and density elucidate one another; and whether local rhythms accord with segmental expansion/contraction. Common pitfalls are localism, running two logics in parallel (canon vs. nature) without reconciliation, and descriptive detail that breaks layered rhythm. Remediation should proceed structure before detail: redraw force-lines and hierarchy with minimal strokes, recalibrate measure, then translate surplus detail into structural information that serves rhythm. Evidence is clearest as a three-image juxtaposition (canon—nature—back-copy).

5.2 Three-Distances Spatial Analysis

This module converts traditional spatial thinking into compositional operation. In the sketch phase, set a spatial pre-plan: *pingyuan* emphasises lateral corridors and concentrated reserves; *gaoyuan* relies on vertical lift with upper sparseness/lower density and graduated contrast; *shenyuan* builds ingress through occlusion—channel—overlap (near dense, far sparse). In the middle draft, use transparent overlays or digital layers to check the co-ordination of hierarchy, density, contrast, and force-lines, eliminating structural conflicts such as “force-line reversal” or “blocked viewing path.” In the final stage, navigability is the terminal criterion: the eye should complete entry—turn—far reach as planned. A frequent error is treating the Three Distances as template labels rather than viewing mechanisms. Remediation begins by redrawing the viewing path and turning points, testing corridor reachability with spare reserves, then back-filling hierarchy and brush rhythm. Evidence is best shown as skeleton—middle draft—final with fine-line annotations for eye path and force-lines.

5.3 Poetic Scene-Making

This module answers how form is made accountable to theme. Procedure: set semantic direction via theme keywords; break these into an image vocabulary keyed to affect, weather, and season; map them to concrete decisions on segment arrangement, reserve placement, contrast strength, edge character, and dry–wet rhythm. The decisive test is interrogability: each salient adjustment should be explained through the *ti-yi-xing* chain and be corroborated by the structure of the image. Typical missteps include substituting a wordlist for thinking (semantic–formal collage) or losing the theme in execution (effect for effect’s sake). Remediation is theme review: first align the three highest-weight decisions—corridor reserves, dominant force-line, and primary contrast—with the theme; what fails to align is revised first. Evidence may be displayed as theme—sketch—final, making the logic of “meaning governs form” visible.

The three modules do not concatenate linearly; they operate cyclically within a triangle of structural legitimacy, spatial navigability, and semantic governance. In practice, one learning unit can be organized as a three-week loop: Week 1, Canon–Nature Cross-Validation to establish structure and operative feel; Week 2, Three-Distances analysis to complete the viewing path and layered rhythm; Week 3, Poetic Scene-Making to compress the theme and apply semantic micro-tuning. Weekly reviews produce a discussable, reviewable, and replicable check system; across a semester, training moves from law-stable, detail-variation toward structural rewiring under isomorphic law-abiding, releasing structural innovation while guarding invariants.

For digital brushes, tablets, AR/VR, and AIGC, operational principles extend to two cross-media baselines. Digital-ink isomorphism prioritizes structural and rhythmic homology: viewing path, hierarchical armature, force-line orientation, and segment rhythm must map one-to-one in digital environments; parameters such as opacity, flow, and diffusion radius are subordinate means to that end. Contextual augmentation subjects technical affordances to theme and situation—for example, organizing AR overlays by the ingress logic of *shenyuan*, or using the scene-making chain to set information density and reveal cadence—so as to avoid virtuosity that breaks *qi* continuity. Thus the mechanism maintains principle-level homology and aesthetic consistency across platforms and remains portable.

In sum, the three modules translate the structural rule of viewing path—hierarchy—force-line, the operative ethic of micro–macro rhythmic isomorphism, and the semantic governance of *ti-yi-jing* into a minimal, immediately executable loop for classroom and studio alike. Guaranteed by the cycle of back-copying—paired reading—cross-validation, they guide a stable growth path “from copying into creation, and from creation back into copying,” and furnish the methodological basis for the subsequent evidence boards and value reassessment.

6 MECHANISM JUSTIFICATION: MINIMAL EVIDENCE UNITS VIA HISTORICAL–MODERN PAIRINGS AND PROCESS SEGMENTS

This section extends a “small-sample, strong-interpretation” approach. Two sets of historical–modern pairings plus process segments are treated as minimal evidence units to render visible the operation of “from copying into creation, and from creation back into copying.” All materials serve mechanism explication rather than statistical significance. Judgment follows three soft criteria—structural legitimacy, spatial navigability, and semantic governance—and is closed by the cycle of back-copying—paired reading—cross-validation.

Case 1: Structural Variation. The materials are juxtaposed as Figure 1(a)–(b)–(c). Figure 1(a) is a Song-period fragment in the *shenyuan* (“deep distance”) paradigm, marked by frequent occlusion–overlap, corridor-like reserves that induce

ingress, and the gradient near dense / far sparse. Figure 1(b) is an onsite sketch or photograph of a contemporary landform (canyon, stream ravine, or inflected valley) that supplies comparanda in structure and tactility. Figure 1(c) is the author's work in mid- to late-stage, showing structural reallocation and brush adjustment from canonical paradigm to modern brief. Three focal points guide the reading: (1) Viewing path. In both Figure 1(a) and Figure 1(b) the path begins with foreground occlusion, opens in the middle distance, and enters a far corridor. Figure 1(c) should maintain isomorphism in force-line design to allow the eye to penetrate through near apertures and turn back in the far distance. (2) Hierarchy and density. Figure 1(a) displays a “near-dense—mid-layered—far-sparse” gradient that Figure 1(b)'s topography can echo; Figure 1(c) must secure a corridor reserve to support ingress and return. (3) Brush rhythm. In Figure 1(b), occlusion zones are “tight” while corridor segments are “loose”; Figure 1(c) should answer *shenyuan*'s advance with a tight-loose-tight-loose paragraph rhythm. Mechanistically, Figure 1(c) abides by Figure 1(a)'s structure-and-rhythm while contextualizing Figure 1(b)'s contemporary terrain. Variation concentrates on three sites—local textural strokes (*cunfa*), corridor morphology, and far-field attenuation—pursuing navigability gains through minimal intervention, exemplifying a law-stable, detail-variation path to *chufa*.



Figure 1 Structural Variation by Paired Reading: Song deep-distance paradigm (a) — Contemporary landform referent (b) — Student studio work (c)

Case 2: Theme-Driven Mapping. The materials are juxtaposed as Figure 2(a)–(b)–(c) (Figure. 2). Figure 2(a) presents a Song-period thematic prompt and image lexicon—*Snow-Scene in a Cold Grove / Cold Grove and Ancient Monastery*—with semantic boundaries and pictorial cues such as “solemn,” “desolate,” “wintry,” “pine eaves,” “bell,” “hearth smoke,” “light snow/frost traces,” and “clarified stillness.” Figure 2(b) is a compositional sketch or digital greyscale plan that prototypes the *ti-yi-jing* mapping. It evokes the visual concept of cold through its visual strategies: the painterly language and the shaping of space[8]; Figure 2(c) is the final or near-final passage focused on the key juncture where grove and monastery adjoin. Three strands structure the paired reading. First, the *ti-yi-jing* chain must be made explicit in Figure 2(b) along a formal path of “solemnity—stillness—coldness”: keep overall contrast low without turning muddy; alternate edge character between dry hard edges and softened wet transitions; use reserves as breath apertures for cold air/fog; embed the architecture in a subordinate placement within the landscape armature so it does not dominate. Figure 2(c) should stabilize these mappings as paragraph organization and brush measure. Second, at least four key decisions are required: (1) pictorial reserves that suggest the flow of clarified stillness; (2) tree-rock relations in which “branch-bone follows force, foliage is kept succinct,” using dry strokes to register “cold” and light ink washes to suffuse atmosphere; (3) monastery massing and siting “heavy below, light above; tucked within yet selectively revealed,” coordinated with force-lines and not taking the primary seat; (4) if bell-sound or smoke is to be indicated, do so by minimal cues (e.g., a faint upward wisp), avoiding descriptive literalism that would seize dominance. Third, rectification must be traceable: if Figure 2(c) shows over-descriptive architecture (tilting toward “religious subjecthood”) or a decorative grove that breaks the force-lines, return to Figure 2(b) for theme review, redesigning the hierarchy between building and trees and the locations of breath apertures; if necessary, insert short back-copying segments to recalibrate wet-dry, light-heavy, and slow-fast. At the level of mechanism, this case foregrounds semantic primacy in formal decision-making: each adjustment must answer why it moves closer to the *Cold Grove and Ancient Monastery* register of clarified stillness.



Figure 2 Semantic Mapping from Theme to Form: Cold Grove and Ancient Monastery (a) — Compositional sketch (b) — Final passage (c)

The two cases test the mechanism from structural and semantic ends, respectively. Case 1 shows that effective ingress in shenyuan does not depend on virtuoso technique but on correct ordering of occlusion–channel–overlap and on paragraph rhythms that sync tight and loose. Case 2 shows that the “clarified stillness” of the monastery-in-grove can be precisely constrained from a theme lexicon down to decisions on contrast, reserve, edge, and architectural subordination; minimal, interrogable interventions significantly improve semantic clarity. Taken together, once the three soft criteria are met, the passage from copying into creation can be achieved through accountable micro-adjustments; the structural choices and semantic compression made in creation then feed back into copying, sharpening the next round’s attention to structure and rhythm. This is exactly how the DLFS mechanism and the three operational modules work in concert.

7 CONCLUSION

This paper proposes and substantiates a Double-Loop, Four-Stage (DLFS) model for the linmo–chuangzuo relationship in Chinese landscape painting. The outer loop—qufa–jiefa–yunfa–chufa—clarifies the progression from paradigm to personal method; the inner loop—mo–xi–bian–zheng—models practical calibration. Accordingly, linmo is defined as embodied modeling of conventions and principles, while chuangzuo is problem-oriented recomposition and contextual response; the two are coupled by a reusable cycle of back-copying—paired reading—cross-validation. To make the mechanism operational, three modules—Canon–Nature Cross-Validation, Three-Distances Spatial Analysis, and Poetic Scene-Making—translate the spatial armature, micro–macro rhythmic consonance, and the ti–yi–jing chain into explicit steps. Under three soft criteria—structural legitimacy, spatial navigability, and semantic governance—minimal, interrogable adjustments can reliably effect the passage “from copying into creation,” while creation in turn improves copying.

A fourfold contemporary revaluation follows. Pedagogy: teaching shifts from style imitation to a coordination of structure–semantics–operation, supported by a three-week minimal loop + method toolkits; evaluation centers on structure, semantics, and process evidence, with isomorphic law-abiding as the boundary against templating. Theory: assessment is re-anchored in li–fa–chengshi–qiyun, establishing structural priority, semantic primacy, and process-based warrant, countering the substitution of technical indices for law-level homology. Media: digital-ink isomorphism and contextual augmentation serve as cross-media baselines, requiring one-to-one structural mapping and supported by process archives and semantic–formal control interfaces to ensure auditability. Culture and society: the mechanism functions as a generative grammar for public art education and place-based narration, shifting production from style consumption to law sharing, while guarding against the rapid commodification that turns images into templates.

COMPETING INTERESTS

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THE INNOVATIVE DISSEMINATION OF TRADITIONAL CULTURE VIA SHORT VIDEOS: A CASE STUDY OF GUOFENG INFLUENCER ZHU TIEXIONG

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Abstract: The digital era of short videos has reshaped the methods of content presentation and transmission pathways for traditional culture. Cultural heritage forms such as Chinese opera and folk arts leverage the fragmented and lightweight nature of short videos to overcome previous dissemination limitations and achieve value regeneration. This study takes Douyin influencer Zhu Tiexiong as a case study to analyze the paradigm innovation and communicative impact of traditional culture within the short video ecosystem. As a creator of "Guofeng" transformation videos, Zhu integrates elements of traditional culture—including Peking Opera, face-changing, lion dance, and Yingge Dance—with modern aesthetics. Through creative audiovisual expression and meticulous production, he enables a broader audience to appreciate the beauty of traditional culture, thereby providing a practical model for its dissemination and inheritance in the short video era.

Keywords: Short videos; Traditional culture; Zhu Tiexiong; Innovative expression

1 INTRODUCTION

The advent of the digital age, particularly the meteoric rise of short video platforms, has fundamentally reshaped the landscape of content creation, dissemination, and consumption. This paradigm shift presents both a unique challenge and an unprecedented opportunity for the preservation and propagation of traditional culture. Historically, venerable cultural heritage forms such as Chinese opera, folk arts, and intricate crafts have grappled with the challenges of a rapidly modernizing society, often perceived as esoteric or inaccessible to contemporary audiences, especially the younger generation. Their dissemination was frequently constrained by traditional media channels, geographical limitations, and the demanding temporal commitments required for appreciation, leading to a gradual erosion of public engagement and a risk of cultural amnesia.

However, the intrinsic characteristics of the short video format—its fragmented, lightweight, and highly engaging nature—offer a powerful antidote to these historical limitations. Platforms like Douyin (TikTok) have emerged as dynamic arenas where the ancient and the modern converge. By leveraging concise, visually arresting, and algorithmically amplified content, traditional culture can bypass previous barriers, achieving what scholars term "value regeneration"—a process where cultural assets are re-contextualized and revitalized for new audiences and contexts. This digital transmediation does not merely represent a change in the delivery mechanism; it signifies a profound innovation in the very paradigm of cultural communication, fostering new forms of aesthetic expression and participatory engagement.

Within this vibrant ecosystem, a new breed of content creators, often dubbed "Guofeng" (National Style) influencers, has risen to prominence. They act as crucial cultural intermediaries, skillfully translating the profundity of tradition into the vernacular of the digital era. This study posits that the work of such creators provides a critical lens through which to analyze the mechanisms and impact of this cultural transformation. To ground this investigation, we focus on a paradigmatic case study: the Douyin influencer Zhu Tiexiong.

Zhu Tiexiong has distinguished himself as a pioneering figure in the "Guofeng" transformation movement. His creative oeuvre represents a sophisticated synthesis of deep-seated traditional elements—including the stylized movements of Peking Opera, the dramatic artistry of Sichuan face-changing (Bian Lian), the vigorous spectacle of the lion dance, and the pulsating rhythms of Yingge Dance—with a distinctly modern, and at times cosmopolitan, aesthetic sensibility. His videos are not simple recordings of performances; they are meticulously produced cinematic vignettes that employ creative audiovisual techniques, narrative storytelling, and stylistic editing to enhance accessibility and emotional resonance.

By examining Zhu Tiexiong's content, this study aims to deconstruct the paradigm innovation inherent in his approach to traditional culture within the short video ecosystem. It will explore how his creative strategies facilitate a communicative impact that transcends mere viewership, enabling a broader and more diverse demographic to encounter, appreciate, and develop an affinity for the beauty and dynamism of Chinese cultural heritage. Consequently, Zhu's practice is not merely a popular online phenomenon; it offers a viable and impactful practical model for rethinking the dissemination and inheritance of traditional culture in the 21st century, demonstrating how digital platforms can serve as fertile ground for ensuring its continued relevance and vitality.

2 SHORT VIDEOS REVITALIZING THE DISSEMINATION OF TRADITIONAL CULTURE

The short video era has injected new vitality into the dissemination of traditional culture. The fragmented and lightweight nature of short videos has expanded the reach of traditional culture, while their vivid visual expressions have lowered the barrier for audience engagement. Creators integrate modern audiovisual techniques with traditional cultural elements, forming unique paradigms of cultural expression. By leveraging built-in interactive platform features, they construct novel interactive scenarios, thereby broadening the scope of cultural dissemination and deepening audience participation. The emerging cultural performance sphere built by short video platforms has narrowed the gap between traditional culture and modern life, allowing traditional elements to integrate into contemporary settings and creating a distinctive model of communication.

Currently, traditional Chinese culture is flourishing on short video platforms. According to the 2024 Douyin Hot Topics Annual Data Report, as of 2024, there were 1,428 inheritors of intangible cultural heritage (ICH) on Douyin, 199 of whom were under the age of 30. Post-95s and Generation Z, who grew up in the internet era, have become a new force in preserving and promoting ICH. Through initiatives such as traffic support and creation incentives, the platform has launched various campaigns including "Dazzling Effects Showcase National Treasures" and "Exquisite Replications of Traditional ICH," fostering the dissemination and innovation of intangible cultural heritage. Researchers such as Xiao Jun from Wuhan University, in their study on the dissemination of traditional Chinese culture via short videos, stated: "The significance of short videos for traditional culture in the present era is primarily manifested through three functions: awakening, activating, and reconstructing [1]." Short videos awaken audiences' connection to traditional culture, activate its core essence, and reconstruct its charm, thereby facilitating its broader dissemination.

3 ZHU TIEXIONG'S INNOVATIVE EXPRESSION OF TRADITIONAL CULTURE THROUGH SHORT VIDEOS

Zhu Tiexiong has garnered widespread attention by producing multiple viral Guofeng videos through his signature creative model of "Guofeng + Narrative + Special Effects Transformations." He innovatively reinterprets traditional cultural elements such as Peking Opera, lion dance, Yingge Dance, and shadow puppetry using modern audiovisual language, portraying iconic characters like Sun Wukong, Guan Yu, and Zhao Yun. Through these portrayals, he conveys traditional spiritual values such as loyalty, righteousness, and resilience, establishing himself as a representative creator in the Guofeng transformation genre. As of April 2025, Zhu's Douyin account has amassed 25.24 million followers, with each of his 41 published videos surpassing one million likes. His works have been repeatedly featured by mainstream media outlets such as People's Daily and Xinhua News Agency. He was also recognized as an outstanding case in the "Good Chinese Netizen" campaign. In 2024, Zhu further showcased his artistry by performing a Qinqiang warrior transformation act at the Xi'an segment of the CCTV Spring Festival Gala.

3.1 Diversified Thematic Content for Disseminating Excellent Traditional Culture

Zhu Tiexiong's short videos, primarily centered on the "Guofeng transformation" format, construct an integrated communication system that merges traditional culture with modern values through diverse themes such as heroism, intangible cultural heritage inheritance, national sentiment, and family ethics. Within this thematic framework, he has successfully shaped a series of deeply resonant Chinese classic images: Sun Wukong wielding the Golden Cudgel as the "Great Sage Equaling Heaven"; Guan Yunchang, bristling with rage yet unwavering in loyalty; Zhao Zilong, galloping with his spear and heroic bearing; the powerfully rhythmic Yingge dancers moving to the beat of the drum; and the inheritor of the intangible cultural heritage skill wielding an iron spoon to cast sparkling molten iron flowers.

Guided by the methodology of "technology empowerment + cultural deconstruction," Zhu integrates traditional elements into modern life scenarios. In a short video released on March 25, 2024, he wove a narrative centered on family affection and themed around Yingge Dance—an intangible cultural heritage—telling the story of a young man who remains true to his passion and pursues his dream of performing Yingge. The video culminates in a stunning Guofeng transformation at the moment of a powerful "Swallow Somersault" move, showcasing the majestic charm of Yingge Dance in a contemporary style. In the finale, Zhu skillfully blends live-action with special effects to present a grand and imposing Yingge Dance performance, vividly conveying both the cultural depth and emotional warmth of this tradition. By adhering to the principle of "strong symbolism, deep resonance," Zhu's short videos transform traditional culture from an inaccessible high-brow art into relatable fragments of daily life that genuinely touch the heart.

3.2 Multimodal Expression Showcasing the Charm of Traditional Culture

Multimodal communication constructs a composite semantic space by integrating multiple symbolic systems such as text, image, audio, and movement. Its core lies in transcending the limitations of single-sensory-channel transmission to achieve a multidimensional conveyance of cultural value. In Zhu Tiexiong's Guofeng videos, he seamlessly blends text, imagery, audio-visual elements, and special effects, engaging visual, auditory, and sensory modalities to form an immersive semiotic whole. This integrated expressive approach surpasses the mere visual impact of a simple costume transformation, creating a culturally rich and meaningful environment that allows the charm of traditional culture to be

displayed in an all-round, multi-layered manner.

Zhu Tiexiong's short video, titled "There is always a breeze in the mortal world, filling my countless dreams" — a poetic line by Song Dynasty poet Yao He — employs this classical verse as the primary modal element for constructing an atmospheric narrative. Through a father-son chess match, the video depicts the father's initial dissatisfaction, which later evolves into a poignant moment of shared tears conveying paternal pride. An intense soundtrack and powerful rhythmic progression drive the emotional narrative forward. At the transformative climax, the youthful protagonist breaks free like an unshackled bird, rising resolutely into the air and instantly metamorphosing into the Great Sage Equaling Heaven. This moment of dramatic transformation embodies countless hours of dedication and effort. Rather than merely reproducing the monastic robe from *Journey to the West*, the costume ingeniously integrates design elements from the martial male role in Peking Opera, showcasing traditional aesthetics and craftsmanship to contemporary audiences. As the emotional dynamic between father and son deepens and evolves throughout the video, it achieves a complete artistic communication. Since its release, the video has garnered 2.85 million likes, 98,000 comments, and 177,000 shares. Zhu Tiexiong's creative work transcends mere replication of traditional cultural forms; it serves as a vehicle for transmitting cultural spirit and fostering profound resonance. Within brief viewing experiences, audiences can perceive the enduring influence and timeless value of traditional culture.

3.3 Humanistic Narratives Highlighting Cultural Emotional Resonance

Affect theory suggests that the construction of cultural identity requires not only the transmission of symbols but also the awakening of collective memory through emotional resonance. By employing humanized storytelling, cultural humanistic sentiment facilitates the intergenerational transmission of cultural values and plays a structurally fundamental role in the dissemination of traditional culture.

Rooted in profound depth, traditional culture carries historical memories, national spirit, and humanistic warmth. When disseminating traditional culture, it is essential not only to innovate in expressive forms, linguistic features, and presentational perspectives but also to delve deeply into its inherent connotations and philosophical essence. The core elements and classic details of traditional culture should be conveyed through vivid character portrayals, skillful plot construction, and dynamically unfolding storytelling [2].

Zhu Tiexiong deconstructs and reconstructs traditional grand narratives by adopting a "micro-perspective – emotional anchoring – symbolic sublimation" strategy to reshape communication pathways. Moving beyond conventional panoramic cultural displays, he selects the most emotionally charged and impactful moments from traditional culture for presentation. His video titled "Borrowing this moonlight, I meet your eyes once more" portrays the intergenerational transmission of monkey opera between grandfather and grandson through a narrative of family warmth, integrating the makeup and movements of traditional opera into a story of familial reconciliation. This approach adds "humanistic warmth" to the dissemination of this cultural heritage. Through multifaceted character emotions, compelling plot developments, and rhythmic narrative pacing, Zhu's short videos convey this profound message: The transmission of certain crafts is not merely for livelihood, but represents an inherent ache flowing through the veins—a cultural pulse sustained by generations through body warmth and heartbeat, carrying the profound emotional attachment and spiritual support that Chinese people hold for their traditional culture.

4 INNOVATIVE DISSEMINATION OF TRADITIONAL CULTURE THROUGH ZHU TIEXIONG'S SHORT VIDEOS

Zhu Tiexiong's phenomenon-level viral video creations, characterized by their visual expression system that blurs the lines between the virtual and the real, coupled with strategic multi-platform distribution, provide a practical model for the dissemination of intangible cultural heritage in the digital age. Furthermore, they offer novel insights for addressing the "last-mile challenge" in modernizing the communication of traditional culture.

4.1 Reaching Young Audiences through Short Video Communication

The rise of short video platforms has dismantled the previous limitation of traditional culture dissemination to specific demographics, enabling more young people to engage with and appreciate traditional culture through this medium. This shift is evident not only in the changing audience composition but also in the innovation of communication methods—transitioning from authoritative one-way transmission to grassroots, highly interactive social communication. Short video platforms have successfully broken down the barriers to traditional culture dissemination [3].

Zhu Tiexiong's Guofeng videos prioritize quality, often drawing upon his own learning journey to spark young people's interest in traditional culture. To enhance the persuasiveness of his content, he has mastered various skills such as diving, horseback riding, and the traditional art of casting molten iron flowers ("da tiehua"). Zhu's team also utilizes technological empowerment to attract viewers, transcending physical limitations and transforming intangible heritage skills into visual spectacles. For instance, in the "Zhao Yun Transformation" video, a moving car dynamically transforms into a galloping warhorse; in monkey opera performances, front flips seamlessly connect with demanding staff techniques; and special effects merge harmoniously with traditional spear movements in opera. These elements preserve the essence of traditional artistry while reaching young audiences through modern visual language.

In his videos, Zhu often portrays an ordinary youth, articulating the unspoken affection that young people wish to

express to their parents, making him a "voice proxy" for his audience. His comment section has become a "tree hollow" for netizens to share their thoughts. Through this approach, the team promotes traditional culture by integrating it with the personal growth of young people, allowing them to see themselves in the characters. The lavish transformation sequences not only reconstruct traditional cultural symbols but also symbolize the spiritual metamorphosis of youth breaking through real-life challenges, enabling young audiences to recognize the charm of traditional culture through emotional resonance.

4.2 Comprehensive Interaction Encouraging Youth Participation in Dissemination

At this stage, the deep integration of short video platforms, social media, and television programs is driving a shift in communication models from one-way output to emotional, ritualized interaction. Zhu Tiexiong's works reach young audiences and, through interactive features like comment sections and like counts, construct a cross-temporal platform for cultural participation.

Firstly, the interactive mechanisms of short videos dissolve the sense of detachment in cultural communication, fostering deep engagement as users like, comment, and share. Zhu's videos operate on a communication chain of creation, presentation, attraction, and participation, incorporating the audience into the dissemination mechanism. Users engage in discussions, imitations, and secondary creations based on Zhu's videos. This shift from "passive viewing" to "active co-creation" breaks the one-way transmission model, forming a complete cycle of "viewing – resonance – secondary creation," transforming cultural dissemination into a dynamic, multi-dimensional social process, and ultimately building a virtuous cycle for cultural communication. Secondly, digital technology expands the dimensions for carrying cultural memory. Visual wonders achieved through special effects, such as temporal folding and object morphing, not only enhance content appeal but also preserve the intricate details of traditional craftsmanship in digital form. Finally, participatory communication cultivates new forms of cultural identity. Through secondary creations, users imitate traditional gestures and movements from the videos, completing the reproduction of cultural symbolism at the level of bodily practice. This innovation in the communication paradigm essentially represents a structural reconfiguration by the short video format of how traditional culture connects with contemporary audiences [4].

4.3 Digital Technology Highlighting the Contemporary Value of Traditional Culture

Digital technology has provided Zhu Tiexiong with new possibilities for showcasing traditional art forms. Utilizing 3D modeling and Augmented Reality (AR) technology, he presents Guofeng performances, traditionally confined to stages, in brand-new immersive formats within short videos.

Zhu's Inheritance video series demonstrates the vitality and contemporary value of traditional culture in modern society through innovative "technology + culture" expressions. Thematically, the videos address intergenerational conflicts and practical challenges in cultural transmission, touching upon the widespread anxiety about cultural discontinuity in contemporary society through the conflict and reconciliation between grandparents and grandchildren regarding the inheritance of Chinese painting, ultimately proposing a solution of "upholding tradition while embracing innovation." Technically, the videos engage in "creative transformation" and "innovative development." Zhu's team combines the traditional art of face-changing ("bianlian") with digital particle effects, achieving a symbolic reconstruction of traditional cultural elements through the signature artistic language of "transformation." The climactic transformation synchronized with stirring music not only delivers a powerful visual impact but also symbolizes the rebirth of traditional culture through modern artistic forms. This technological empowerment liberates traditional art from static, museum-like presentations, turning it into dynamic, participatory contemporary cultural practices.

The frequent appearance of terms like "heartbreaking" and "cultural confidence" in the comment sections confirms the emotional resonance and value recognition achieved by traditional culture through modern media. By employing this "dialogic" narrative approach, Zhu Tiexiong articulates the "soul" of traditional culture while endowing it with a "form" that aligns with the characteristics of the times, achieving an organic integration of traditional values and modern life.

4.4 Awakening Collective Memory and Connecting National Sentiment

Collective memory involves the selective reconstruction of shared historical experiences by specific groups, with its core function being the maintenance of cultural identity and the shaping of national consciousness. French sociologist Maurice Halbwachs posited that collective memory constructs "realms of memory" through symbolic systems, ritual practices, and emotional narratives, transforming abstract cultural values into tangible identity markers [5]. Zhu Tiexiong's videos extract symbolic elements that coalesce national memory and embody the essence of traditional culture. Through digital technology, they achieve situational recreation and complete emotional activation within intergenerational stories, effectively forging cultural connections to national sentiment.

Zhu's videos are distinctly characterized by their Guofeng style: they use traditional Chinese culture as their foundation, explore classic character archetypes, integrate contemporary values, and are complemented by sophisticated special effects. The "Guofeng transformations" are skillfully woven into narratives aimed at promoting and inheriting the perseverance and determination intrinsic to the Chinese spirit. In terms of symbol usage, he adeptly blends ICH elements like face-changing, lion dance, and Peking Opera with fantastical storylines, evoking memories of traditional culture and immersing viewers in the ambiance of vibrant opera stages. Regarding scene evolution, he creates environments rich with traditional charm, using immersive set restorations that allow audiences to experience historical

lifestyles. Through the performance of rituals, he imitates traditional folk ceremonies, solemnly evoke viewers' reverence and nostalgia for customary practices. Concerning intergenerational transmission, Zhu's videos serve as cultural bridges connecting different generations. They enable older individuals to reminisce about familiar cultural scenes from their past while helping younger generations understand the lifestyles and cultural traditions of their ancestors, thereby fostering a greater appreciation and respect for history and culture, strengthening familial and national cohesion, and ensuring the continuous, living transmission of traditional culture.

5 LIMITATIONS IN ZHU TIEXIONG'S SHORT VIDEO DISSEMINATION OF TRADITIONAL CULTURE

While short video creators represented by Zhu Tiexiong actively promote traditional culture through innovations in content and form, certain shortcomings persist in the communication process.

5.1 Insufficient Cultural Depth in Short Video Expression

Although Zhu Tiexiong's short videos demonstrate innovation in cultural expression, some works overly prioritize visual spectacle and entertainment effects, potentially weakening cultural depth. Zhu's team employs technical means like special effects transformations and scene teleportation to distill cultural symbols such as Peking Opera masks and martial arts moves into highly impactful visual elements. This creative model yields a dual effect: when special effects and light outlines delineate historical figures, audience attention is captivated by the dazzling imagery, often failing to recall cultural archetypes beyond those specifically labeled on screen. This "instant-understanding culture" dissemination strategy lowers the threshold for reception but simultaneously flattens the framework for cultural cognition. More notably, the trend of content homogenization driven by traffic algorithms is concerning: once the success formula of "transformation + special effects + sentiment" was validated by million-view hits, the team began repetitively applying similar structures in their works, gradually solidifying a fixed template—"30 seconds of conflict buildup, 1 minute of effects foreshadowing, 10 seconds of highlight transformation." This industrialized production model ensures communication efficiency but squeezes out the narrative space necessary for cultural interpretation.

5.2 Traffic Pursuits Compromising Cultural Communication Space

While Zhu Tiexiong's most popular short video has garnered over 11.21 million likes, a significant disconnect exists between dissemination and cultural conversion. In the video "Borrowing this moonlight, I meet your eyes once more," comments reached 250,000, with high-frequency interaction primarily reflecting immediate reactions to the visual spectacle. In the comment section of the Zhao Yun transformation video, which received 1.92 million likes, over 2,000 comments focused on the special effects creativity, while remarks concerning shadow puppetry were minimal. This "watch-and-forget" dissemination characteristic exposes the limitations of short videos in transmitting traditional culture—the platform users' average attention span of 7 seconds struggles to support the establishment of systematic cultural cognition. More critically, the traffic-oriented approach is reshaping the creative ecology: to sustain data growth, the team continuously increases the complexity of special effects. Recent videos feature technically impressive but culturally decontextualized elements like "suspension transformations" and "temporal folding scenes," a trend that may lead to the excessive entertainment-focused adaptation of cultural symbols. When algorithms persistently recommend similarly superficial content, the essence of traditional culture requiring quiet contemplation risks being marginalized at the end of the communication chain.

6 RECOMMENDATIONS FOR SHORT VIDEO DISSEMINATION OF TRADITIONAL CULTURE

In the short video era, the dissemination of traditional culture faces a dual challenge: adapting to fragmented information delivery while balancing entertaining expression with cultural depth.

6.1 Overcoming Communication Challenges through High-Quality Creation

Short video content is predominantly entertainment-oriented. Creators like Zhu Tiexiong, who disseminate traditional culture via short videos, face the dilemma of "high attention but low conversion rates" and the prevalence of content homogenization. Addressing this issue requires constructing a tripartite innovative path: at the content level, deeply excavate cultural knowledge systems, integrating the underlying cultural logic of techniques into narratives more naturally; at the formal level, adopt a "display + puzzle-solving" creative model, using detailed designs to construct immersive scenarios; at the technical level, utilize cutting-edge technologies to transform modern elements alongside traditional imagery, accurately restoring the rhythmic beauty of traditional arts.

6.2 Evolving from "Dissemination" to "Inheritance" in Cultural Communication

Within the cultural communication landscape reshaped by short videos, traditional culture is transitioning from mere "dissemination" to deeper "inheritance [6]." Creators build cultural communities through topic tags like "ICH inheritance" and "Guofeng transformation," forming a closed-loop mechanism of creation-dissemination-feedback that

guides young people from passive viewing to active participation. This new paradigm of "viewing as participation," leveraging algorithm recommendations and user interaction, enables traditional culture to break through circle barriers and achieve wider dissemination among Generation Z. Moving beyond superficial technical prowess to return to an in-depth exploration of core cultural values is essential for genuinely realizing the "living inheritance" of traditional culture.

Short videos have pioneered new pathways for disseminating traditional culture, expanding its reach. Zhu Tiexiong narrates stories themed on traditional culture through short videos, skillfully employing digital storytelling and cultural symbol reinvention to promote the social inheritance of traditional culture. However, the inherent attributes of short videos also pose challenges for cultural transmission. The balancing act between cultural communication and the pursuit of traffic is becoming increasingly prominent. Issues such as the flattening and symbolization of cultural interpretation, leading to a superficial audience understanding of traditional culture, require ongoing exploration.

7 CONCLUSION

The phenomenon of Zhu Tiexiong offers a compelling case study for understanding the transformative potential and inherent limitations of disseminating traditional culture within the short video ecosystem. This research demonstrates that short video platforms, characterized by their fragmented, visual, and interactive nature, have indeed reshaped the paradigm for cultural communication. They provide a powerful antidote to the historical challenges of accessibility and engagement that have long plagued traditional art forms. Through the innovative practices of creators like Zhu, traditional culture undergoes a process of "value regeneration," where elements such as Peking Opera, Yingge Dance, and lion dance are deconstructed and re-contextualized through modern audiovisual language and narrative techniques. His model of "Guofeng + Narrative + Special Effects" successfully bridges the gap between heritage and modernity, enabling a broader, younger audience to encounter and appreciate cultural beauty through emotionally resonant and visually spectacular content. This represents a significant shift from one-way, authoritative transmission to a participatory, grassroots-driven social communication model [7-8].

However, this study also reveals critical limitations within this new paradigm. The pursuit of viral success and the constraints of the short video format can lead to a compromise in cultural depth. The over-reliance on spectacular special effects and a formulaic template—such as the predictable "transformation climax"—risks reducing complex cultural symbols to flattened, instantly consumable visuals. This creates a "watch-and-forget" dissemination pattern where high viewer engagement does not necessarily translate into profound cultural understanding or systematic knowledge acquisition. The algorithm-driven pressure for traffic can foster content homogenization and an excessive entertainment focus, potentially marginalizing the very essence of traditional culture that requires quiet contemplation.

Therefore, the future of traditional culture dissemination on short videos lies in a conscious evolution from mere "dissemination" to meaningful "inheritance." While creators like Zhu Tiexiong have masterfully expanded the reach of traditional culture, the next step involves deepening its impact. This requires moving beyond technical spectacle to a more profound excavation of cultural knowledge systems. Recommendations include integrating underlying cultural logic more naturally into narratives, adopting creative models that encourage active audience "puzzle-solving," and utilizing technology not just for visual wonder but for the accurate restoration of traditional artistry's rhythmic and aesthetic principles. Ultimately, by balancing entertaining expression with cultural authenticity and fostering a transition from passive viewing to active participation and co-creation, short videos can truly become a fertile ground for the living inheritance of traditional culture in the digital age [9].

COMPETING INTERESTS

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NEWS AVOIDANCE PHENOMENON OF "GENERATION Z" IN THE ERA OF INTELLIGENT COMMUNICATION—AN EMPIRICAL ANALYSIS BASED ON 311 QUESTIONNAIRES

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Abstract: With the rapid development of new technologies such as 5G, big data, and artificial intelligence, news communication methods and audience reception habits have undergone significant changes. This study focuses on "Generation Z" (born 1995-2009), a group of digital natives, and uses the questionnaire survey method to collect 311 valid samples to deeply explore the phenomenon of news avoidance among "Generation Z" in the era of intelligent communication. The study found that the news consumption habits of "Generation Z" are characterized by socialized channels, entertaining content, and visualized forms; news avoidance behavior is mainly caused by factors such as personal preferences, information overload, algorithmic recommendations, and information disorder; this behavior may have both negative effects such as information cocoons and social differentiation, as well as positive effects such as enhancing individual autonomy and promoting journalism innovation. Based on this, this study proposes countermeasures from five levels: communicator, content, channel, audience, and effect, aiming to build a trusted news ecosystem that conforms to the information consumption logic of "Generation Z".

Keywords: News avoidance; Generation Z; Intelligent communication; Digital natives; Media trust

1 INTRODUCTION

In June 2023, the Reuters Institute for the Study of Journalism released the *Digital News Report 2023*, which revealed new trends in global digital news consumption: in 46 countries, more than one-third (36%) of respondents said they sometimes or often avoid news, mainly because news is depressing or difficult to understand. Additionally, in many Nordic countries, the reach of mass media to young audiences continues to decline, and the media are facing an unprecedented crisis of trust, low engagement, and news avoidance. Faced with the large "Generation Z" group of 260 million in China, how the news industry can cope with this challenge has become an important issue that needs to be solved urgently. This study aims to systematically investigate the phenomenon of news avoidance among "Generation Z" through empirical analysis, exploring the causes and dual impacts on society and the news industry, and providing theoretical and practical support for building a news industry trust system that aligns with the information consumption logic of "Generation Z".

2 LITERATURE REVIEW

2.1 Theoretical Origins of News Avoidance Behavior

The study of news avoidance behavior can be traced back to the 2001 annual meeting of the Association for Education in Journalism and Mass Communication (AEJMC), when scholars first held a special study on "Internet news avoiders." The emergence of this research paradigm marked a significant shift in communication studies from focusing on "what audiences are exposed to" to "what audiences are not exposed to."

Morten Skovsgaard defined news avoidance in the *Oxford Research Encyclopedia of Communication* as "the behavior of people who, over a continuous period of time, avoid or even completely refrain from news due to aversion to news or a higher preference for other media products[1]." This definition emphasizes the time continuity, motivational diversity, and behavioral manifestation of news avoidance, providing a theoretical basis for subsequent research.

2.2 Typological Analysis of News Avoidance Behavior

As research has deepened, scholars have begun to conduct typological analyses of news avoidance behavior. Wang Bin and Huang Jing[2], based on the Chinese context, refined news avoidance into four types: "disconnection avoidance" refers to completely cutting off contact with news; "encounter avoidance" refers to ignoring news when it is encountered unintentionally; "curation avoidance" refers to actively filtering and selecting news content; "monitoring avoidance" refers to reducing attention to specific issues or sources. This classification helps to more precisely understand the characteristics and causes of different avoidance behaviors. Meanwhile, similar international studies, such as Toff Benjamin, have categorized news avoidance into "emotionally driven" and "cognitively driven" types[3]. The former refers to avoidance due to negative emotions triggered by news content, while the latter refers to avoidance due to high cognitive load or complex and incomprehensible information. This classification reveals the psychological

mechanisms of news avoidance behavior. By comparing domestic and international research, it can be seen that the news avoidance behavior of "Generation Z" has both commonalities and differences across different cultural backgrounds.

2.3 Multidimensional Causes of News Avoidance Behavior

Foreign scholars have mainly explored the causes of news avoidance from three dimensions:

Individual Psychological Dimension: Toff Benjamin found through in-depth interviews with news avoiders that avoiders have an imbalanced and weakly internalized norm regarding the perceived obligation to stay informed[3]. They expect news to make them feel anxious, helpless, or angry, and thus choose to avoid it to protect their emotional health. This "emotional management" strategy reflects the self-protection mechanism of modern individuals in an information-overloaded environment.

Media Environment Dimension: Prior proposed the "high-choice media environment" theory, which suggests that in an environment with a rich selection of media, people are more likely to choose content based on their preferences, thereby leading to news avoidance[4]. The widespread application of algorithmic recommendation technology has further exacerbated this phenomenon by reinforcing users' existing preferences through personalized recommendations and reducing exposure to diverse information.

Socio-Cultural Dimension: Factors such as political polarization, declining media trust, and increased social complexity can all lead to news avoidance. When social issues are overly complex or political positions are too divided, some audiences may choose to avoid them to simplify their cognitive load.

3 RESEARCH METHODS

3.1 Research Design

This study employs quantitative research methods and collects data through questionnaire surveys. The questionnaire design is based on literature reviews and theoretical frameworks, covering multiple dimensions such as demographic information, news consumption habits, news avoidance behavior, and its causes. The study aims to systematically collect and analyze data to deeply explore the phenomenon of news avoidance among "Generation Z" in the era of intelligent communication.

3.2 Sample Selection

The research subjects are individuals born between 1995 and 2009, known as "Generation Z." A total of 330 electronic questionnaires were distributed via the WJX platform, with the survey conducted from July to September 2023. After removing invalid questionnaires, 311 valid samples were obtained. The sample characteristics are as follows:

- Gender Distribution: 50.8% male, 49.2% female, which is relatively balanced.
- Education Distribution: 33.76% with an associate degree or below, 33.44% with a bachelor's degree, and 32.8% with a master's degree or above.
- Major Distribution: 48.87% in journalism and communication, 51.13% in non-journalism and communication fields.
- Geographical Distribution: The sample covers multiple provinces across the country, with a relatively balanced representation from both northern and southern regions.

3.3 Measurement Tools

The study used a self-designed 5-point Likert scale questionnaire (1=Strongly Disagree, 5=Strongly Agree), developed based on literature (Peng, 2019; Wang & Huang, 2023) and pre-interviews[5]. It included 3 core modules (30 items total):

1. News Consumption Channel Preference (8 items): Measures news access frequency via different channels;
2. News Avoidance Behavior (12 items): Assesses avoidance types and frequency;
3. Demographic Information (10 items): Collects gender, education, etc., for group analysis.

Reliability and validity tests were conducted via SPSS 26.0:

- Reliability Test: Overall Cronbach's $\alpha=0.901$; module α values were 0.872 (channel preference) and 0.895 (avoidance behavior), all >0.7 (good consistency). Results see Table 1.

Table 1 Cronbach's Reliability Test Results (N=311)

Cronbach's α Coefficient	Number of Items
0.901	12

- Validity Test: The Kaiser-Meyer-Olkin (KMO) value is 0.939 (>0.9 , suitable for factor analysis); Bartlett's Test: $\chi^2=1168.908$, $df=66$, $p<0.001$ (significant correlation). Results see Table 2.

Table 2 Results of Kaiser-Meyer-Olkin (KMO) and Bartlett's sphericity tests (N = 311)

KMO value	0.939	
Bartlett' s test of sphericity	Approx.	1168.908
	Chi-Square	
	df	66
	P-value	0.000

3.4 Data Analysis Methods

Data analysis employs statistical methods such as factor analysis and analysis of variance (ANOVA). Factor analysis is used to extract the main dimensions of news consumption habits and news avoidance behavior, while ANOVA is used to examine the impact of different demographic variables (such as education level, region, gender, etc.) on news avoidance behavior.

3.5 Challenges and Solutions in the Research Process

During the research process, we encountered the following challenges:

1. Low Response Rate: Some potential respondents showed low willingness to participate in the survey, resulting in a lower response rate than expected.

- Solution: To enhance the attractiveness of the questionnaire (e.g., by simplifying questions and offering small incentives) and expanding the distribution channels for the questionnaire (e.g., through social media, school clubs, etc.), we were able to improve the response rate.

2. Data Quality Control: During the data collection process, some questionnaires were found to be incomplete or poorly filled out, affecting data quality.

- Solution: In the questionnaire design phase, logical validation functions were added to ensure the completeness and logical consistency of the questionnaires. During the data cleaning phase, clearly invalid questionnaires were removed to ensure data reliability.

3. Sample Representativeness: Due to the use of convenience sampling, the sample may have certain selection biases, affecting the generalizability of the research findings.

- Solution: When selecting samples, we endeavored to cover "Generation Z" individuals from different regions, education levels, and majors to enhance sample representativeness. Additionally, the limitations of the study were discussed, and suggestions for future research improvements were proposed.

Through these methods, this study systematically investigated the phenomenon of news avoidance among "Generation Z," ensuring data quality and the credibility of the research findings.

4 RESEARCH RESULTS

4.1 Characteristics of News Consumption Habits of "Generation Z"

4.1.1 Channel preferences: mobilization and socialization

The survey results show that the news consumption channels of "Generation Z" exhibit distinct mobilization and socialization characteristics. 44.05% of respondents choose to browse news through social media platforms such as WeChat public accounts, Weibo, and Douyin, far exceeding other channels. 36.01% choose to browse through websites, 28.94% through news clients, while the proportion of those who browse news through traditional media (newspapers, radio, television) is relatively low.

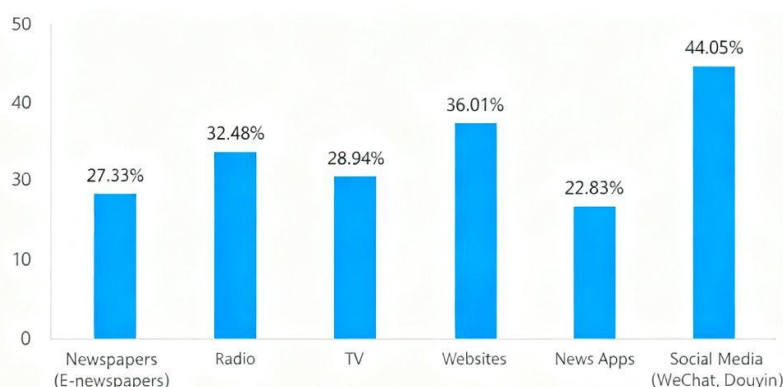


Figure 1 Distribution of News Consumption Channels among Generation Z (N = 311)

Figure 1 shows that "Generation Z" relies heavily on social media platforms compared to other channels. This preference not only reflects their high dependence on mobile devices but also highlights the significance of social media

in information dissemination. Further analysis reveals the following characteristics of social media news consumption among "Generation Z": First, platform diversification, as they obtain news from multiple social platforms simultaneously, forming a complex media usage matrix; second, social drive, as news consumption is often triggered by social relationships, with friends' shares and trending topics becoming important mechanisms for discovering news; third, interactive participation, as they are not only receivers of news but also disseminators and commentators, participating in news events through likes, comments, and shares.

4.1.2 Content preferences: coexistence of entertainment and utility

In terms of news content selection, "Generation Z" shows a coexistence of entertainment and utility. In terms of news categories, 76.06% of respondents prefer entertainment news, followed by sports and cultural news (33.12%) and social news (28.94%). At the same time, 65.92% of respondents indicated that they pay attention to hard news related to national livelihood and their own interests, reflecting this group's emphasis on practical information. Further analysis reveals that the content preferences of "Generation Z" exhibit significant situational dependency. In learning and working scenarios, they tend to seek information that is practical and related to their own development; in leisure and entertainment scenarios, they prefer light-hearted and interesting content. This situational information demand reflects the role-switching and psychological state changes of "Generation Z" in different life scenarios.

4.1.3 Disconnect behavior: media fatigue and selective avoidance

Despite being an online generation, "Generation Z" also exhibits significant disconnect behaviour. As shown in Figure 2, 61.1% of respondents indicated that they would actively or passively ignore certain news for a period of time.

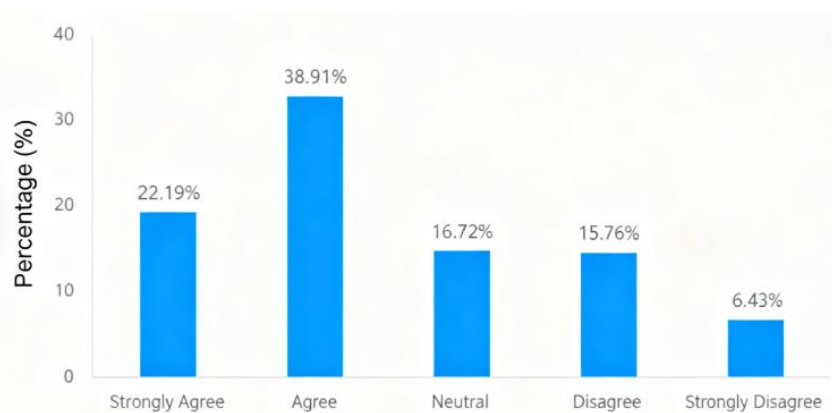


Figure 2 Proportion of Generation Z Respondents who Report Ignoring News under different Agreement Levels

Among them, 61.74% would choose to ignore news unrelated to themselves, and 62.71% would choose to ignore news that contradicts their existing views. It is worth noting that the disconnect behavior of "Generation Z" exhibits strategic and phased characteristics. They do not completely cut off contact with news but selectively reduce news exposure in specific periods or contexts. For example, during exam periods, busy work times, or low moods, they would actively reduce news consumption to protect their attention and emotions. This strategic disconnection reflects the adaptability and self-management awareness of "Generation Z" in the digital environment.

4.2 Causes of News Avoidance Behavior

4.2.1 Subjective causes: individual-level choices

Personal Preferences and Selective Exposure: From the audience perspective, the news avoidance of "Generation Z" is essentially a form of selective exposure. The Uses and Gratifications theory suggests that audiences, as individuals with clear needs, actively use media based on specific need motives. In the era of intelligent communication, "Generation Z" selectively exposes themselves to news that meets their needs and avoids the rest. This selective exposure reflects the proactive consumption characteristics of "Generation Z." They are no longer the traditional passive audience but active choosers with clear information needs, aesthetic standards, and value judgments. For example, in the questionnaire survey report, "Generation Z" prefers entertainment news (76.06%), while paying less attention to financial news (13.39%). This preference not only reflects their interest orientation but also their judgment on the value of different types of information.

Information Overload and Attention Diversion: Information overload is an important cause of news avoidance. In recent decades, the media environment has undergone tremendous changes, with a sharp increase in the amount of available content, leading people into a high-choice media environment. Under such circumstances, "Generation Z" faces unprecedented information pressure, with attention becoming a scarce resource, thus necessitating selective avoidance. Psychological defense mechanisms play an important role in news avoidance. When individuals are exposed to excessive information stimuli, they may experience cognitive overload and decision-making difficulties. News avoidance becomes a self-protection strategy, reducing information exposure to maintain mental health. While this avoidance behavior may alleviate anxiety in the short term, it can lead to information bias and cognitive limitations in the long run.

4.2.2 Objective causes: environmental constraints

Algorithmic Recommendations and Information Cocoons: Algorithmic recommendation technology provides users with personalized information while potentially reinforcing existing preferences, forming information cocoons. When "Generation Z" is constantly exposed to content that matches their preferences, they naturally develop avoidance behavior towards news that does not conform to their preferences. This technology-driven avoidance is often unconscious but has a more profound impact. Algorithmic recommendation systems analyze user behavior data (clicks, dwell time, interactions, etc.) to build user profiles and recommend content based on similarity principles. While this mechanism enhances user experience, it may also narrow the information horizon. The more users avoid a certain type of information, the less likely the algorithm is to recommend that type of information, creating a negative feedback loop. This "algorithmic bias" may exacerbate information segregation and polarization among social groups.

Information Disorder and Trust Crisis: The survey shows that 64.31% of "Generation Z" have a decreased trust in news media. Phenomena of information disorder, such as fake news, clickbait, and content homogenization, severely damage the credibility of the media. When audiences lose trust in the media, news avoidance behavior naturally arises. Information disorder not only includes the spread of false information but also the decline in information quality, content homogenization, and excessive commercialization. In a traffic-oriented media environment, some media outlets resort to exaggerated headlines, emotional expressions, and fragmented presentations to attract attention, compromising the professionalism and solemnity of news. This "survival of the fittest" phenomenon leads to an overall decline in news quality, thereby affecting audience trust and consumption willingness.

4.3 Impact of Demographic Variables

To further examine the drivers of news avoidance behaviour, we tested four demographic variables.

Gender Differences

An independent-samples t-test revealed no significant difference between male ($M = 3.59$, $SD = 0.86$) and female ($M = 3.61$, $SD = 0.83$) respondents, $t(309) = -0.27$, $p = .789$, $d = 0.02$, 95% CI $[0.15, -0.20]$ (Table 3).

Table 3 News avoidance by gender (mean \pm SD); $t(309) = -0.27$, $p = .789$, $d = 0.02$, 95 % CI $[0.15, -0.20]$, $N = 311$

	Gender	N ^o	Mean	standard deviation	t ^o	p ^o
"Generation Z" News Avoidance Behavior	Male	158	3.59	0.86	-0.268	0.789
	Female	153	3.61	0.83		
	Total	311	3.6	0.84		

* $p < 0.05$ ** $p < 0.01$

Educational Background

A one-way ANOVA showed a significant main effect of education, $F(2, 308) = 7.80$, $p < .001$, $\eta^2 p = .05$. Post-hoc Tukey HSD indicated that respondents with an associate degree or below ($M = 3.86$, $SD = 0.65$) scored higher than both bachelor's ($M = 3.50$, $SD = 0.92$) and master's-level respondents ($M = 3.43$, $SD = 0.89$); the latter two did not differ (Table 4).

Table 4 News Avoidance by Education Level (mean); $F(2, 308) = 7.80$, $p < .001$, $\eta^2 p = .06$, $N = 311$. Post-hoc Tukey HSD: associate-degree group > bachelor = master groups

Educaton	N	Mean	SD	F	p
Junior College and Below	105	3.86	0.65	7.796	0.000**
Bachelor's Degree	104	3.5	0.92		
Postgraduate	311	3.6	0.84		

* $p < 0.05$ ** $p < 0.01$

Academic Major

Journalism-communication majors ($M = 3.52$, $SD = 0.85$) and non-journalism majors ($M = 3.68$, $SD = 0.83$) reported similar avoidance levels, $t(309) = -1.65$, $p = .10$, $d = 0.19$, 95 % CI $[-0.35, 0.03]$ (Table 5).

Table 5 News Avoidance by Major (mean \pm SD); $t(309) = -1.65$, $p = .10$, $d = 0.19$, 95 % CI $[-0.35, 0.03]$, $N = 311$.

	Major	N	Mean	standard-deviation	t	p
"Generation Z" News Avoidance Behavior	Journalism & Communication	152	3.52	0.85	-1.649	0.1
	Journalism & Non-Journalism Communication	159	3.68	0.83		
Total		311	3.6	0.84		

* $p < 0.05$ ** $p < 0.01$

Regional Differences

Northern-region respondents ($M = 4.07$, $SD = 0.58$) scored significantly higher than southern-region respondents ($M =$

3.12, SD = 0.80), $t(309) = -11.95$, $p < .001$, $d = 1.36$, 95 % CI [0.82, 1.90] (Table 6).

Table 6 News Avoidance by Region (mean \pm SD); $t(309) = -11.95$, $p < .001$, $d = 1.36$, $N = 311$. Northern-Region Respondents Scored Significantly Higher (i.e., greater news avoidance) than Southern-region Respondents

Region	N	Mean	SD	t	p
Southern Region	155	3.12	0.8	–	
Northern Region	156	4.07	0.58	–11.95	–0.000**
Total	311	3.6	0.84	–	

* $p < 0.05$ ** $p < 0.01$

5 DISCUSSION

5.1 Dual Impact of News Avoidance Behavior

5.1.1 Negative impact

Individual Level: Information Cocoons and Cognitive Rigidity: News avoidance behavior may lead "Generation Z" into information cocoons, narrowing the scope of information exposure and rigidifying cognitive structures. Long-term avoidance of news that contradicts existing views will reinforce cognitive biases and affect the cultivation of critical thinking skills. This information bias phenomenon is not conducive to the comprehensive development of individuals. For example, a study on college students found that those who frequently avoid news often show lower information processing and critical thinking skills when facing complex social issues.

Societal Level: Decline of Publicness and Social Differentiation: When a large number of "Generation Z" avoid public affairs news, it may lead to a decline in citizen participation and the decline of publicness. Different groups, based on their preferences, selectively expose themselves to information, which may exacerbate social differentiation and affect the formation of social consensus, having a negative impact on the democratic process. For example, in some social hotspot events, due to uneven information acquisition, the differences in viewpoints between different groups are further amplified, leading to the intensification of social contradictions.

5.1.2 Positive impact

Individual Level: Enhancing Autonomy and Mental Health: Moderate news avoidance helps "Generation Z" maintain mental health in an information-overloaded environment. By avoiding negative and anxiety-inducing news, they can reduce information anxiety and enhance their sense of control over life. This selective exposure reflects individual media literacy and autonomy. For example, some respondents indicated that they would temporarily stay away from social media when facing a large amount of negative news to maintain a good mental state.

Industry Level: Promoting Innovation in Journalism: The phenomenon of news avoidance forces the news industry to reflect on and innovate itself. When a large number of audiences avoid traditional news, the media are forced to rethink how to improve content production and dissemination methods to re-attract audiences. This pressure helps promote the innovative development of the news industry. For example, some media have begun to try more interactive and immersive forms of news reporting to attract young audiences.

5.2 Theoretical Framework for Countermeasures

Based on Lasswell's "5W" communication model, this study constructs a countermeasure framework for dealing with the news avoidance behavior of "Generation Z" from five levels: communicator, content, channel, audience, and effect.

Communicator Level: Practicing the "Four Powers" of News Media, namely, physical strength, vision, brainpower, and writing ability, to improve the quality and attractiveness of news reporting. By delving into the grassroots, observing society, thinking deeply, and expressing precisely, news products that "Generation Z" is willing to watch and likes to watch can be produced.

Content Level: Empowering Content Production with New Technologies. Fully utilizing new technologies such as artificial intelligence, big data, and virtual reality to innovate the production methods and presentation forms of news content. By adopting new forms such as data journalism, immersive reporting, and interactive news, the attractiveness and dissemination effectiveness of news can be enhanced.

Channel Level: Promoting the Platformization of Mainstream Media. Mainstream media should actively adapt to the trend of platformization, strengthen cooperation with social media platforms while maintaining content advantages, and expand dissemination channels. By building autonomous and controllable platforms, the ability to reach "Generation Z" can be enhanced.

Audience Level: Cultivating New Media Literacy. Strengthening media literacy education for "Generation Z" and cultivating their abilities in information screening, critical thinking, and diverse information exposure. Through educational guidance, helping "Generation Z" establish healthy information consumption habits and reducing irrational news avoidance.

Effect Level: Developing Human-Computer Interaction Feedback. Establishing an effective human-computer interaction feedback mechanism to timely understand the information needs and preference changes of "Generation Z." By using data analysis and user surveys, content strategies can be dynamically adjusted to improve the precision and effectiveness of dissemination.

6 CONCLUSIONS AND IMPLICATIONS

6.1 Main Conclusions

Based on the empirical analysis of 311 valid questionnaires, the following main conclusions are drawn:

1. The news consumption habits of "Generation Z" are characterized by socialized channels, entertaining content, and visualized forms, while also exhibiting significant disconnect behavior[6].
2. News avoidance behavior is mainly caused by personal preferences, information overload, algorithmic recommendations, and information disorder, with subjective and objective avoidance interacting with each other.
3. News avoidance behavior has dual impacts: it may lead to negative consequences such as information cocoons and social differentiation, but it may also enhance individual autonomy and promote innovation in the news industry.
4. There are significant differences in news avoidance behavior among "Generation Z" with different educational levels and from different regions, while no significant differences are found based on gender and major.

6.2 Theoretical Contributions

Innovation in Research Perspective: Focusing the research object on the "Generation Z" group of digital natives enriches the theoretical research on news avoidance behavior.

Construction of Analytical Framework: Based on the "5W" model, a countermeasure framework is constructed, providing a systematic analytical tool for related research.

Empirical Data Supplement: Through large-sample questionnaire surveys, empirical evidence for the study of news avoidance behavior is provided in the Chinese context[7].

6.3 Practical Implications

Implications for the News Industry: News organizations should pay attention to the changing information needs of "Generation Z" and re-establish connections with young audiences through content innovation, channel expansion, and form optimization. For example, they can try more interactive and immersive forms of news reporting to attract young audiences.

Implications for Policy Making: Relevant departments should pay attention to the potential social impacts of news avoidance and maintain a healthy media ecosystem through strengthening media regulation, promoting media convergence, and enhancing public media literacy.

Implications for Education: Educational institutions should strengthen media literacy education for "Generation Z" and cultivate rational and diverse information consumption habits. For example, they can offer relevant courses to help students establish healthy information consumption habits[8].

6.4 Research Limitations and Future Outlook

This study has certain limitations: First, the sample was mainly obtained through convenience sampling, which may introduce selection bias; second, cross-sectional data cannot reveal the dynamic changes in news avoidance behavior; third, the study did not delve into the differences among different types of news avoidance behavior. Future research can be carried out in the following directions: First, adopting a longitudinal research design to track the trends in news avoidance behavior; second, using in-depth interviews and other qualitative methods to better understand the psychological mechanisms behind news avoidance behavior; third, expanding the sample scope to improve the representativeness and universality of the research[9].

COMPETING INTERESTS

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THE IMPACT OF ECOLOGICAL MIGRATION ON ECOLOGICAL ENVIRONMENT AND LIVELIHOOD WELL-BEING SATISFACTION: AN EMPIRICAL ANALYSIS BASED ON HEZE CITY, SHANDONG PROVINCE

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Abstract: Ecological migration constitutes an essential component of China's ecological civilization construction, aiming to achieve dual goals of ecological restoration and livelihood improvement. Using three counties and seven ecological resettlement communities along the Yellow River in Heze City, Shandong Province as research samples, this study constructs a three-dimensional participation framework of "cognitive-affective-behavioral" engagement. Through reliability and validity tests, correlation analysis, analysis of variance, and multiple regression methods, the study systematically explores the influence mechanism of migrants' participation on satisfaction with the ecological environment and livelihood well-being. The findings indicate that: (1) Overall, post-relocation migrants report higher satisfaction with the ecological environment than with livelihood well-being, yet exhibit relatively low behavioral participation, revealing a structural pattern of "cognition-affection leading, behavior lagging." (2) Multidimensional participation significantly enhances both ecological and livelihood satisfaction, among which cognitive participation exerts the strongest direct effect on livelihood well-being satisfaction, while affective and behavioral participation indirectly influence it through improved ecological environment satisfaction. (3) Ecological environment satisfaction plays a partial mediating role in the "participation-well-being" relationship, unveiling the intrinsic coupling mechanism between ecological construction and livelihood improvement. The study concludes that the sustainable development of ecological migration depends not only on material resettlement but also on migrants' initiative and agency in institutional participation, social identity, and behavioral practice. Strengthening grassroots participatory governance, rebuilding community emotional cohesion, and improving ecological industrial incentive mechanisms are identified as key pathways to achieving synergistic enhancement of ecological protection and livelihood well-being in the Yellow River Basin.

Keywords: Middle and lower reaches of the Yellow River; Ecological migration; Ecological environment; Livelihood well-being; Satisfaction survey

1 INTRODUCTION

As an essential component of ecological civilization construction, ecological migration serves as a key policy instrument for coordinating the human-land relationship and achieving the dual goals of ecological restoration and livelihood improvement [1]. International research has shown that since the 1990s, ecological migration has gradually shifted from a passive response to environmental displacement toward an active approach to ecological governance [2]. Its core lies in achieving a dynamic balance between ecological security and social well-being through institutional design and community participation. Domestic studies similarly emphasize that ecological migration is not merely a technical measure of environmental protection, but a transformative process of social structure and lifestyle reconstruction, the effectiveness of which depends largely on migrants' level of participation in ecological governance and community rebuilding [3-4].

The Yellow River Basin represents one of the earliest, largest, and most complex regions for implementing China's ecological migration policy. In recent years, with the advancement of the Ecological Protection and High-Quality Development Strategy of the Yellow River Basin, ecological migration has evolved from the initial goals of "moving out and settling down" to the higher objectives of "becoming prosperous and integrating well". However, post-relocation ecological restoration and livelihood enhancement are not automatically achieved. Existing research has primarily evaluated post-migration outcomes in terms of income growth, housing improvement, and social security, yet has rarely examined how migrants' participatory behaviors influence their overall satisfaction with the ecological environment and livelihood well-being [5]. In this process, whether migrants cognitively understand the policy, emotionally identify with their communities, and behaviorally participate in governance directly affects the sustainability and effectiveness of post-relocation development.

Against this backdrop, this study focuses on typical resettlement villages in three counties along the Yellow River in Heze City, Shandong Province. It seeks to explore the "participation-satisfaction" causal chain by addressing three research questions:

(1) What is the overall level of ecological and livelihood satisfaction among post-relocation ecological migrants?

- (2) How do cognitive, affective, and behavioral participation differ in influencing ecological environment satisfaction and livelihood well-being satisfaction?
- (3) Does ecological environment satisfaction play a mediating role between participation level and livelihood well-being satisfaction?

By constructing an empirical model incorporating multidimensional participation variables and controlling for demographic characteristics, this study aims to reveal the intrinsic mechanisms through which migrants' participation enhances their post-relocation quality of life and ecological perceptions.

2 LITERATURE REVIEW

Since the 1990s, research on ecological migration has gradually shifted from “environmentally driven passive relocation” to “institutionally guided proactive governance.” Black et al. argued that environmental change interacts with economic, social, and institutional factors to shape migration behavior [2], while McLeman conceptualized migration as an adaptive strategy for coping with ecological degradation, emphasizing the importance of institutional design and community participation [6]. This paradigm shift has transformed ecological migration into a crucial institutional arrangement for building ecological civilization, with objectives that extend beyond ecological restoration to include social stability and livelihood improvement [1]. In the Chinese context, ecological migration has been incorporated into the national framework for ecological civilization construction, serving as a key measure to balance human–land relationships and promote coordinated regional development [7].

With the evolution of environmental governance concepts, participatory governance has emerged as a critical perspective for explaining the effectiveness of ecological migration. Reed highlighted that stakeholder participation can significantly enhance the sustainability of ecological governance [8], while Pretty defined participation as a process of learning and co-governance, emphasizing the synergistic role of cognitive, affective, and behavioral dimensions in social governance [9]. Subsequent studies demonstrated that residents' cognitive understanding, emotional identification, and behavioral participation can markedly improve policy acceptance and satisfaction [10]. Moreover, post-relocation community satisfaction depends not only on improvements in income and housing but also on social integration and environmental identification [5, 11], providing theoretical support for examining the “participation–satisfaction” mechanism in ecological migration.

Although previous research has confirmed the positive effects of ecological migration on ecological restoration and livelihood improvement [12], two major gaps remain in post-relocation studies. First, existing literature primarily focuses on objective indicators, lacking systematic analysis of migrants' subjective perceptions and participatory behaviors. Second, few empirical studies have explored the intrinsic relationship between ecological environment satisfaction and livelihood well-being satisfaction. To address these gaps, this study takes ecological resettlement communities along the Yellow River in Heze City, Shandong Province, as its research sample. It constructs an analytical framework of “multidimensional participation–ecological environment satisfaction–livelihood well-being satisfaction,” aiming to reveal, from a micro-level perspective, the mechanism through which ecological migration influences satisfaction with both ecological environment and livelihood well-being.

3 RESEARCH DESIGN

3.1 Research Hypotheses

In the field of ecological migration and environmental governance, scholars generally agree that individual participation constitutes a key mechanism influencing the effectiveness of ecological policies. Reed emphasized that community participation not only enhances the sustainability of ecological governance but also improves residents' recognition and satisfaction with environmental policies [8]. From the perspective of social learning, Pretty proposed that participation is a progressive process encompassing three dimensions—cognitive, affective, and behavioral—whereby residents' policy understanding (cognitive participation), emotional identification (affective participation), and practical engagement (behavioral participation) jointly form the internal structure of participatory governance [9]. This multidimensional participation framework has been widely applied in studies of environmental governance and community reconstruction.

Furthermore, existing research has confirmed a significant positive correlation between public participation in environmental governance and environmental satisfaction. Participation at the cognitive level enhances environmental attitudes through information acquisition, policy comprehension, and risk perception [13], thereby improving evaluations of ecological restoration and environmental quality. Participation at the affective level strengthens residents' emotional attachment and environmental identity to their resettlement areas, helping to alleviate potential psychological imbalances during the migration process [14]. Participation at the behavioral level, manifested through residents' actions in environmental protection, community governance, and resource utilization, promotes improvements in ecological conditions and the reconstruction of social order [15]. Hence, individual participation functions not only as a pathway variable in ecological governance but also as an important psychological mechanism influencing ecological satisfaction.

Within the context of ecological migration, migrants' satisfaction after relocation depends not only on improvements in objective conditions but also on their subjective experiences of participation. Domestic scholars have found that the effectiveness of migration policies largely hinges on the extent of migrants' involvement across cognitive, affective, and

behavioral dimensions: on the one hand, policy understanding at the cognitive level helps reduce institutional uncertainty; on the other hand, affective identification and active behavioral engagement facilitate synergistic effects in environmental governance [15-16]. Accordingly, this study proposes the following hypotheses:

H1: Migrants' level of participation has a positive effect on their satisfaction with the ecological environment.

H1a: Cognitive participation has a positive effect on ecological environment satisfaction.

H1b: Affective participation has a positive effect on ecological environment satisfaction.

H1c: Behavioral participation has a positive effect on ecological environment satisfaction.

Compared with ecological environment satisfaction, livelihood well-being satisfaction provides a more comprehensive reflection of post-relocation residents' overall quality of life across material, social, and psychological dimensions. Existing research generally suggests that individual participation is an important pathway to enhancing life satisfaction and subjective well-being [17]. Amartya Sen's Capability Approach posits that human well-being depends not only on objective conditions but also on the extent to which individuals can expand their capabilities and realize their values through social participation [17]. This theoretical perspective has inspired a growing body of empirical studies on the "participation-well-being" relationship.

In the Chinese context, recent empirical studies have increasingly explored the link between public participation and subjective well-being. Based on a meta-analysis of 76 studies, Dong et al. found that public participation significantly improves both environmental governance performance and residents' perceptions of livelihood, and that cognitive, affective, and behavioral participation each contribute positively—albeit to varying degrees—to individual life satisfaction [15]. Similarly, Han et al., in their study on farmers' participation in land transfer, found that higher levels of participation were associated with greater satisfaction in income, social relationships, and overall happiness [18]. These findings collectively indicate that post-relocation migrants' willingness and ability to engage actively in social affairs affect not only their economic adaptation but also their subjective perceptions of livelihood well-being and life quality.

Integrating prior theoretical and empirical evidence, it can be inferred that migrants' cognitive, affective, and behavioral participation during the post-relocation stage influence their livelihood well-being satisfaction through three distinct mechanisms. First, cognitive participation enhances individuals' confidence in institutional fairness and public service delivery at a rational level. Second, affective participation strengthens community identification and psychological belonging, thereby alleviating social distance and cultural alienation caused by relocation. Third, behavioral participation enables individuals to obtain tangible benefits and psychological fulfillment through involvement in community co-governance, public affairs, and resource sharing [19]. The synergistic effect of these three dimensions contributes to higher levels of livelihood well-being satisfaction among ecological migrants. Accordingly, this study proposes the following hypotheses:

H2: Migrants' level of participation has a positive effect on their livelihood well-being satisfaction.

H2a: Cognitive participation has a positive effect on livelihood well-being satisfaction.

H2b: Affective participation has a positive effect on livelihood well-being satisfaction.

H2c: Behavioral participation has a positive effect on livelihood well-being satisfaction.

From the perspective of the relationship between the ecological environment and livelihood well-being, ecological environment satisfaction serves as a crucial variable influencing residents' quality of life and overall well-being. Existing studies have demonstrated that favorable natural and living environments can significantly enhance life satisfaction by improving health, safety, and social participation [20-22]. Biedenweg et al. found that experiences with the natural environment foster social relationships and psychological belonging, thereby promoting life satisfaction [10]. Similarly, Brown and Raymond revealed that residents' emotional attachment to the environment and recognition of landscape values play a positive role in shaping subjective well-being [14].

In the Chinese context, Gao et al., through an investigation of resettled rural communities in Suqian, observed that improvements in ecological and neighborhood environments significantly increased residents' post-relocation life satisfaction [5]. Huang et al., using urban compulsory relocation as a case, confirmed that higher residential environmental quality leads to stronger satisfaction with life outcomes [11]. Wu et al. further demonstrated that the implementation of ecological migration policies substantially enhances migrants' environmental perception and life happiness [12], while Zhang et al. found that residents relocated to ecologically suitable areas reported higher levels of livelihood well-being [4]. Taken together, these findings suggest that ecological environment satisfaction enhances individuals' sense of security, health, and social identity, which in turn promotes positive evaluations of their living conditions. Accordingly, this study proposes the following hypotheses:

H3: Ecological environment satisfaction has a significant positive effect on livelihood well-being satisfaction.

3.2 Data Sources

The research team conducted a field survey across seven villages in three counties (districts) of Heze City, Shandong Province. Data were collected through questionnaires, interviews, and on-site observations to capture rural residents' perceptions and feedback regarding ecological environment protection, living conditions, living standards, and social security after relocation. A structured questionnaire was designed to measure multiple dimensions, including ecological migrant participation, ecological environment satisfaction, and livelihood well-being satisfaction. Using random sampling, residents from the seven villages across the three counties (districts) were invited to complete the survey. In total, 225 questionnaires were distributed, and 215 were returned. After excluding responses with excessively short or

long completion times and those containing incomplete information, 210 valid questionnaires were retained, yielding a valid response rate of 93.3%.

3.3 Questionnaire Reliability and Validity Testing

The reliability analysis results indicate that the overall reliability of the questionnaire is satisfactory. The Cronbach's α coefficients for the affective participation and cognitive participation dimensions are 0.765 and 0.794, respectively, both exceeding the 0.7 threshold, suggesting a high level of internal consistency. Although the behavioral participation dimension shows a relatively lower reliability coefficient ($\alpha = 0.624$), it still maintains acceptable explanatory power. For the two outcome variables, the Cronbach's α coefficients of ecological environment satisfaction and livelihood well-being satisfaction are 0.838 and 0.843, respectively, indicating strong reliability of the measurement instruments [23].

In terms of validity testing, the Kaiser-Meyer-Olkin (KMO) value of the questionnaire is 0.903, far exceeding the acceptable threshold of 0.7, demonstrating that the sample data are well-suited for factor analysis. The Bartlett's test of sphericity is also significant ($\chi^2 = 3537.983$, $df = 595$, $p < 0.001$), confirming the questionnaire's strong structural validity [24]. These reliability and validity results provide a solid empirical foundation for subsequent hypothesis testing.

In summary, the study's hypothesis framework is methodologically rigorous, encompassing the multidimensional pathways of migrant participation while modeling the logical relationship between ecological environment satisfaction and livelihood well-being satisfaction. The descriptive statistics clearly depict the demographic and social characteristics of the sample, highlighting the contextual relevance of the research. The reliability and validity analyses confirm the sound psychometric properties of the scales, ensuring the scientific rigor and credibility of the study's conclusions.

4 RESULTS

4.1 Descriptive Analysis

In terms of descriptive statistics, the sample of this study covers 210 respondents, with relatively diverse group characteristics. The age distribution shows that those aged 31–45 (29.05%) and 46–59 (30.48%) constitute the main groups, followed by those 60 years and above (24.76%), while the proportion of the youth group is relatively low. Regarding educational attainment, respondents with primary school and below (31.43%) and junior middle school (28.57%) account for nearly 60 percent, whereas the proportions of junior college (10.48%) and bachelor's degree and above (5.71%) are relatively low, reflecting an overall lower educational level in the sample. In terms of political affiliation, the majority are the general public (63.33%), Party members account for about 30.48%, and League members have the lowest proportion. In occupation types, agricultural production is the main form of employment (47.29%), followed by casual labor (19.70%) and self-employment (13.79%), indicating that the group as a whole is still dominated by traditional agriculture. Most respondents are employed within their own township (76.08%), reflecting relatively low regional mobility. In terms of sources of income, agricultural income and asset-based income are the main sources (44.24% and 38.79%), while the shares of government subsidies and transfer income are smaller. These results not only present the demographic structural characteristics of the sample but also provide a basis for subsequent tests of differences in satisfaction and participation across groups with different characteristics.

4.2 Correlation Analysis

In the correlation analysis, the relationships among the core variables show a high degree of consistency and significance. There is a significant positive correlation between ecological environment satisfaction and livelihood well-being satisfaction ($r = 0.637$, $p < 0.001$), indicating that individuals who are more satisfied with the ecological environment also tend to have higher satisfaction with their overall livelihood well-being.

All three dimensions of participation demonstrate significant positive correlations with both satisfaction indicators, though the correlation strengths vary. The correlation coefficient between cognitive participation and livelihood well-being satisfaction is the highest ($r = 0.706$, $p < 0.001$), suggesting that cognitive investment at the rational level has a profound impact on individuals' perceptions of overall life quality. Affective participation is also strongly correlated with livelihood well-being satisfaction ($r = 0.633$, $p < 0.001$), highlighting the crucial role of emotional identification and sense of belonging in shaping satisfaction with life. Behavioral participation shows relatively lower but still significant positive correlations (with livelihood well-being satisfaction: $r = 0.608$, $p < 0.001$; with ecological environment satisfaction: $r = 0.506$, $p < 0.001$), implying that while actual behavioral engagement is not as strong as cognitive or affective involvement, it remains an important influencing factor.

On the whole, the three dimensions of participation are also highly interrelated, particularly between cognitive participation and affective participation, which exhibit a correlation coefficient as high as 0.742 ($p < 0.001$), indicating that participation behaviors are often jointly driven by cognitive and emotional engagement.

Table 1 Correlations among Core Variables

Pearson Correlation	Mean SD	Ecological Environment Satisfaction	Livelihood Well-being Satisfaction	Cognitive Participation	Affective Participation	Behavioral Participation
Ecological Environment Satisfaction	3.9830.612	1				
Livelihood Well-being Satisfaction	3.6180.513	0.637***	1			
Cognitive Participation	4.1290.853	0.531***	0.706***	1		
Affective Participation	4.3590.683	0.512***	0.633***	0.742***	1	
Behavioral Participation	3.0190.696	0.506***	0.608***	0.668***	0.558***	1

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

4.3 Analysis of Variance

4.3.1 Analysis of differences among age groups

In the difference analysis, this study conducted ANOVA tests to examine the variations in participation, ecological environment satisfaction, and livelihood well-being satisfaction among migrants with different demographic backgrounds. The results show that age has a significant effect on several core variables. Specifically, cognitive participation varies significantly across age groups ($F = 2.870$, $p = 0.024$), with younger groups demonstrating higher levels of cognitive participation, while those aged 60 and above exhibit the lowest level. Ecological environment satisfaction also differs significantly by age ($F = 2.522$, $p = 0.042$), with younger groups generally reporting higher satisfaction than older groups, indicating age-based differences in perceptions and satisfaction regarding the ecological environment. More notably, livelihood well-being satisfaction decreases with age, showing a highly significant difference ($F = 5.387$, $p < 0.001$), which may be related to the increased living costs and changing needs that come with aging.

Table 2 Differences in Core Variables among Age Groups

Variables	17 and below (n=6)	18–30 (n=27)	31–45 (n=61)	46–59 (n=64)	60 and above (n=52)	F	p
Cognitive Participation	4.389±0.953	4.370±0.775	4.284±0.827	4.094±0.872	3.833±0.828	2.87	0.024*
Affective Participation	4.667±0.558	4.556±0.539	4.388±0.684	4.365±0.676	4.179±0.742	1.819	0.126
Behavioral Participation	3.300±0.735	3.067±0.659	3.062±0.685	3.041±0.746	2.885±0.662	0.834	0.505
Ecological Environment Satisfaction	4.537±0.518	4.177±0.617	3.998±0.646	3.906±0.614	3.893±0.533	2.522	0.042*
Livelihood Well-being Satisfaction	4.156±0.559	3.835±0.542	3.651±0.544	3.610±0.485	3.414±0.397	5.387	0.000***

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

4.3.2 Analysis of Differences among educational levels

In terms of education, the differences are particularly pronounced. Cognitive participation, affective participation, behavioral participation, ecological environment satisfaction, and livelihood well-being satisfaction all show significant differences among groups with different educational levels ($p < 0.001$). The overall trend indicates that the higher the level of education, the greater the degree of participation and satisfaction. For example, respondents with junior college or bachelor's degrees and above scored significantly higher in both cognitive and affective participation compared with those with primary school education or below. Similarly, ecological environment satisfaction and livelihood well-being satisfaction also increase with higher educational attainment. These findings suggest that education not only enhances migrants' understanding and ability to participate in public affairs but also strengthens their perception of improvements in living environments and welfare.

Table 3 Differences in Core Variables among Educational Levels

Variables	Primary or Below (n=66)	Junior Middle School (n=60)	Secondary/Technical/High School (n=50)	Junior College (n=22)	Bachelor's and Above (n=12)	F	p
Cognitive Participation	3.758±0.834	4.072±0.846	4.333±0.747	4.727±0.531	4.500±0.980	8.164	0.000***
Affective Participation	4.076±0.751	4.383±0.640	4.520±0.607	4.697±0.435	4.500±0.689	5.459	0.000***
Behavioral Participation	2.706±0.548	2.983±0.675	3.184±0.774	3.545±0.596	3.267±0.535	8.741	0.000***
Ecological Environment Satisfaction	3.785±0.524	3.920±0.657	4.073±0.599	4.374±0.510	4.287±0.613	5.607	0.000***

Livelihood Well-being Satisfaction	3.389±0.430	3.603±0.541	3.804±0.484	3.867±0.466	3.722±0.521	7.1040.000***
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Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

4.3.3 Analysis of differences among political affiliations

Significant differences are also observed across political affiliations. Party members and League members score substantially higher than the general public in all three participation dimensions — cognitive participation ($F = 13.909$, $p < 0.001$), affective participation ($F = 7.915$, $p < 0.001$), and behavioral participation ($F = 15.784$, $p < 0.001$). Similarly, both ecological environment satisfaction and livelihood well-being satisfaction differ significantly among political groups ($p < 0.05$), with Party members reporting the highest overall satisfaction. These results may reflect the stronger sense of social responsibility, policy awareness, and access to institutional resources associated with political affiliation. Consequently, individuals with formal political identities tend to be more engaged in community affairs and express higher satisfaction levels with their ecological and livelihood conditions.

Table 4 Differences in Core Variables among Political Affiliations

Variables	Communist Youth League Members (n=13)	Communist Party Members (incl. probationary) (n=64)	Non-affiliated Public (n=133)	F	p
Cognitive Participation	4.641±0.552	4.484±0.713	3.907±0.864	13.909	0.000***
Affective Participation	4.718±0.542	4.568±0.602	4.223±0.697	7.915	0.000***
Behavioral Participation	3.323±0.635	3.356±0.671	2.827±0.643	15.784	0.000***
Ecological Environment Satisfaction	4.197±0.637	4.134±0.590	3.889±0.604	4.451	0.013*
Livelihood Well-being Satisfaction	3.754±0.476	3.802±0.472	3.516±0.511	7.645	0.001***

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

4.3.4 Analysis of differences among occupational types

Significant statistical differences are observed across occupational groups in terms of cognitive participation, affective participation, and ecological environment satisfaction. Respondents with stable employment in enterprises reported the highest levels of both cognitive and affective participation, while temporary workers and self-employed individuals scored relatively lower (cognitive participation: $F = 5.419$, $p < 0.001$; affective participation: $F = 2.580$, $p = 0.039$; ecological environment satisfaction: $F = 3.420$, $p = 0.010$). Differences were also found in livelihood well-being satisfaction across job types ($F = 2.632$, $p = 0.036$), with formally employed respondents exhibiting the highest satisfaction, and temporary workers the lowest. This finding underscores the crucial role of stable employment in enhancing ecological migrants' sense of social integration and overall satisfaction with life after relocation.

Table 5 Differences in Core Variables among Occupational Types

Variables	Agricultural Production (n=96)	Self-employed (n=28)	Fixed Employment (>1 year) (n=26)	Temporary Work (n=40)	Others (n=13)	F	p
Cognitive Participation	4.295±0.758	3.964±0.813	4.487±0.675	3.700±1.001	3.923±0.954	5.419	0.000***
Affective Participation	4.424±0.715	4.226±0.679	4.628±0.435	4.142±0.704	4.282±0.705	2.58	0.039*
Behavioral Participation	3.129±0.684	2.907±0.719	3.123±0.640	2.780±0.659	3.000±0.702	2.209	0.069
Ecological Environment Satisfaction	4.101±0.603	3.810±0.548	4.073±0.500	3.744±0.636	3.863±0.647	3.42	0.010**
Livelihood Well-being Satisfaction	3.653±0.506	3.569±0.489	3.851±0.431	3.475±0.564	3.472±0.487	2.632	0.036*

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

4.3.5 Analysis of differences among economic sources

The analysis of economic sources further highlights group-level variations. Significant differences were found in cognitive participation and affective participation across different income sources ($p < 0.05$). Respondents whose income mainly derives from agricultural activities or asset-based earnings scored higher in both dimensions, while those dependent on transfer payments (such as subsidies or family support) scored the lowest. A similar trend was observed in ecological environment satisfaction and livelihood well-being satisfaction ($p < 0.05$). Migrants relying on agricultural income or government subsidies exhibited higher satisfaction levels, whereas those depending primarily on subsidies and remittances showed significantly lower satisfaction. This pattern underscores the vital role of economic independence and stability of income sources in shaping post-relocation satisfaction.

Overall, the results of the difference analysis indicate that age, education, political affiliation, occupation, and economic sources collectively influence migrants' participation and satisfaction levels. Younger, better-educated, politically active,

and stably employed individuals with reliable economic sources demonstrate stronger cognitive, affective, and behavioral participation and report higher ecological and livelihood satisfaction. These findings reveal disparities in social participation and life experiences among different groups and suggest that policies should focus on improving education, promoting stable employment, and optimizing resource allocation to enhance migrants' overall satisfaction and social integration.

Table 6 Differences in Core Variables among Economic Sources

Variables	Agricultural Income (n=73)	Non-agricultural Employment (n=17)	Asset Income (n=64)	Transfer Income (n=5)	Government Subsidy (n=6)	F	p
Cognitive Participation	4.237±0.789	4.020±0.731	4.089±0.838	3.067±1.234	3.556±1.167	3.1180	0.017*
Affective Participation	4.434±0.702	4.196±0.708	4.391±0.559	3.600±0.641	4.111±0.779	2.4580	0.048*
Behavioral Participation	3.107±0.725	2.824±0.678	2.891±0.630	2.400±0.316	3.000±0.955	2.003	0.097
Ecological Environment Satisfaction	4.029±0.609	3.732±0.405	3.920±0.591	3.400±0.575	4.278±0.746	2.5050	0.044*
Livelihood Well-being Satisfaction	3.625±0.492	3.529±0.366	3.586±0.426	2.920±0.708	3.544±0.695	2.6840	0.033*

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

4.4 Multiple Regression Model Analysis

4.4.1 Model 1: the impact model of participation on ecological environment satisfaction

Ecological environment satisfaction is taken as the dependent variable, population characteristics as control variables, and each dimension of participation as independent variables to test H1. In the regression analysis, this study takes ecological environment satisfaction as the dependent variable, population characteristics as control variables, and the three dimensions of participation—cognitive, emotional, and behavioral—as independent variables, constructing a model to test Hypothesis H1.

The results show that the overall model fit is good, with $R^2 = 0.394$, adjusted $R^2 = 0.350$, $F(11,150) = 8.879$, $p < 0.001$, indicating that the model has strong explanatory power. Specifically, emotional participation ($B = 0.230$, $t = 2.859$, $p = 0.005$) and behavioral participation ($B = 0.200$, $t = 2.676$, $p = 0.008$) both have significant positive effects on ecological environment satisfaction, while the effect of cognitive participation, though positive, does not reach the level of statistical significance ($B = 0.098$, $t = 1.339$, $p = 0.183$). This means that in the formation process of migrants' ecological environment satisfaction, emotional input and actual behavioral participation play more critical roles, while simple cognitive understanding and identification are not enough to directly improve satisfaction.

As for demographic control variables, most indicators do not have significant effects on ecological environment satisfaction, with only age and work location being close to the significant level ($p = 0.068$ and $p = 0.058$). This suggests that older groups and those working in other places may have potential differences in their perception of environmental satisfaction, but this effect is not yet stable. Other variables (such as education level, political affiliation, and economic source) do not show significant effects. This result further emphasizes that individual subjective participation plays a core role in shaping environmental satisfaction rather than merely relying on social background factors.

Table 7 Regression Analysis Results for Model 1

Variable	Unstandardized Coefficients (B)	Std. Error	Standardized Coefficients (Beta)	t	p	VIF	Tolerance
Constant	1.478	0.299	—	4.946	0.000***	—	—
Cognitive Participation	0.208	0.047	0.368	4.383	0.000***	2.727	0.367
Emotional Participation	0.093	0.053	0.128	1.731	0.085	2.109	0.474
Behavioral Participation	0.125	0.049	0.178	2.52	0.013*	1.934	0.517
Ecological Environment Satisfaction	0.215	0.053	0.267	4.075	0.000***	1.651	0.606
Age	-0.079	0.027	-0.176	-2.938	0.004**	1.385	0.722
Education Level	-0.041	0.027	-0.1	-1.541	0.126	1.621	0.617
Political Affiliation	-0.001	0.027	-0.003	-0.043	0.966	1.436	0.697
Number of Registered Household Members	0.035	0.012	0.157	2.838	0.005**	1.181	0.846
Occupation Type	0.029	0.027	0.084	1.082	0.281	2.348	0.426
Work Location	-0.061	0.033	-0.104	-1.828	0.069	1.255	0.797
Economic Source	-0.014	0.032	-0.033	-0.441	0.66	2.116	0.473

Total Subsidy Amount 0.000 0.000 -0.125 -2.176 0.031* 1.269 0.788

$R^2 = 0.614$

Adjusted $R^2 = 0.583$

$F(12,149) = 19.737, p = 0.000$

Durbin–Watson = 1.766

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

4.4.2 Model 2: the influence model of participation on livelihood well-being satisfaction

Livelihood well-being satisfaction is taken as the dependent variable, population characteristics as control variables, and each dimension of participation as independent variables to test H2. In the regression analysis of Model 2, livelihood well-being satisfaction is used as the dependent variable, population characteristics are taken as control variables, and the three dimensions of participation—cognitive, emotional, and behavioral—are introduced as independent variables to verify research hypothesis H2.

The results show that the model fits well ($R^2 = 0.571$, adjusted $R^2 = 0.539$, $F = 18.136$, $p < 0.001$), indicating that participation and some demographic factors can effectively explain the variation in livelihood well-being satisfaction. Among the independent variables, cognitive participation has the most significant effect ($B = 0.229$, $t = 4.620$, $p < 0.001$), showing that the deeper the migrants' participation in rational understanding and knowledge accumulation, the higher their satisfaction with livelihood well-being. Emotional participation and behavioral participation also have positive effects on livelihood well-being satisfaction ($B = 0.142$, $p = 0.010$; $B = 0.168$, $p = 0.001$), indicating that emotional identification and practical engagement are also important factors that promote the improvement of satisfaction.

Among the control variables, age shows a significant negative effect on livelihood well-being satisfaction ($B = -0.095$, $p < 0.001$), meaning that as age increases, the level of satisfaction tends to decline; number of household members has a positive effect ($B = 0.033$, $p = 0.011$), showing that larger family size may enhance overall well-being through resource sharing or social support; work location and total subsidy amount have certain negative effects ($p < 0.05$), reflecting that working outside the home and relying on subsidies may lead to a lower perception of life quality. Overall, these results confirm Hypothesis H2—that migrants' participation level has a significant positive influence on their livelihood well-being satisfaction.

Table 8 Regression Analysis Results for Model 2

Variable	Unstandardized Coefficients (B)	Std. Error	Standardized Coefficients (Beta)	t	p	VIF	Tolerance
Constant	1.949	0.29	—	6.729	0.000***	—	—
Cognitive Participation	0.229	0.05	0.406	4.62	0.000***	2.695	0.371
Emotional Participation	0.142	0.055	0.197	2.597	0.010*	2	0.5
Behavioral Participation	0.168	0.051	0.24	3.302	0.001**	1.846	0.542
Age	-0.095	0.028	-0.212	-3.41	0.001***	1.354	0.738
Education Level	-0.03	0.028	-0.074	-1.087	0.279	1.605	0.623
Political Affiliation	0.006	0.028	0.013	0.207	0.836	1.43	0.699
Number of Registered Household Members	0.033	0.013	0.149	2.56	0.011*	1.18	0.848
Occupation Type	0.019	0.028	0.053	0.652	0.515	2.326	0.43
Work Location	-0.082	0.035	-0.14	-2.367	0.019*	1.225	0.816
Economic Source	-0.004	0.034	-0.01	-0.124	0.902	2.104	0.475
Total Subsidy Amount	0.000	0.000	-0.127	-2.105	0.037*	1.269	0.788

$R^2 = 0.571$

Adjusted $R^2 = 0.539$

$F(11,150) = 18.136, p = 0.000$

Durbin–Watson = 1.749

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

4.4.3 Model 3: prediction model of livelihood well-being satisfaction incorporating ecological environment satisfaction

Livelihood well-being satisfaction is the dependent variable, and ecological environment satisfaction is added to Model 2 to test H3. In the regression analysis of Model 3, ecological environment satisfaction is introduced as an additional independent variable based on Model 2 to further verify Hypothesis H3. The model's goodness of fit is significantly improved ($R^2 = 0.614$, adjusted $R^2 = 0.583$, $F = 19.737$, $p < 0.001$), indicating that the inclusion of ecological environment satisfaction further enhances the explanatory power for livelihood well-being satisfaction. Specifically, ecological environment satisfaction has a significant positive effect on livelihood well-being satisfaction ($B = 0.215$, $t = 4.075$, $p < 0.001$), suggesting that when migrants' perception of their living environment improves, their overall satisfaction with livelihood well-being also increases accordingly.

Compared with Model 2, cognitive participation remains the strongest positive factor ($B = 0.208$, $p < 0.001$), and behavioral participation continues to be significant ($B = 0.125$, $p = 0.013$). However, emotional participation no longer reaches significance after introducing environmental satisfaction ($B = 0.093$, $p = 0.085$), indicating that the role of emotional engagement may partly influence livelihood well-being satisfaction indirectly through environmental perception.

Among the control variables, the results remain largely consistent: age continues to have a negative effect ($B = -0.079$, $p = 0.004$), number of household members exerts a positive effect ($B = 0.035$, $p = 0.005$), and total subsidy amount has a negative impact ($p = 0.031$), further emphasizing the potential influence of demographic structure and resource allocation on well-being perception.

Table 9 Regression Analysis Results for Model 3

Variable	Unstandardized Coefficients (B)	Std. Error	Standardized Coefficients (Beta)	t	p	VIF	Tolerance
Constant	1.478	0.299	—	4.946	0.000***	—	—
Cognitive Participation	0.208	0.047	0.368	4.383	0.000***	2.727	0.367
Emotional Participation	0.093	0.053	0.128	1.731	0.085	2.109	0.474
Behavioral Participation	0.125	0.049	0.178	2.52	0.013*	1.934	0.517
Ecological Environment Satisfaction	0.215	0.053	0.267	4.075	0.000***	1.651	0.606
Age	-0.079	0.027	-0.176	-2.938	0.004**	1.385	0.722
Education Level	-0.041	0.027	-0.1	-1.541	0.126	1.621	0.617
Political Affiliation	-0.001	0.027	-0.003	-0.043	0.966	1.436	0.697
Number of Registered Household Members	0.035	0.012	0.157	2.838	0.005**	1.181	0.846
Occupation Type	0.029	0.027	0.084	1.082	0.281	2.348	0.426
Work Location	-0.061	0.033	-0.104	-1.828	0.069	1.255	0.797
Economic Source	-0.014	0.032	-0.033	-0.441	0.66	2.116	0.473
Total Subsidy Amount	0.000	0.000	-0.125	-2.176	0.031*	1.269	0.788

$R^2 = 0.614$

Adjusted $R^2 = 0.583$

$F(12,149) = 19.737$, $p = 0.000$

Durbin-Watson = 1.766

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Taken together, the results of the multiple-model analysis indicate that Models 2 and 3 jointly reveal the close relationship between migrants' participation and livelihood well-being satisfaction. Cognitive participation consistently plays a central role, showing that enhancing rational understanding and knowledge level can directly improve individuals' satisfaction with life quality. Emotional and behavioral participation are both significant positive factors in Model 2, but when ecological environment satisfaction is included, the direct effect of emotional participation weakens—implying a mediating role of environmental perception. In Model 3, ecological environment satisfaction is confirmed as a significant predictor, further verifying Hypothesis H3: ecological environment satisfaction is not only an essential component of migrants' life experience but also enhances their overall satisfaction with livelihood well-being by strengthening environmental identification and a sense of security.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Based on a sample of ecological migrants in Heze City, Shandong Province, this study constructed a multidimensional participation model consisting of cognitive, emotional, and behavioral dimensions to explore its effect on ecological environment satisfaction and livelihood well-being satisfaction. The results show that migrants' multidimensional participation significantly enhances both types of satisfaction. Among them, cognitive participation exerts the strongest direct effect on livelihood well-being satisfaction, while emotional and behavioral participation influence it indirectly by improving ecological environment satisfaction. Ecological environment satisfaction plays a partial mediating role in the relationship between participation and well-being, revealing the internal coupling mechanism between ecological construction and livelihood improvement. The study indicates that the sustainable development of ecological migration depends not only on material resettlement but also on the migrants' active participation in cognitive understanding, emotional identification, and behavioral practice. Enhancing migrants' subjectivity and sense of participation is a key pathway to achieving the coordinated advancement of ecological civilization and social well-being, providing empirical support for the transformation of ecological migration policy from "resettlement-oriented" to "participation and co-construction-oriented."

5.2 Recommendations

In the new era, China's ecological migration policy system has been continuously improved. The ecological relocation projects in the middle and lower reaches of the Yellow River have achieved remarkable progress in ecological restoration and livelihood improvement, yet post-relocation challenges remain prominent. These include weak participation awareness, insufficient community integration, low environmental identification, and lagging public service provision. Overall, the institutional design of current policies emphasizes "relocating and stabilizing" but pays insufficient attention to fostering the psychological and social conditions as well as the agency and capability needed for "prosperous integration". As a result, some migrants have developed a passive dependency on state policies and show limited motivation to participate in community building. Based on the empirical results of this study, reforms should focus on institutional design, community reconstruction, and developmental empowerment, so as to promote the transformation of ecological migration from policy-driven relocation to socially embedded integration.

(1) Build a participation-oriented grassroots co-governance system. In the Yellow River floodplain areas such as Heze, the ecological migration policy should shift from administrative resettlement to institutionalized co-governance. Governments should establish a three-tier participation platform composed of "village-level consultation – township coordination – county-level feedback," ensuring migrants' voice and decision-making power in key domains such as land transfer, compensation funds, and public projects. Through institutional arrangements such as policy disclosure, budget transparency, and democratic evaluation, the government can enhance migrants' policy cognition and trust, reducing both policy alienation and welfare dependency. Meanwhile, a post-assessment system for ecological relocation communities should be established, incorporating migrant satisfaction indicators into ecological project performance evaluations to realize institutional feedback and dynamic improvement.

(2) Rebuild community solidarity and cultural identity mechanisms. Ecological migrants along the Yellow River in Heze often face psychological and social reconstruction challenges due to village disintegration and relationship disruption. Local governments and grassroots Party organizations should focus on cultural revitalization and public participation, encouraging village councils, women's federations, and youth volunteer teams to engage in community governance. By promoting custom-reforming activities, local festivals, and moral conventions (such as red-white councils and cultural revitalization initiatives), communities can rebuild social trust and emotional bonds. Cultural identity projects—centered on themes like "The Yellow River Stories" and "Homeland Culture"—should be developed to restore a sense of belonging and historical continuity, enabling ecological migrants to feel "at home" both materially and emotionally.

(3) Improve the ecological industry chain and behavioral incentive mechanisms. At present, industries in the Yellow River floodplain ecological migration areas remain dominated by primary agriculture, lacking diversified support. It is essential to leverage ecological resource advantages to establish a "eco-agriculture – cultural tourism – community services" three-dimensional development pattern. The development of industries such as dairy farming, high-quality grain production, and wetland ecotourism should be encouraged to achieve "ecological assetization"—transforming ecological advantages into economic value. Meanwhile, behavioral incentive mechanisms should be established: residents who actively participate in ecological restoration, waste sorting, and water-saving irrigation can earn points and shared green dividends, translating personal participation into sustainable economic and social returns. Local governments may set up ecological public service positions and migrant entrepreneurship funds to encourage participation in community management and industrial operations, thus enhancing the practical benefits of behavioral participation.

(4) Enhance post-relocation participation capacity and civic awareness. Given that many Heze migrants have relatively low educational levels and limited access to information, it is vital to build an enabling foundation for participation. Party schools, agricultural training centers, and community schools should regularly organize programs on ecological knowledge, vocational skills, and policy literacy. Universities and research institutions should participate in community-based ecological civilization education programs, offering specialized social work and psychological counseling services to strengthen migrants' institutional understanding, sense of self-efficacy, and public consciousness. This will help transform ecological migrants from policy recipients into active participants and co-creators in sustainable development governance.

COMPETING INTERESTS

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THE SYMBIOTIC RELATIONSHIP AND DYNAMIC BALANCE OF THE FIVE GOVERNANCE ELEMENTS IN THE COMMUNITY GOVERNANCE ECOSYSTEM—A CASE STUDY OF COMMUNITY S IN CITY C

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Abstract: To address the dilemma of fragmented governance elements and inadequate coordination in the modernization of urban community governance, this paper introduces ecological theory into community governance to examine the symbiotic relationships among the five governance elements of “politics, rule of law, moral governance, intelligent governance, and self-governance” within the community governance ecosystem, and proposes a theoretical research framework of “element symbiosis-system balance”. Through an in-depth case study of Community S, this paper verifies that Party-building leadership functions as the “core ecological niche” in the community governance ecosystem. It further reveals the dual mechanisms of complementary symbiosis between politics and intelligent governance, and competitive and cooperative symbiosis between rule of law and moral governance. Additionally, this study demonstrates that intelligent governance technology acts as a key lever to break the inefficient balance of traditional governance. This study provides a theoretical explanation and practical path for addressing the fragmentation of governance elements in urban community governance through the achievement of dynamic balance.

Keywords: Community governance; Party-building leadership; Integration of the five governance elements; Symbiotic relationship; Dynamic balance

1 INTRODUCTION

As a basic unit of the national governance system, community governance has played a key role in promoting the modernization of grass-roots social governance. According to the data of the National Bureau of Statistics in 2024, the permanent urban population in China is 943.5 million, and the urbanization rate has reached 67.00%[1]. Community governance is directly related to the daily life of the town population. In the context of the new era, community governance has faced many challenges, such as the diversification of the population structure and interest demands, and the complication of social contradictions.

In academic research on community governance, the academic community currently focuses on the mechanism construction of community governance under the leadership of gross-root Party building and the summary of practice experience. Chen Donghui, based on the leading attributes and organizational characteristics of grassroots core organizations, systematically demonstrated their leading logic in community governance, and from the perspective of organizational networking, analyzed the operational mechanism of these grassroots organizations in coordinating social resources[2]. Zhang Yi et al. focused on the path of institutional innovation and advocated to improve cross-level collaboration and optimize service supply[3]. Chen Ji put forward that “unified linkage” governance model centered on gross-root Party organization integrating social forces and mobilizing multiple subjects, which provides an institutional innovation path for Party-building to guide residents’ self-governance to break through the dilemmas in urban community governance[4]. Wu Lanbo and Yuan Ke proposed that Party-building-led community should anchor a five-innovation framework of demands, technology, culture, inspiration, and resources by strengthening organizational capabilities. And through the adjustment of relationships among subjects and the nesting of governance goal (neighborhood mutual assistance + residents’ self-governance + co-construction and co-presence), it can promote the generation of a composite governance model[5]. Zhang Xuandi analyzed three-fold constraints faced in improving community self-governance efficiency, constructed the multi-collaborative governance system led by Party building, and cultivated a benign community cultural ecosystem and innovative engagement mechanism, which can effectively activating the vitality of grass-roots self-governance and form promotable experiences[6]. Shi Lufu and Liu Hongde proposed that construction of urban residents’ self-governance building should be driven by the dual cores of Party-building coordination (organization framework and rule system) and the connection between legislation and legal principles, and achieve governance modernization through scientifically meshing self-governance units and activating[7]. Some scholars have also demonstrated the leading role of gross-root Party building in community governance in terms of the activating effect of Party embedding on community self-governance[8], structural adjustment in the process of the sinking of the governance system[9], and the specific employment dimensions and methodologies for Party-building leadership[10]. and in terms of summarizing practical experiences, some scholars have refined innovative practices from governance cases, including the response mode of “gross-root demands -

department linkage”[11], construction plan for a “shared community governance”[12,13], and the mechanism of “Party-building-led integration of five types of governance”[14,15].

The gross-root governance system of “integration of five types of governance” centered on political leadership, legal guarantee, moral cultivation, self-governance as the foundation, and intelligent governance support. And through Party-building leading direction, the rule of law regulating order, moral governance cultivating the folk customs, self-governance activating vitality, and intelligent empowering efficiency, the multi-dimension collaborative governance mode can be formed. Some scholars used related theoretical qualitative analysis to conduct research on how “Five-governance Integration” on promoting urban governance, and demonstrated its advantages in integrating resources and promoting efficiency, meeting the needs of complex modernization governance, constructing a co-construction, co-governance and sharing pattern with multi-party participation, guaranteeing long-term stability with policies, as well as promoting the transformation of modernization of gross-root governance system and capacity. However, the existing studies explore the community governance mechanism from a single dimension: either focusing on the political integration function and value cohesion function of Party-building leadership, or emphasizing its core role in the process of governance modernization, or paying more attention on the empowering effect of intelligent governance technology, but rarely systematically explaining the symbiotic relationships and dynamic balance mechanism among the elements of politics, rule of law, moral governance, self-governance, and intelligent governance[16-18]. At the same time, ecological theory has been innovatively introduced into the field of social governance. Currently, the studies on community governance ecosystem are mainly reflected in two aspects: one is the macro-analysis framework based on social ecosystem theory, emphasizing on multi-level system coupling with less focus on the micro-mechanism of element interaction within the community scale; the other is the mode exploration of “Five-governance Integration” based on democratic practices[19,20]. Based on ecosystem theory, Pang Rong and Wang Miao put forward Party-building leads community governance through environment intervention, systematic integration, and value guidance. And the Shanghai practice coordinates multiple subjects to solve governance problems, providing a reference for megacities[21]. But some elements involved in social ecology, such as symbiotic units, symbiotic relationships, symbiotic energy cycles, have not been deeply integrated into social governance practice. Similarly, based on the collaborative governance model framework proposed by Ansell and Gash, some scholars dedicated to the study on the multi-subject collaborative governance mechanism and optimization paths under the leading of Party-building in urban community governance[22-24]. But much existing research is limited to the description of element function, with the lack of explanation and analysis on symbiotic relationships and dynamic balance[25]. This theory gap leads to the fact that many existing policy tools depend more on static institutional design and are hard to deal with some dynamic challenges including the interweaving of multiple demand and the intensification of resource constraints. Against the background of the national governance modernization and the in-depth promotion of the “co-construction, co-governance and sharing” social governance system, the community governance should break through the dilemma of element fragmentation and low-efficiency coordination.

Community S in City C is the innovative model of gross-root Party building in China, and its “Five-governance Integration” practice provides a vivid example for solving the above problems. This community reshaped the “core ecological niche” of political leadership through reconstructing “four-level Party-building system” and activated the symbiotic chain of moral governance and self-governance through the point-based management rules of the “point management platform”. And it has successfully realized the dynamic adjustment driven by intelligent governance with the help of “intelligent community”. As a result, the community has successfully increased the contradiction resolution rate by 85% and raised the residents' satisfaction rate to 99%. This practice not only verifies the systematic integration efficiency of Party-building leadership, but also further reveals the possibility of the transformation of five-governance elements from “mechanical superposition” to “organic symbiosis”. However, most of existing case reports only stay at the level of experience description, and have failed to explain and analyze its inner logic from the perspective of ecology. Based on this, this paper uses the ecological symbiosis theory as a framework to study how the five governance elements in community ecosystem realized dynamic balance through symbiotic relationships. For the first time, it constructs an “element symbiosis - system balance” analysis model, revealing the synergistic effect of the “energy supply” of Party building leadership and the “information feedback” of intelligent governance technology in breaking the inefficient balance. At the theoretical level, this paper integrates ecology with governance science to make up for the application limitations of social ecosystem theory at community scale. At the practice level, it provides “ecological niche adaptation” strategy for the transformation of old communities and the governance of megacities, contributing to the transforming the institutional advantages of governance modernization into effectiveness.

2 COMMUNITY GOVERNANCE ECOSYSTEM AND GOVERNANCE MODEL

Drawing on ecological theory, the core of community governance ecosystem is to regard community governance as an organic system consisting of five elements, namely, “political governance, legal governance, moral governance, self governance, and intelligent governance. Dynamic balance is realized through the energy flow, material circulation, and information feedback among the five elements.

2.1 Ecological Theories

2.1.1 Symbiosis theory: the ecological logic of element interaction

The symbiosis theory derived from ecology was first proposed by German biologist de Bary in 1879. The theoretical system refers to a three-dimension analytic framework consisting of symbiotic units, symbiotic models, and symbiotic environments. Initially, it's used to explain the mutually beneficial relationships formed by different organisms in nature through material exchange and energy circulation. Professor Hu Shoujun, a Chinese sociologist, first proposed the concept of social symbiosis theory while exploring the transformation issues of Chinese modern society[26]. It provides new dynamic study perspective and methods for understanding, explaining, and analyzing social system[27,28]. In the field of social science, the application scale of symbiosis theory has expanded to the research on the collaborative development of organizations, emphasizing that heterogeneous subjects can achieve system evolution through resource complementarity[29,30]. Regarding the community as a life system with self-organizing ability, the five governance elements in the community ecosystem can form a core symbiotic unit to create a multi-interactive dynamic evolution system, and form a governance community through functional differentiation and collaborative integration.

In the specific community governance practice, five governance elements assume different ecological niches. Political leadership acts as a “producer”, integrating resources of units in the jurisdiction through a four-level Party-building responsibility system to complete the primary transformation of governance energy. For example, the Community S explored the mechanism of “co-location, co-construction, co-discussion, and co-governance” between sub-district communities and Party organizations of resident units, which can integrate the advantage resources, such as talents, intelligence, funding, and service. Legal governance guarantee plays the role of a “decomposer” by formulating regulatory documents such as *Residents' Convention*, *Residents' self-governance charter* to eliminate contradictions and conflicts to maintain the stability of the system. Besides, moral governance and education serve as a cultural gene pool. With the help of “a point-management platform” which encourages residents to participate in community activities such as moral and cultural activities and public service to earn moral points, inherit the community spirit, and cultivate residents' value identity. Moreover, self governance forms self-organization network. Relying on the residents' council and promoting the renovation of old communities, it can realize the circulation and regeneration of governance energy. Finally, intelligent governance constructs a digital neural network. By means of the intelligent platform, it can establish a real-time feedback channel which shortens the response time by 93%. These symbiotic units form a governance ecosystem with self-adaptive ability through symbiotic models such as resource sharing, information exchange and communication, and value transmission in a symbiotic field consisting of community cultures and traditions, technology, and institutional environments. At the same time, maintaining the symbiotic relationship of five governance elements needs a dynamic balance mechanism for the elements. This not only requires maintaining the professional division of labor of each governance element, but also promoting the collaborative symbiosis of these elements through Party-mass joint meeting, the data sharing platform, and other channels.

In the symbiotic evolution process of community governance system, there can be multi-dimensional interactive relationships formed among different governance elements. Among them, the complementary symbiosis and competitive symbiosis constitute the two pillars of the dynamic balance, with the former promoting system efficiency through element coupling, while the latter maintain vitality of ecology with moderate tension. In the dimension of positive synergy, political leadership and intelligent governance support form a symbiotic loop empowered by technology. The grass-root Party organization can obtain various governance parameters such as residents' demands and resource distribution in real-time, and increase the accuracy of service supply by 40% through decision-making model. Moral governance and education and self-governance can form the symbiotic channel of value transformation. For example, the point policy of “point-governance platform” allows residents to exchange 21 services such as priority use of community parking spaces, discounts at the senior canteen, supermarket shopping discounts, and housekeeping services with points earned from good deeds, which can achieve the bidirectional loop between spiritual inspiration and material rewards. This kind of cross-element resource exchange mechanism is essentially a production process of converting cultural capital into governance effectiveness. In the dimension of system balance, the functional game between legal governance guarantee and moral governance and education forms the necessary ecological adjustment mechanism. For example, when there are behavioral disorders such as high-altitude parabolic objects, the legal framework can implement rigid punishment through *Regulations Governing Property Management*, while the moral governance system will organize Red-heart Consultation Meeting and Neighborhood Appraisal Meeting for moral repair. Both form a gradient intervention model in the applicable scenarios. This kind of competitive symbiotic relationship can not only prevent the over-expansion of a single governance method, but also promote policy evolution by eliminating contradictions. The hierarchical processing process of “moral mediation first, legal intervention later” formed by community in practice can shorten the resolution cycle of similar disputes by 35%. However, healthy competition must be maintained within a moderate threshold. When there are disputes over jurisdiction between legal mediation and moral evaluation, the scope of action should be reclassified through coordination mechanisms such as the Party-mass joint meeting, which is exactly the embodiment of the self-adjustment ability of the symbiotic system.

2.1.2 Ecological theory: energy flow and dynamic balance

Ecological theory can provide a dynamic analysis framework for explaining and analyzing the modernization of community governance through the ternary coupling mechanism consisting of energy flow, material circulation, and information feedback. In the field of community governance, political leading constitutes the “primary energy source” of the system, and continuously inputs policy resources and social capital through institutional carriers such as Party-mass joint meeting. Taking community S as an example, the “1+4+N” Party-building alliance system it has constructed integrates the public service resources of 98 enterprises and institutions including hospitals, schools, and companies in the jurisdiction. And it also establishes a volunteer alliance, forming a voluntary service energy flow of

4000 hours per year driving the operation of the governance system. This kind of energy input can not only activate governance subjects, but also complete energy transformation through resource reallocation. During the reallocation process, the grass-root Party organizations convert the administrative authority into community mobilization ability, and transform fiscal appropriations into investment in livelihood projects, constructing an energy transformation chain similar to the “photosynthesis” in ecosystem. Driven by energy, the five governance elements can realize value recreation through material circulation: the rule of law system can solidify the “filial piety and good-neighborliness” principle advocated by moral governance into *Community Dispute Mediation Measures*, which make the moral rules gain institutional constraints; besides, the self-governance mechanism can convert the law-based framework into residents’ deliberation rules, forming the hierarchical progressive transformation of governance elements.

The dynamic balance of the system relies on accurate information feedback regulation. A neural network constructed by intelligent governance technology can collect 12 types of data sources such as the 12345 hotline and grid inspections through intelligent platform, and use machine learning algorithms to identify the five types of important issues including parking shortages and noise nuisance. These information flow can trigger the agenda-setting mechanism of the Party building joint meeting, thereby increasing the problem disposal rate to 92%. During this process, the information feedback can form a bidirectional regulating loop: one is that it revises the governance strategy downward, such as optimizing the meal delivery routes based on the demand data of meal assistance for the elderly living alone, which increases the coverage rate by 35%; the other is that it reshape the system structure upward, such as reconstructing the three-level disposal system of “Legal Mediation Room - Moral Appraisal Hall - Neighborhood Meeting Room” based on the distribution data of types of contractions and disputes. This synergistic effect of energy, material, and information enables the community to have adaptability similar to the natural ecology: when the external environment causes the change of governance energy, the system can realize dynamic balance through elements reshaping (for example, the self-governance force undertakes 60% of material distribution during the epidemic), model innovation (such as developing “Cloud Discussion” program to break through the limitations of time and space), which verifies the core proposition of the ecosystem theory on “steady-state maintenance”.

2.2 Community Governance Ecosystem Model

Different from the social-ecological theory which emphasizes multi-level coupling, this paper focuses on the symbiotic unit relationships among five governance elements, constructing a three-dimension analytic framework of community governance ecosystem of “core ecological niches - functional module - feedback network” (shown in Figure 1), and thereby explaining and constructing the symbiotic relationships and dynamic balance mechanisms of the five governance elements. This framework reveals how each governance element interacts and operates in coordination to achieve the high efficiency and stability of the community governance. The organic unity of “core ecological niches - functional module - feedback network” can optimize the displacement and allocation of five governance elements, thereby maintaining the social governance system at a dynamic balance state.

2.2.1 Core ecological niches: systematic integration function led by Party-building

As the “core species” in community governance ecosystem, Party-building plays the leading role of ecological niche, which can maintain the stability of the system through multi-dimensional functions. In terms of resource coordination, Party-building plays a key role in integrating various resources, including policy resources, social resources, and human resources. For example, it can effectively integrate community service resources through establishing a “Red Steward” team. In terms of organizational guarantee, it provides a solid organizational foundation for community governance through enhancing the organizational capacity and public participation. In terms of rule formulation, the Party-building leadership not only promotes institutional innovation, but also elevates some moral constraints into conventions with legal nature, such as the formulation and implementation of *Community Civilization Convention*. For conflict mediation, Party-building leadership can coordinate the competitive relationships among different governance elements. For example, it can realize dynamic balance in the issue of the application boundaries between the rule of law and the rule of virtue. Finally, in terms of value guidance, the Party-building culture provides directional guarantee for governance actions, making various decisions more in line with public interests. These multi-dimensional functions enable the Party-building leadership a key force to promote other governance elements.

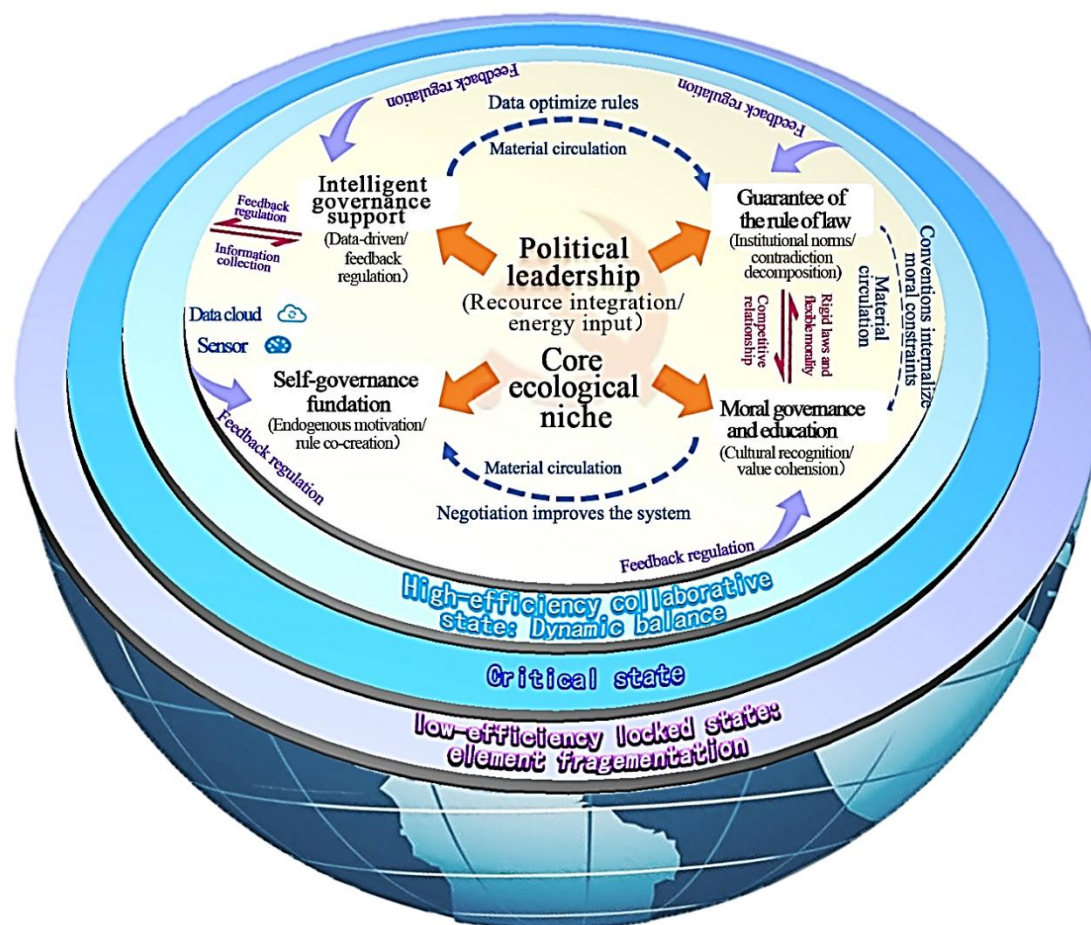


Figure 1 Framework of Community Governance Ecosystem

2.2.2 Functional module: the ecological niche division of five governance elements

For the functional module, the five governance elements have their own functions and complement each other. The first one is the “energy-information” coordination chain between political governance and intelligent governance, and this complementary ecological niche shows that political decision-making relies on the data support and technical backing provided by intelligent governance. The second one is the fundamental ecological niche formed by self-governance and moral governance, and the combination of both provides resilience for the community governance system. The residents enhance their sense of responsibility through participating in decision-making, while moral governance reduces the governance costs through moral identification. Additionally, the restrictive ecological niche of the rule of the law is crucial for maintaining the system order, which defines the behavior boundaries and prevents system from disorder.

2.2.3 Feedback network: the regulating mechanism of dynamic balance

In order to maintain the stable operation of the ecosystem, it is essential to construct an effective feedback network. In terms of positive feedback, it's possible to collect residents' demands in a timely manner and adjust governance strategy through establishing a smooth channel of information communication. For example, the “digital platform” of Community S can shorten the service response time from 8 hours to 30 minutes, which greatly improves residents' sense of gain and satisfaction. At the same time, strengthening the inspiration mechanism to commend the good deeds is beneficial to the formation of good interaction. At the level of negative feedback, it can correct deviant behaviors in a timely manner through constructing a correction mechanism and improving legal guarantee, which contributes to preventing the system imbalance. This bidirectional regulating mechanism can ensure self-optimization and dynamic balance during the governance process.

2.2.4 Threshold effect of system dynamic balance

In the dynamic balance mechanism of social governance, the threshold effect is manifested in maintaining the stability and innovative vitality through the coordinated configuration of key governance elements. In practice, it can be observed that when there is a structural coupling between the in-depth application of intelligent governance technology and the intensity of political leadership, the technology empowerment and organizational mobilization capacity will have an overlapping effect, which can significantly improve the decision-making accuracy and policy penetration of the governance system. However, this balance has the characteristic of dynamic sensitivity. For example, although excessive strengthening of legal norms can enhance institutional rigidity, it may suppress the value-guiding function of the moral governance system, leading to a dual dilemma of the dependence on rules and weakening of moral subjectivity. This imbalance risk shows that when the intensity of institutional constraints exceeds a specific threshold,

it may compress the social self-regulation space and weaken the vitality of flexible governance elements such as cultural identification. Therefore, it's necessary to build a feedback network mechanism to realize dynamic adjustment, such as approximately increasing the weight of moral incentives or accurately adjusting the balance between the political leadership and technology empowerment, thereby maintaining the balanced development of policy ecology. This dynamic governance strategy based on system threshold identification can not only avoid the suppression of innovation ability by rigid institutions, but also relieve the disorder risk caused by fragmentation of flexible governance, ultimately realizing the symbiotic evolution of improving governance efficiency and stimulating social vitality.

3 THE PRACTICE IN COMMUNITY S CITY C

3.1 Characteristics of Community Governance Ecosystem

Community S is located in an old area, with many typical old, dilapidated, and scattered residential communities within it. Its governance ecosystem has once presented two characteristics of “high vulnerability - strong resilience”. And the dilemma is mainly shown as: (1) The proportion of the elderly aged over 60 in the community reached 28%, and the phenomena of empty-nest and living alone are widespread; (2) The fundamental facilities are severely aged, nearly 70% buildings have problems such as pipeline leakage and wall cracking; (3) Market-oriented property management companies have long abandoned the management due to limited profit, and the maintenance of public space has long relied on government support. This low inefficient governance state has led to a high rate of residents' complaints.

Facing the systematic governance crisis, the community realized a leap in system resilience through reconstructing the ecological niches. The core path is to construct a “four-level Party-building system”, that is, under the overall coordination of the community Party committee, a three-level organizational network of “Party branch - Party group - Party member center household” is established vertically; and 23 units such as enterprises, merchants, and social organizations in the jurisdiction are linked to form a Party-building joint meeting horizontally. This system embeds the “Red Steward” service team (with Party members accounting for 92%) into grid governance, and thus converts the Party organizations from traditional “policy implementer” to “resource integrator” and “conflict mediator”. For example, in 20022, through the Party building joint meeting, the resources of the district heating company and the municipal department were integrated, and the pipe network renovation of 38 buildings was completed, benefiting more than 1200 residents. Therefore, the Party organizations occupy the “core ecological niche” of the governance ecosystem, which lays a structural foundation for the coordination of the five governance elements.

3.2 Symbiotic Practice of Five Governance Elements

3.2.1 Political leading: resource integration and systematic drive

The Party committee of the community establishes a “resource pool” mechanism through Party building joint meeting. It has cumulatively integrated 420,000 yuan of funds from enterprises in the jurisdiction and approximately 46,000 hours of volunteer service in total, which were allocated to areas such as the renovation of old residential areas and elderly-care services. Taking the pipeline network maintenance as an example, the Party committee coordinated the municipal department, the property management company, and the residents' representatives to sign a *Co-construction Agreement*, classifying the division of responsibilities and cost-share ratio, thereby achieving the sustainable operation and maintenance mode of “a little subsidy from the government, a little concession from the enterprises, and a little contribution from the residents”. The Party building leadership can not only solve practical problems, but also realize the sinking of governance forces through the “Red Grid”. In 2023, the coverage rate of visits by grid managers increased to 100%, and the proactive discovery rate of issues related to people's livelihood jumped from 35% to 82%.

3.2.2 Guarantee of the rule of law: institutional norms and behavior constraints

For high-frequency disputes in the community, such as noise nuisance and pet management, the community proposed the “Three Chiefs” negotiation mechanism (including grid chief, building chief, and unit chief) and formulated the *Community Civilization Conventions* to specify reward and punishment provisions. For example, while dealing with the conflict over square dance noise, the decibel monitoring equipment was introduced and the activity periods were regulated. Those who violate the regulations should participate in community public welfare services. The legal methods enable the resolution rate of conflicts and disputes to increase from 58% in 2018 to 85% in 2023, and the number of legal petitions has decreased by 67%. At the same time, the community established the “Legal Knowledgeable Persons” training program, which has cultivated 36 resident mediators, promoting the rule of law transforming from “external restraints” to “internal norm”.

3.2.3 Moral governance and education: cultural identification and value condensation

The community has implemented a points system to convert voluntary services (such as delivering meals to the elderly and environmental cleaning) into “moral points” that can be exchanged for daily-life services. And the total number of registered volunteers has reached more than 3200, and the point exchange service has been available 12000 times. The typical examples include: a resident, Wang, has gained household management service without charge through points 12 times, and the self-organized “Neighborhood mutual assistance team” has successfully rescued an elderly person living alone who suffered such a heart attack. Additionally, the community established an atmosphere of advocating virtue through “Good People List” and the “Family Virtue Wall”. In 2023, 23 families were selected as moral models, and the residents' recognition of the community culture has increased to 91%.

3.2.4 Self-governance basis: endogenous motivations and co-building of rules

The community constructed various negotiation platforms and attached importance to the self-governance mechanism of “three-meeting”, namely, hearing, coordination meeting, and deliberation meeting, which has successfully solved residents’ concerned issues such as revolution of the community, parking difficulties, and square design. For example, after fully democratic negotiation, the collection rate of monthly 20-yuan residents’ self-governance service fee has reached 100%. And it also innovated “three-down and three-up” negotiation method (publicity and mobilization → collection of opinions → signing and confirmation), promoting the 100% implementation of the residents’ conventions. The self-governance practice not only solves the practical problems, but also cultivates 11 community self-organized organizations, such as calligraphy and painting club and the patrol team. These have formed a governance closed-loop of “joint discussion of affairs - shared responsibility - shared achievements”.

3.2.5 Intelligent governance support: technology empowerment and dynamic adjustment

The community has cooperated with Alibaba Cloud to build the province’s first “digital community” platform, integrating functions such as face recognition access control, intelligent security monitoring, and online discussion halls. The technology empowerment enables the service response time to be reduced from average 8 hours to 30 minutes, which has solved 6070 resident reports. For example, by analyzing the water and electricity usage data of elderly people through AI algorithms, 14 health crisis events have been successfully warned and handled in 2023. Besides, the intelligent governance system has constructed “a demand hotspot map”, automatically pushing high-frequency issues (such as corridor clutter and noise complaints) to the Party-building joint meeting agenda, realizing the transformation from “passive response” to “active governance”.

4 SYMBIOTIC RELATIONSHIPS OF FIVE GOVERNANCE ELEMENTS AND DYNAMIC BALANCE MECHANISM

4.1 Complementary Symbiotic Relationship

Complementary symbiosis is the core mechanism to ensure the high-efficiency operation of community governance ecosystem, presenting as resource complementation and function coordination among five governance elements.

4.1.1 Coordination of political governance and intelligent governance: accurate governance driven by data

Political leadership achieves precise allocation of governance resources and decision-making optimization through the in-depth integration of Party-building data platform and intelligent governance technology. Taking the Community S as an example, the Party committee in the community integrates three types of data: data of units in the jurisdiction, data of residents’ demands, and data of service resources based on the “Digital Party Building” system, and constructed an intelligent matching model of “resource-demand”. For example, during the COVID-19, this platform analyzed the distribution of the elderly living alone through heat maps and coordinated “Red Stewards” team to deliver supplies to 3800 people on a targeted basis with a 100% coverage rate. The coordinate capacity of the political leadership and the analytic capacity of the intelligent governance can form a closed loop of “decision - execution”, increasing the response efficiency to issues related to people’s livelihood by 67%.

4.1.2 Interaction of moral governance and self-governance: the cultivation path of endogenous order

Moral governance and education inspire residents to participate through informal norms, providing a value basis for self-governance practice. In the “point governance platform” in community S, the points system qualifies volunteer services into “moral capital” that can be exchanged for daily life service. A total of over 3,200 volunteers have been registered, and a total of 12000 point exchange services have been conducted. This mechanism activates the endogenous motivation of residents’ self-governance: in 2023, the *Residents’ Convention* formed through “three-down and three-up” negotiation method has maintained a 100% implementation rate for three consecutive years under the incentive of points. The complementarity between moral governance and self-governance is embodied as a chain reaction of “moral recognition → behavior incentive → rule co-creation”, significantly reducing the implementation cost of institutions.

4.2 Competitive Symbiotic Relationship

Competitive symbiosis reflects the function boundary conflicts among five governance elements, which need dynamic adjustment to avoid the imbalance of the system. There are competitions for applicability the rigidity of the rule of law and the flexibility of moral governance in specific scenarios. Taking the noise governance for square dancing, Community S initially depended on moral methods, such as neighborhood persuasion and moral evaluations, but some residents refused to cooperate, leading to a high rate of complaints.

Subsequently, the community introduced the legal tools: install decibel monitoring devices and incorporate them into Community Civilization Convention, which stipulates that those whose activity volume exceeds 55 decibels and those who exceed the time limit should participate in public service of the community. Although this method has significantly reduced the volume of complaints, it also induced criticism from some residents about “indifference in human relationships”. In practice, it was observed that over-reliance on legal measures will lead to the reduction of residents’ moral vitality. This indicates that the rule of law and moral governance needs “proportional adaptation” to maintain the balance. That is, the law sets the bottom line and morality fills the gap.

4.3 Dynamic Balance Mechanism

The determination and adjustment strategies for the balance state of the system can be analyzed from two dimensions: the characteristics of high-synergy are presented as collaborative drive of political governance and intelligent governance, and through “Red Grid + Intelligent Platform”, it can achieve the strong complementarity of the elements, and there is a significant positive feedback between the vitality and self-governance efficiency of moral governance, forming a virtuous cycle. Besides, the characteristics of low-efficiency locked state are that there is a negative correlation between the constraints of the rule of law and the vitality of moral governance. And the competitive disputes dominate and the residents’ satisfaction reduces significantly.

The policy design should adhere to the principle of “niche adoption”: for megacities, the “intelligent governance-dominated” mode can be promoted, emphasizing the development of refined management empowered by technology. The data-driven decision-making capacity can be strengthened by improving the percolation rate of the intelligent governance and refining the coordinate mechanism of “Red Grid - Intelligent Platform”. While for western cities and towns, the “integrated model of moral governance - self-governance” can be implemented, emphasizing the political leading role of the grass-root Party organizations, integrating resources for the rural revitalization strategy, cultivating the self-governance capacity of the community, and promoting the in-depth integration of the construction of rule of law and moral education.

5 EVALUATION OF GOVERNANCE EFFICIENCY AND SYSTEM RESILIENCE

5.1 Qualifying Achievements: Element Coordination and System Balance

The efficiency of the community governance ecosystem can be comprehensively evaluated through the intensity of political leadership and the balance state of the system. In terms of political leadership, Community S can achieve the 100% coverage rate of Party building program through “a four-level Party building system”. In 2023, a total of 48 regional Party-building activities were carried out, and 23 units in the jurisdiction were mobilized to participate in livelihood programs such as the renovation of old residential areas and elderly-care service, with a Party member participation rate of 92%. This high participation rate not only reflects the cohesion of the Party organization, but also shows the integration efficiency of political leadership on governance resources. The Party-building joint meeting coordinates an average of 420000 yuan in funds annually, targeting and resolving 38 issues such as pipeline network maintenance and parking management, benefiting more than 1200 residents.

In terms of system balance, the governance achievements and efficiency are presented by the dual leaps of a 95-point (out of 100) resident satisfaction score in 2023 and a 85% year-on-year decline in conflicts and disputes. The satisfaction investigation shows that residents gave the highest scores to the response speed of “Red Steward” service (30 minutes), and the convenience of points exchanges (with a 92% approval rate). The sharp reduction in conflicts and disputes is attributed to the coordinate mechanism of rule of law and moral governance. For example, disputes such as square dance noise and pet nuisance are resolved at the beginning through Community Civilization Convention, and thus, the proportion of mandatory legal intervention significantly reduces. The investigation data confirm the positive effect of the complementary and symbiotic relationship of the five governance elements on the system stability.

5.2 Resilience Performance: Risk Resistance and Self-Adaptive Adjustment Ability

The resilience of community governance ecosystem is manifested in its risk resistance ability to withstand external shocks and its self-adaptive adjustment ability to deal with internal changes. During COVID-19, Community S established an emergency service system relying on “Red Stewards” team: 63 Party members in the community had provided voluntary services for 2500 hours, and have delivered material supplies to 3800 people. Besides, the daily monitoring coverage rate of the elderly living alone reached 100%. These contributed to achieving the goal of a zero-infection community. This risk-resistance efficiency stems from the rapid mobilization ability to assemble the team within 4 hours under the political leadership and from the information integration capacity to form intelligent governance support by matching demands and resources in real-time through the “Digital Community” platform.

In regular governance, the self-adaptive adjustment capacity is presented as the dynamic response to changes in population structure. Targeting the current situation where the aging rate in Community S is 28%, it has transformed the idle housing into elderly-care stations through “three-down and three-up” negotiation method, providing services such as daily care and health monitoring, with an average daily reception of 45 elderly persons. During this process, the flexibility of the system was highlighted: (1) Demand perception: the intelligent platform monitored that the activities of the elderly groups are concentrated on the square in the community, triggering the generation of the renovation topic. (2) Resource allocation: the Party-building joint meeting coordinates with the municipal department to allocate 200000 yuan, connecting the community health service center to provide medical support. (3) Rule iteration: the Regulations on the Management of the Care Station are revised according to the usage, and a family member reservation system is added, which contributes to the effective improvement of satisfaction.

The path to enhance resilience needs to optimize governance structure through the complementarity of multiple elements. Specifically, the incentive mechanism of moral governance can effectively mobilize the willingness to participate, thereby reducing the over-dependence on a single governance tool and avoiding the problems of system fragility caused by “over-reliance on the rule of law”. This diversified governance method can not only improve governance efficiency, but also enhance the adaptability and stability of the governance system, contributing to the

construction of a modern governance system.

6 CONCLUSION

This study constructed an analytic framework of “core species - functional module - feedback network” by introducing ecological theory, revealing the symbiotic relationships and dynamic balance mechanism of five governance elements in community governance ecosystem. At the theoretical level, it first introduces the concept of “core species” into governance study, verifying the dual functions of political leadership as “energy supplier” and “rule maker”, namely, the political leadership occupies the core ecological niche through integrating resources and driving institutional transformation, while the intelligent governance acts as an “information center” to shorten the feedback cycle, forming a bidirectional enhancement mechanism of “political governance inputting energy - intelligent governance circling information”. This framework breaks through the static limitation of traditional “element superposition theory” and makes up for the application gap of the social-ecological system theory at the community scale. In terms of practice, this paper proposes the differentiated governance strategy of “ecological niche adaptation”: eastern megacities can promote “intelligent governance-driven” mode based on intelligent infrastructure, and achieve conflict prediction and targeted intervention through the data center platform; communities in western region need to strengthen the integration of “moral governance - self-governance”, and activate the endogenous order based on residents’ convention. At the same time, it is necessary to be vigilant against the dilution risk of political authority by technology empowerment. Furthermore, the “Party’s management of algorithms” mechanism needs to be further explored to balance technological rationality and Party-building leadership.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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