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Constructing Students' Identities through Social Media: A Case Study of Chinese Mainland Students in Macao

Jing Jing^{1*}

¹Qingdao City University, China

*Corresponding author: jingjingmust@gmail.com

Abstract

The role of social media in young generation's live become more salient nowadays, especially for them to searching for relationships and maintaining social connections. In the particular life transitions, social media provide adolescents amounts of resources to help them construct their new identities and cope with culture issues. In this study, I employ social comparison theory to explore how do Chinese mainland students in Macao use social media to manage their online and offline identities in different phases of college life. The research reveals that respondents experience affirmation, acculturation and integration from their past "Freshman" period to the present "Junior" period. Besides, social comparison plays a mainly negative role in handling students' identities, which leads a series of difficulties and worries in their college life.

Keywords: social media; mainland Chinese students in Macao; identities

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Introduction

Social media plays an important role in teenage social life, especially for self-presentation, maintaining new relationships and constructing their identities in digital world (Boyd, 2007). A growing body of work has investigated digital identity of people at different life transitions (Orzech, Moncur, Durrant, & Trujillo-Pisanty, 2016), and how do university students use social media resources to help them adapt into new environment (DeAndrea, Ellison, LaRose, Steinfield, & Fiore, 2012). However, little is known about what particular themes or patterns related to the usage of social media in different stages of college life for young adults, as well as how does social comparison affect their process of formation or construction of social identities. This study aims to fill the gap of previous research.

This paper targets at Chinese mainland third-year students in Macao, trying to explore the role played by social media in different stages of their college life. I compared with related work concerning with how do expatriates and immigrants cope with acculturation issues when they enter into the new community (Mao & Shen, 2015), and the structure of this paper is as followed: I first employ the literature on social media social comparison and identity work, then I adopt the semi-structured interview to interpret the usage of social media in students' college life. The final section discusses the empirical results and conclusion. Based on the theoretical framework of social comparison theory and identity work of mainland Chinese students in Macao, the following questions are proposed to inform the study:

- How do mainland Chinese students in Macao use social media in different stages of college life to construct their identities?
- How do mainland Chinese students in Macao manage and balance their online and offline identities in social comparison processes?

Theoretical Framework and Previous Research

Since there has a growing number of studies explored the usage of social media technologies by young adults and their online participation nowadays, social comparison on social network has attracted great attention in recent years. Even though social media provide more chances for young generations to present themselves through various of ways, such as share their photos, a range of anxieties may also be brought in the processes of social comparison. As one of the necessary components in college life, the knowledge of social comparison and identity work are explored further below.

Social Comparison theory

Social comparison theory was first proposed by Festinger (1954), which posits that people have an innate desire to evaluate themselves through comparing to others. This process reflects that people often compare themselves with those who share similar characteristics with them to achieve accurate and stable evaluations, which involves two types of social comparison: ability and opinion. The nature of social comparison of ability is competitive in terms of performance and achievement comparison. In contrast, the goal of social comparison focuses on constructing one's own values, attitudes and behaviors, etc. (Suls et al. 2000), regarding comparison targets as role models (Park & Baek, 2018).

The processes of social comparison can either boost the confidence and self-image, or hurt the self-esteem, which can be achieved by downward comparison and upward comparison. The downward comparison refers to compare favorably to someone who is less than or inferior to them aiming at establishing positive effect, while the upward comparison is defined as comparing themselves to others who is better or superior to them, which set themselves into a low status and threaten the self-esteem (Gibbons & Gerrard, 1989). The processes of social comparison have an impact on social connectedness, which is an important feature in social identity formation (Shafie et al, 2012).

Social Comparison Processes and Social Media

The popularity of social networking sites in the digital age allows users to easily share their life updates and construct the online identities, which provides a unique context and rich opportunities for social comparisons. However, most of the users tend to create a “desired self” (Leary & Kowalski, 1990) through selective self-presentation, which leads more upward comparison performed on social media platforms. According to Goffman (1959), each person adopts behaviors of front stage as well as backstage in order to display a good image and perform “ideal self” in front of the audiences. For example, as a common and new tool for self-presentation, selfie posting is popular on social networking sites, especially for young generations. The standards of beauty are gradually constructed through self-presentation and peer comparison when a person posts selfie desiring at expectation and preferences of others (Chua & Chang 2016). In the specific context of college students in Macao, selfie postings on social media platforms can be testified on how social comparison influence the construction of their identities, which manifests a desire towards claiming membership of a specific group and community.

Social pressure can also be brought in through self-presentation and then causes the risk of damaging self-esteem (Pounders, Kowalczyk, & Stowers, 2016) and identity clarity, which are important dimension of identity development. Campbell et al. (1996) argues that self-esteem regards the evaluation of one’s identity and self-value, while identity clarity concerns the coordination of different senses of identity, such as beliefs and purposes. As an important stage in life transitions, university gives particular salience to self-esteem and identity clarity that may get influenced by social comparison of ability as well as opinion when accessing social media platforms. This position suggests that the identity formation and development of Chinese mainland students in Macao would be affected by different types of social comparison online, which then brings particular salience on social norms and rules of interaction.

Social Media Social Comparison and Identity Work

There has been a rapidly growing body of research on how young adults form or reflect their online identities on social media. However, most of the studies employ Facebook which is a popular and widely used social network as dominate platform (Yang & Brown, 2013), while other sites like WhatsApp and WeChat that also attract more attention in international context remain largely unexamined. Therefore, this study aims at exploring how university students in Macao construct their identities through WeChat platform, which plays a more vital role in online communication globally nowadays.

Since social comparison on social media platforms drew a special attention increasingly, little is known that the implication of it for identity development on youth (Yang et al., 2018). Drawing on the theory of social comparison, this research targets at Macao college students who use WeChat as dominate platform, aiming to shed light on the gap of how different types of social comparison on social media influence identity variables, including self-esteem and identity clarity. Meanwhile, many studies fail to explore fully how to adapt and balance the relationship between online identity and offline identity of college students, which is also be filled through this investigation.

Methodology

Participants

I recruited 13 university students (aged around 21) who study in Macao University and Science and Technology or City University of Macao. All of the participants are junior students from Chinese Mainland who use social media platforms a lot. Among all of the respondents, eight females and five males of them took part.

Procedure

In order to understand the different stages of college life, the participants were firstly required to reminisce their experience involving the usage of WeChat in the past three years, especially for their “identity work” in the period of Freshman, Sophomore as well as Junior. I then further proposed a few of questions in terms of their attitudes and psychological states towards social media platforms to encourage them to think retrospectively of the WeChat Moments that they posted. The subsequent extracts from the answers of the interviewees helped me comprehend their former experiences of commencing college at the very beginning, gradually getting familiar with the new community, as well as the confusion and difficulties in the process of social comparison on social media for the construction of their identities. Besides, pseudonyms in the following sections were used to protect the privacy of the participants with informed consent from them.

Measure

All interviews transcripts were first recorded and transcribed, and subsequently organized into different categories and a thematic analysis was conducted through selective coding. According to Braun and Clarke's (2006), thematic analysis is a fundamental method for qualitative analysis and six phases analysis are supposed to follow. The first and foremost of conducting thematic analysis is to immerse yourself into familiarizing the data and write down the initial ideas and comments. This initial coded data will be produced through comparison among different features and potential patterns of the data, which allows us to search for key themes and refine the specifics of each of them. Selection of attractive extract examples is the final stage of doing thematic analysis and subsequently the findings are prepared for writing down. This analysis focuses on how mainland students in Macao construct their online identities via social media, in particular the role of WeChat to enhance their social comparison. The key findings below focus on the following practices, including affirmation, acculturation and integration.

Data Analysis

The analysis showed a number of different ways in which students from Chinese mainland used WeChat Moments during their study in Macao, and more crucially, revealed that how online and offline identities constructed and interacted in the processes of social comparison. Firstly, the findings explored how students express and connect their preestablished identities to retain a tradition from home in a brand-new environment through social media, especially for expecting the affirmation from their parents and old friends. Secondly, the findings reveal that how students use social media in the process of assimilation to the new community and acculturation into the new environment, establishing and constructing a new “university” identity at the same time. Finally, the obstacles of using social media for international students in the process of the integration to manage their identities into new context are also be revealed. The findings under these different subheadings are as follows.

Affirmation- “hometown” identity supported from family and friends

I found that almost all participants used social media to express their feeling towards people and things in their hometown publicly, which indicates the important role of social media in strengthening students’ preestablished identities related to the family and friends. It was necessary for them to keep the relationships being left behind intact when they were studying in Macao:

Me and my friends from high schools still keep in touch after I going to university. I often post group photos with them on my WeChat Moments for celebration and memorization, especially

when I back to my hometown in summer and winter holidays, I have more time to hang out with them and take photos with them. Whenever I miss them in my college, I am able to scroll down my Moments to check the photos and reminisce a bit. (Lin)

Apart from the topic of friendship the extract showed above, it is common for mainland students feel homesick and nostalgic triggered by cultural differences like food:

I think sometimes I feel nostalgic when I am in Macao. I remember I used to post a photo of a meal that I made on Moments, which called Laba rice porridge. This is a kind of traditional food of Laba Festival in my hometown. I missed my family on that day, so I cooked this by myself because I still remembered the feeling when my mom cooked it for me at home. (Lee)

Even though almost all the students agreed that digital technology was important to keep in touch and comfort them, there was still one male participant who hoped to adapt into new environment as much as possible concerning of social comparison and pay more attention on the college life:

I mainly focus on my college friends when I got into uni, so I seldom post the photos with my high school students on WeChat Moments. To be frank, I want to show up my new friends. (Rob)

Acculturation & Assimilation- “university” identity construction

I believed that many participants regarded social media as a platform for them to make early comparisons. It is evident that most of the students tend to make themselves look good on the social media in order to establish a “perfect university identity”. They admitted that it’s necessary for them to “edit” and “polish” the posts because they acknowledged the crucial role of self-presentation in the digital world (Chua & Chang 2016):

I spent much time to edit everything I posted on WeChat Moments, no matter the pictures of food or my selfies. I think it’s important for me to carefully pick up the selfies, like deleting all my ugly photos and choosing the ones I look pretty and editing them. The main reason I did something like that because I wanted to leave a good impression to others, especially for the people we barely meet and just known each other online, including some college friends. It’s obvious that my photos posted online is the only way for them to make a judgement and know about me, so it’s worth for me to spend lots of time on the social media. (Lin)

I quite care about what people think about me, so I make sure every Moment I post shows the best side of me...I dislike someone who complains everything on the Moment all the time, people won’t be interested about what you complain about, they just want to see the positive side of you. (Wong)

Even though social media was seen as an important platform for self-management and self-presentation in the process of adjustment and assimilation, some of our participants expressed their worry and concern towards online friendship:

I don’t wish that I know about someone through WeChat Moments, because social media is so ‘fake’ and maybe not the best ideal platform for knowing people. I much preferred in making friends face-to-face, which is more genuine and realistic. (Xu)

For the international students, especially for the mainland students in Macao context, it’s challenging for them to face communication barriers because people from different regions with

various accents and dialects. It’s a considerable issue for them to balance their old identities and a new one when it comes to self-expression. Some respondents claimed that they would avoid to post words on WeChat Moments that can only be understood by their hometown friends, in case that the college students from other provinces would feel confused:

I will consider the feelings of all my classmates in the university, because they may don’t understand what I post when I put jokes or cross-talk related to my dialect [Hunan dialect] on the WeChat Moments. I think if you want to integrate into a new community, it’s necessary to step out of your comfort zone and change into a more acceptable persona. (Rob)

Some of the students even learn or affected by the various languages in Macao in the process of acculturation into college life, which aims to demonstrate and construct new identities who study in Macao via social media:

I am fond of learning Cantonese and I love this kind of language, so sometimes I post WeChat Moments or Weibo in Traditional Chinese and use the expression of Cantonese. Apart from that, I also tried to post in English instead of my native language. I think maybe I gradually influenced by multilingual cultural environment of Macao since I got into college. (Zhang)

Integration - difficulties in the process of online and offline identities construction

Most students acknowledged social media was useful and convenience engaging in construction of new identity, but it has plenty of evidences that they also worried about the negative consequences of online social comparison. One obvious one was “wrapping up” yourself and pretend to be “happy”:

Sometimes I posted groups photos of club activities on WeChat Moments, but that didn’t indicate I was enjoy with them. Actually, I just wanted to show that I was integrated and fit into the new community and pretended I was having fun. (Sun)

In light of the theory of upward social comparison on social media, it’s also notable to see that some of the participants feared of posting the true feelings online. Consequently, social pressure can be brought in and the risks of self-esteem can be increased. A quote below will illustrate this point:

I’m good at hiding my feelings on social media. I never posted some WeChat Moments to complain something or expressed my true feelings even though I encountered some problems and felt depressed and emotional. I just wish I can have the “likes” from others instead of sympathy... (Liu)

Interestingly, some students also use other social media for posting and self-expression, which they believe these platforms offered great opportunities to open their minds:

I tend to post my true feelings or some nonsense on social media, like Weibo, Instagram, because few of people know me and I don’t wish my parents worry about me when I put these on WeChat Moments. (Lee)

Final Discussion

In this study, I focused on two dimensions that how social media played a crucial role for the international students in the social comparison process. Firstly, I demonstrated the main types of identities of participants in different period of college life. Secondly, my study also explored how Chinese mainland students managed and balanced their online identities as well as offline identities in the context of Macao. Based on the thematic analysis

of the collected data, I summarized the three different stages of identity construction for students from their past “Freshman” period to the present “Junior” period, which includes affirmation, acculturation and integration. These phases of identity processes have been discussed in numerous research paper concerning with that people cross different cultures into a brand-new environment, as in the example of the undergraduates’ transitions into college (Julienne, David & Susan, 2016) and transitional migrants living abroad (Lingel et al., 2014). The following section will examine how social comparison plays out across the three stages of the college life for Chinese mainland students studying Macao according to the related work in detail.

Firstly, the study draws out that the students showed their worries and encountered some difficulties in the process of retaining their preestablished identities and creating the new identities at the same time. In the previous research, the formation of an online persona, including sharing selective ideas and beliefs online as well as the construction of digital identity, has become one of the major concerns revealed by young adults (Orzech et al., 2016). In the stage of assimilation and acculturation for the participants’ sophomore year, the usage of visual impression management had a strong role to play for shaping the online identities of students, which encouraged them to tailor and edit their photos before they post them on WeChat Moment in order to present an “ideal self” in the digital world. Goffman’s work articulates that the ‘performers’ restrain their authentic behaviour as well as attitudes and take advantage of self-presentation in the complex social transitions of life, which may cause some troubles when they face the intersection of different identities (Marwick & Boyd, 2010). It can be clearly concluded that the respondents were more likely to pay much attention on their acculturation into the new community when they were in a dilemma of whether holding back and affirming their “home” identity or embracing their novel “university” identity.

Another aspect that could emerge from my research was that social comparison processes are mainly fraught and negative concerning with the students’ online and offline identities management issues in their past college life. When the international students in Macao seeking to integrate with the new environment and culture, it’s inevitable for them to “polish” their profiles and selfies on social media aiming to “look better” to outsiders and audiences, which was usually accompanied by a set of anxieties, such as peer pressure and the risks of self-esteem. Furthermore, these following anxieties are no longer only existing in the offline communication when people are exposed more about their “authentic self”, but also can be reflected on the internet in terms of the self-presentation issue (Grieve & Watkinson, 2016). From my research, I believe that whether the college need to pay more attention and offer more help to the students’ online identity work, especially for their freshmen years at the traditional time, can be seen as a considerable question in the future.

Conclusion

In conclusion, this study has illustrated how Chinese mainland students used social media to construct and manage their different identities when studied in Macao. The results revealed that social comparison played a mainly negative role in tackling students’ online and offline identities, which led a series of difficulties and worries in different stages of the college life, especially for the issues of self-esteem and peer pressure. The findings of this study have the similarity concerning with the usage of social media by young adults in the process of transition with the research conducted in UK institutions (Thomas et al. 2017). These results suggest that there are still some problems for young people to balance their online and offline identities and thus further effective knowledge as well as psychological guidance may need to be provided and conducted on campus more widely.

I recognize this study has some limitations and also spaces for future investigation. The participants in this research could only

answer the questions that related to their experience in Freshmen and Sophomore period by reminiscing their past college life and refreshing the memory out of the time limited and restricted resources at the current stage. The ideal study could be tracing and recording a specific group of students for four years of their whole college life in the future. Further, the role of social media in the important transition for young adults proceeding into the society and getting on work can also be explored in the next stage of my research.

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Statements and Declarations

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No funding was received for conducting this study. The present study has no relevant financial or non-financial interests to disclose.

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About the Authors

Jing Jing
Qingdao City University, China

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The Impact of Smile Intensity on Hiring Decisions in China

Fei Xu^{1a}, Xueqin Zhang^{2*b} and Junho Lee^{1c}

¹Department of Business Administration, The Hoseo University, Cheonan, Republic of Korea

^{*}Corresponding author: 1732418377@qq.com

Abstract

This study examined the effect of job applicants' smiles on recruitment decisions using Chinese participants. In an experimental study, 305 Chinese participants were requested to rate the smiling behaviors of male and female job applicants at six different smile intensities. This study showed that perceived credibility is an important moderator of the effect of smiles on hiring. During the job interview process, job applicants' emotional displays, such as smiles, play a crucial role in making a positive impression. Earlier investigations have explored the influences of genuine emotional expressions on service satisfaction, but empirical research on the joint effects of smile intensity and job applicant gender is scarce, especially in China. To address this gap, this research examined the impact of this interaction on job applicants' perceived reliability. Our results showed that bright smiles were perceived as more reliable when job applicants were female (but not male). In contrast, faint smiles were more consistent with male stereotypes, leading to higher perceptions of reliability. This study further suggests that perceived credibility is a psychological mechanism that can explain the link between smile intensity and recruitment decisions.

Keywords: Smile intensity, Nonverbal behavior, Perceived credibility, Recruitment decisions, Gender stereotypes, gender stereotypes

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Introduction

The human race has one effective weapon, and that is laughter. - Mark Twain

Smiling is a universal facial expression that plays an important role in interpersonal relationships (Hall, 2009). Research suggests that a smile not only influences others' emotions but also contributes to forming first impressions of interaction partners. For example, smiling conveys characteristics of friendliness and trustworthiness (Schnall & Laird, 2003). In the context of job recruitment, a job seeker's nonverbal behavior—such as smiling, eye contact, and body language—is considered an important signal of their competence and attitude (Barrick et al., 2009). However, existing literature primarily focuses on the expression and impact of smiling in Western cultures, while systematic research on the social function of smiling and its influence on recruitment decisions within the unique cultural context of China remains insufficient. This study aims to explore the influence of job applicants' gender and smile intensity on recruitment decisions within the Chinese cultural background. Specifically, it examines how smile intensity affects the perception of applicants' trustworthiness and subsequently influences interviewers' recruitment decisions. Additionally, this study seeks to identify the moderating role of gender role stereotypes in this process.

Previous research indicates that smile intensity is closely related to social judgment. For instance, a broad smile is generally associated with higher enthusiasm, kindness, and cooperativeness (Krumhuber et al., 2007). However, cultural interpretations of smiling and gender stereotypes may significantly influence these associations. In Western cultures, smiling is often seen as a sign of confidence and openness (Matsumoto et al., 2008), whereas in China, smiling is more frequently interpreted as a symbol of politeness and humility. These differences may lead to variations in the effect of smiling in recruitment settings.

Gender differences in the effect of smiling on perceived trustworthiness have also been demonstrated in research. Studies have shown that a bright smile on women aligns with social expectations, presenting them as friendly and trustworthy (Deutsch

et al., 2007). In contrast, a bright smile on men may be perceived as inconsistent with traditional male traits (authority and seriousness), potentially reducing their perceived trustworthiness (Hess & Hareli, 2017). Wang et al. (2017) found that a bright smile could weaken perceptions of men's competence because such a smile conveys information that does not align with traditional male gender roles. On the other hand, a bright smile on women is often associated with social perceptions of honesty and trustworthiness (Otta et al., 2009). Krys et al. (2016) discovered that the interaction between smile intensity and gender roles can affect evaluations in recruitment contexts. A slight smile on men was perceived as more professional and trustworthy than a bright smile, whereas a bright smile on women was more likely to meet societal expectations for female emotional expression, leading to higher trustworthiness ratings. These studies provide a theoretical foundation for exploring the interaction between gender and smile intensity in recruitment decisions. Building on this literature, the present study aims to fill the research gap in the Chinese cultural context and reveal the dual influence of culture and gender roles on how smiling affects recruitment decisions.

The main objective of this study is to explore how different smile intensities (broad smile, slight smile, and neutral expression) influence applicants' perceived trustworthiness and recruitment decisions. Additionally, it examines whether perceived trustworthiness mediates the relationship between smile intensity and recruitment decisions. Furthermore, this study analyzes the moderating role of gender role stereotypes in this relationship, specifically investigating how male and female applicants are evaluated differently when displaying a broad or slight smile.

Theory and Hypotheses

Impression Management by Smiling in Interviews

Smiling is a common nonverbal behaviours in social interactions, and it also serves a crucial function in interview situations. The intensity of a job applicant's smile can not only affect the

interviewer's judgment of his or her characteristics but may also have an important impact on the final hiring decision. In the interview, signal exchange occurs via verbal and nonverbal IM on the part of both recruiters and applicants. Applicant verbal IM has been extensively studied, and tactics vary along two main dimensions: Assertive vs. defensive (Bolino et al. 2008) and honest vs. deceptive (Leary & Kowalski 1990; Levashina & Campion 2006 and Brosy et al. 2021) Nonverbal behaviours includes Several aspects of body language include facial expressions (smiling), eye contact, posture, gestures, and interpersonal distance. (Mehrabian 1972 and Pinto, A. P., & Sousa, C. D. 2014). This process can be regarded as IM signal exchange. Nonverbal behaviours in selection may constitute a limiting situation for strategic communication, as some non-verbal behaviours are harder to control than verbal behaviours. Instant communication by recruiters has been little researched, but a recent study (Wilhelmy et al. 2017) suggests that recruiters try to project an attractive and authentic image and attempt to demonstrate intimacy (rapport, credibility) and professional distance in interview interactions (Brosy et al. 2021). Thus, IM research has focused primarily on consciously controlled job applicant behaviours. Because deceptive IM (or fakery) is both common (Levashina & Campion, 2006, 2007) and difficult for recruiters to detect (Roulin et al. 2015), recruiters may be manipulated by job applicants. The fact that applicants' IM positively affects recruiters' evaluations and that recruiters' perceptions of applicants' IM do not align with applicants' self-reports (Roulin et al. 2014) suggests that manipulation attempts are often successful (Brosy et al. 2021) so several nonverbal interview behaviours may potentially constitute honest signals of trustworthiness, likeability, and credibility.

Of these, perhaps the least well-understood is laughter (Brosy et al. 2021). Smiling is a common and effective impression management strategy. By smiling, job applicants can convey positive emotions and friendly attitudes. Studies have shown that the intensity of a smile is positively correlated with the interviewer's favourability toward the job applicants (Jones & Pittman 1982). By smiling moderately, job applicants can create a positive self-image during the interview, thereby increasing the possibility of being hired. These variables (impression management, verbal and non-verbal behaviours) as well as appearance attractiveness are associated with interview ratings (Goldberg & Cohen 2004). In previous studies, Gifford and Wilkinson (1985) found a correlation between interviewer ratings and separate ratings of nonverbal behavior (dress code, angle of inclination, facial expressions, smiles, and gestures), while Tsai et al. (2005) found that self-reported friendliness was correlated with behaviours such as nonverbal behavioural cues (e.g., smiles and nods) correlated with interviewer ratings. However, it may be useful to translate these verbal statements into nonverbal codes to produce a categorization that can serve as a guide for selecting interviewers (Pinto, A. P., & Sousa, C. D. 2014).

Job applicants' smile intensity and recruitment decisions

The intensity of a job applicant's smile at the beginning of an interview is crucial to the interviewer's first impression. As a positive nonverbal signal, smiling can quickly convey friendliness, confidence, and optimism, thereby helping job applicants leave a deep and good impression on the interviewer at the start of the interview. The intensity of a job applicant's smile will directly affect the interviewer's perception of their personality traits. Krumhuber et al. (2007) found that job applicants with higher smile intensity are more likely to be considered friendly, enthusiastic, and cooperative. These characteristics are often regarded by interviewers as important qualities in teamwork and work environments, thereby increasing the chances of job applicants being hired. The authenticity of the smile is also an important factor influencing the interviewer's decision. Ekman and Friesen (1986) distinguished between a sincere "Duchenne smile" and an

insincere smile. The Duchamp smile not only involves the corners of the mouth rising but is also accompanied by the activity of the eye muscles and is considered to be a true expression of emotion. Interviewers are more likely to trust and like job applicants who show a Duchamp smile, thereby increasing their chances of being hired.

This study uses impression management theory and the elaboration likelihood model (ELM) to explain the relationship between job applicants' smile intensity and hiring decisions. Impression management theory holds that individuals consciously control and regulate their behaviour in social interactions to influence others' impressions of themselves (Leary & Kowalski 1990). In an interview situation, job applicants convey a positive image through a sweet smile. Job applicants can shape a positive self-image in an interview and try to influence the interviewer's judgment. Previous research has shown that some nonverbal interview behaviours may constitute honest signals of credibility, likability, and trustworthiness. These signals increase the likelihood of being hired. The Elaboration Likelihood Model (ELM), introduced by Petty and Cacioppo in 1986, explains how persuasion operates through two distinct routes: the central and the peripheral. The central pathway relies on the deep processing of information, while the peripheral pathway relies on the surface features of information and situational cues. Smiling, as a nonverbal cue, mainly influences the interviewer's decision through the peripheral pathway. When the interviewer relies on the peripheral pathway in the decision-making process, nonverbal behaviours such as smiling become particularly important. A sweet smile can improve the interviewer's overall evaluation of the job applicant through mechanisms such as emotional contagion and social recognition, thereby influencing hiring decisions. One explanation for these findings is that a bright smile is associated with greater sociability, which leads to more positive relationship outcomes (Scarr 1992). Therefore, compared with a slight smile, a broad smile may convey a stronger signal that the expresser wants to establish social connections, which increases the impression that the expresser is friendly and approachable. Therefore, we believe that a broad smile (relative to a slight smile or no smile) can enhance the positive image of the job applicant, thereby obtaining a higher evaluation in the hiring decision. (Wang et al. 2016)

Hypothesis 1: A broad smile (versus a slight smile and no smile) will be evaluated positively in recruitment decisions.

Perceived Credibility

Boone and Buck (2003) suggested that facial expressions are a reliable signal that builds a sense of trust amongst social interaction partners. Smiling is particularly considered a marker of trust and willingness to engage in cooperative interactions. This behaviour is common in interactive situations and is typically signalled by the Duchenne marker, which is challenging to fake (Scharlemann et al. 2001; Schmidt & Cohn 2001). Boone and Buck's (2003) hypothesis is that smiling people are often interpreted as socially trustworthy, especially during brief encounters with strangers, when there are relatively few other credibility cues available (Scharlemann et al. 2001). Previous research on trust games has found that smiling unfamiliar partners are more trusted than expressionless partners (Scharlemann et al. 2001). Newscasters who display positive rather than neutral emotions have also been described as more trustworthy (Ravaja et al. 2004).

Comparable findings were observed in research conducted by Centorrino, Djemai, Hopfensitz, Milinski, and Seabright (2011), who had respondents participate in a modified trust game in which participants were required to decide whether to invest in someone based on a motivational video. The results showed that smiling can promote cooperation because smiling people are perceived as more persuasive and trustworthy than those with a neutral face. It is claimed that people who are perceived as more credible ought

to be more persuasive (Ohanian 1990). Perceived credibility indicates the credibility of an individual and consists of three subdimensions: attractiveness, expertise, and trustworthiness (Ohanian 1990). Expertise: refers to the applicant's knowledge and skills in his or her field of expertise. Trustworthiness: refers to whether the applicant is considered honest, reliable, and upright. Attractiveness: refers to the applicant's appearance and personality charm. Although this dimension may be relatively unimportant in recruitment decisions, it still has a certain influence.

Chiang and Suen (2015) delved into the work of Kristof-Brown et al. (2005) and added interpersonal fit. This fit is based on subjective impressions, such as the applicant's opinions and background, and can also influence recruiters' hiring decisions. This interpersonal fit is guided by the peripheral pathway of the ELM, which invokes simple judgmental cues or heuristics to influence a person's attitudes. Thus, a person can positively influence a recruiter by using irrelevant cues, such as perceived trustworthiness, instead of job-related information (Chiang & Suen 2015). Especially since recruiters have limited time to carefully investigate applicants' qualifications (Kluemper & Rosen, 2009; Van der Land et al. 2016), a person's perceived trustworthiness may be an attribute that increases the positive evaluation of hiring decisions. Hausknecht et al. (2004) studied the impact of different evaluation dimensions in interviews on hiring decisions and found that expertness significantly affects interviewers' decisions. They found that the stronger the professional ability of job applicants, the more willing the interviewers are to hire them; Barrick et al. (2009) explored how the personal traits displayed by job applicants in interviews affect interviewers' recruitment decisions. They found that the credibility of job applicants, especially the performance of honesty and reliability, has an important impact on interviewers' hiring decisions. Job applicants with high credibility are considered more suitable for long-term employment and trust; McDaniel et al. (1994) meta-analysis showed that the integrity and reliability of job applicants are significantly correlated with their future work performance. The results show that interviewers are more inclined to hire job applicants who show high credibility in interviews because they are considered more reliable and trustworthy in actual work. These previous studies show that when this is related to the recruitment process, it can be said that people with high credibility will have a higher chance of persuading recruiters, thereby increasing interviewers' positive evaluation in hiring decisions.

Hypothesis 2: A broad smile (versus a slight smile and no smile) will be evaluated positively by interviewers in recruitment decisions through perceived credibility.

Smile Intensity and Gender Stereotypes

Social Role Theory is used to explain gender differences and social behaviour patterns. Society transmits gender role expectations and norms through various channels, thereby affecting individual behaviour. Men and women are expected and guided to assume different social roles during their growth. Gender role beliefs arise from observing that men and women assume different social roles, exhibit different behavioural differences in different situations and infer that they have corresponding personalities. Thus, both men and women are believed to possess characteristics that enable them to perform gender-typical roles. These attributes are evident in consensus beliefs or gender stereotypes" (Eagly and Wood 2011).

Based on gender stereotypes, we believe that a bright smile is inconsistent with masculinity. Men are expected to be task-oriented, competitive, and strong, traits that discourage bright smiles (Hall et al. 2000). Furthermore, Wang et al. (2017) demonstrated that a bright smile hurts perceptions of competence—a key trait attributed to men in the stereotype content model (Cuddy et al., 2008). Research has found that in some cultures, men with bright smiles may be seen as less serious or lacking in intelligence and honesty, which is inconsistent with the traditional male stereotype of

authority and seriousness. Kryes, et. al. (2016). Hess, U., & Hareli, S. (2017) demonstrated that Men smile less often in formal and authoritative situations to maintain a serious and authoritative image, while women smile more often in social and supportive situations to display socially desirable warmth and friendliness. Therefore, we believe that a broad smile is not compatible with the male action trait, temperament. On the other hand, previous research has shown that bright smiles tend to be associated with higher levels of sociability and friendliness, two attributes typical of women (Scarr 1992, Miles 2009, Wang et al. 2017 and Choi et al., 2020)). (Otta, E., Ambrosio, F.F., & Hoshino, R. L. 2009) showed that women's bright smiles are often perceived as conveying more honesty and trustworthiness, whereas men's bright smiles are perceived as less conforming to traditional images of masculinity. Kryes, et. al. (2016) Women's bright smiles are often perceived as more trustworthy and sincere. This phenomenon is consistent with societal expectations of female emotional expression and warmth. In sum, women's broad smiles are perceived as more trustworthy and friendly (Deutsch, et.al. 2007) consistent with typical female stereotypes (LaFrance and Carmen, 1980, Briton and Hall 1995).

Social role theory suggests that people are "rewarded by others for conforming to gender roles and penalized for deviating from them" (Eagly and Wood 2011, 468). Consequently, conforming to gender roles produces positive responses, while deviating from such role-based expectations elicits negative responses (Anderson et al. 2001, Carli 2001, Eagly and Wood 2011).

Hypothesis 3: The gender of the job applicant will moderate the effect of smile intensity on perceived credibility. Specifically,

Hypothesis 3a: In an interview, a female job applicant's a broad smile (versus a slight smile and no smile) will receive a higher credibility evaluation and be considered more trustworthy.

Hypothesis 3b: In an interview, a male job applicant's a slight smile (versus a broad smile and no smile) will receive a higher credibility evaluation and be considered more trustworthy.

Methodology

Study Design and Sample

To test the hypotheses presented in Figure 1, this study employed a 3 (smile intensity: broad smile, slight smile, no smile) × 2 (job applicant gender: male, female) between-subjects factorial design. The independent variables were the job applicant's smile intensity and gender, while the dependent variables included recruitment decision scores and perceived credibility scores. Data collection was conducted online, as internet-based surveys offer faster response times and higher response rates (Fricker & Schonlau, 2002; Treadwell, 2014). A total of 315 Chinese participants were initially recruited, but 10 participants with incorrect data were excluded, leaving 305 valid responses (155 males, 150 females; Mage = 31.82, SD = 8.10). Participants were selected based on specific criteria to ensure consistency, including the absence of visual or auditory impairments and no prior experience in the relevant industry to prevent bias in recruitment decisions. The questionnaire was distributed via Google Forms, and most respondents had a bachelor's degree (35.1%), followed by 28.2% with a professional degree. In terms of interview experience, 55.4% had prior experience, while 44.6% did not. An industry distribution analysis showed that 31.8% of respondents worked in the service sector, followed by finance and insurance (21%), science, education, culture, health, and medicine (15.1%), with 6.6% representing other industries. This sample design ensured consistency in participants' physiological conditions and background experiences, minimizing potential biases caused by individual differences.

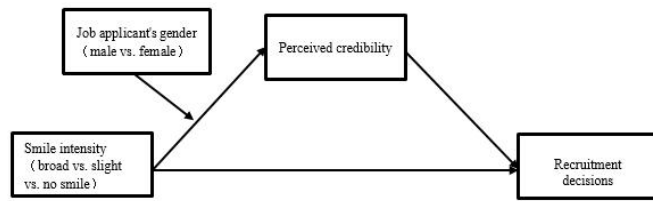


Figure 1. Conceptual Model

Experimental Design

The experimental materials consisted of six simulated job application videos, each lasting 30 seconds. To ensure consistency, all videos featured a uniform white background, and all candidates wore dark-colored professional attire. In each video, the candidates delivered a self-introduction following a pre-written standardized script, covering basic information such as name and educational background, job-related experience including prior roles as a teaching assistant or intern, and motivation for applying along with their understanding of the company's development. To control for the effects of smile intensity and gender on recruitment decisions, standardized video materials were prepared for both male and female candidates. The female candidate, Li Fei, applied for a hotel manager position. In the video, she introduced herself in a humble yet confident tone, highlighting her educational background in business administration, her teaching assistant experience, and her enthusiasm for hotel management. Additionally, she answered questions related to her weaknesses and motivation for applying, demonstrating a strong alignment with the company's culture and career development opportunities. The male candidate, Chen Yunqian, applied for a sales position. He showcased strong verbal communication skills and emphasized his professional background, including marketing internship experience. While answering questions, he expressed a deep interest in the sales industry and discussed his career aspirations. To ensure consistency in experimental conditions, all videos were recorded under standardized settings, maintaining a white background and consistent lighting, while all candidates wore dark-colored professional attire. This rigorous standardization controlled for extraneous variables, ensuring the validity and reliability of the experimental stimuli.

Manipulation Material

Smile intensity

This study uses six videos as stimuli for the experiment. Each of the six videos contains two job seekers. The six videos were differentiated according to the facial expressions of the male and female job applicants. Each video consisted of three different levels of smiles for males and three different levels of smiles for females. First, the applicants in this study exhibited a Duchenne smile (Ekman, Davidson, & Friesen 1990). This type of smile expresses joy, positive emotions, and happiness (Ekman et al. 1990). This type of smile was chosen because non-Duchenne smiles or fake smiles may lead to negative emotions and less positive evaluations of job attributes such as reliability and motivation (Krumhuber et al., 2009; Bernstein, Sacco, Brown, Young, & Claypool 2010). Choosing the right smile is important because there are fifty different types of smiles, and they can all be associated with a certain emotion. (Ekman 2009). The Duchenne smile is characterized by the zygomaticus major muscle producing a diagonal stretch of the lips and the orbicularis oculi muscle elevating the person's cheeks and producing wrinkles at the outer corners of the eyes, also known as crow's feet (Ekman et al. 1990).

Secondly, the age of the selected job seekers was relatively young (24 years old). This choice was made because of the impression that young people have on recruiters. According to

Bendick, Jackson, and Romero (1997), younger job applicants receive more positive responses to their job applications than older job seekers. Furthermore, these results are supported by Finkelstein, Higgins, and Clancy (2000), who found that age was more relevant in the hiring process when older applicants were considered compared to younger applicants. (Bram Lips, n.d.2017)

Third, job applicants wear dark sweaters. CareerBuilder (2011), a company that helps both job seekers and employers, conducted an online survey asking 2009 hiring managers and human resource professionals which colours were most appropriate for job interviews. The results showed that dark colours were the most preferred. These results are supported by Ruetzler, Taylor, Reynolds, and Baker (2011), who noted that employers prefer job applicants to wear dark conservative clothing during job interviews. Wear dark conservative clothing during interviews. (Bram Lips, n.d.)

Control Variables

To control for potential confounding variables, several measures were implemented in this study. Regarding physical attractiveness, a pretest screening was conducted with 30 independent participants rating the physical attractiveness of candidates on a 1–7 scale. Only candidates with no significant differences in attractiveness scores were selected for the formal experiment. Additionally, video consistency was maintained by ensuring that all candidates wore dark-colored professional attire, with background and lighting conditions strictly controlled to prevent bias in attractiveness perception caused by variations in clothing or setting.

To minimize the influence of candidates' emotional expressions or personality traits on the results, facial expressions and vocal tones were standardized. Facial expression screening was performed using facial recognition software to verify consistency across the no-smile, slight-smile, and broad-smile conditions, ensuring the absence of emotional exaggeration or excessive nonverbal behavior. Moreover, script standardization was applied, requiring all candidates to follow a strictly pre-set script in terms of content, speech rate, and tone of voice to avoid perception biases arising from vocal differences.

Other confounding variables were also addressed. The order of video presentation was randomized to eliminate potential order effects. To prevent bias due to gender composition, the number of male and female participants was roughly balanced, with 155 males and 150 females. Finally, to reduce the impact of cultural differences on the results, all subjects were individuals who grew up in a Chinese cultural environment to ensure cultural homogeneity within the sample.

Procedures

Each survey had the same set of questions/statements to measure perceived credibility and hiring decisions. In addition, Respondents participated in a series of demographic questions, such as "Please indicate your age." All items were measured on either a seven-point Likert scale or a Seven-point semantic discrimination scale ranging from negative (1) to positive (7).

Participants were randomly assigned to one of six experimental groups. First, all Participants were asked to imagine that they were recruiting employees for a company. Participants then watched six videos of the interview process (for both males and females) with varying levels of smiles (broad, slight, and no smile). Smile intensity varied with the level of zygomatic muscle movement (Ekman 1993), producing slight and broad smiles (see Appendix). Following the viewing of each video, participants were prompted to evaluate the intensity of the job applicant's smile on a seven-point scale. (1, no smile; 7 showing a broad smile; Wang et al. 2017) and then later to complete one of the fifteen items assessing the perceived credibility of the job applicant's smile. To measure perceived credibility, the present study utilized the seven-point Semantic Differences Scale provided by Ohanian (1990). The scale

comprises 15 items, divided into three sub-dimensions with 5 items each. (attractiveness, expertise, and credibility). An example item for the attractiveness vacancy is “The candidate is unattractive/attractive”, for the expertise vacancy “The candidate is unqualified/qualified”, and for credibility “The candidate is insincere/sincere. “. To measure the hiring recruitment decision, two components based on the (Heilman 1979) were used. One was “Based on current information, how likely are you to hire this candidate?” Ratings were made (1, very unlikely; 7, very likely), and finally, we measured demographic data.

Results

Reliability and Validity Analysis

Reliability

In this study, the Cronbach's alpha coefficient was employed to indicate the degree of reliability of the questionnaire. Generally, for the data results of a questionnaire to be valuable, the Cronbach's alpha coefficient must be guaranteed to be at least 0.7, and when it is higher than 0.8, it means that the questionnaire possesses a high degree of reliability. As illustrated in Table 1, the Cronbach's alpha coefficients of perceived trustworthiness and interviewer's hiring evaluation are 0.941 and 0.863, respectively, which are above 0.8, indicating that the questionnaires all have superior reliability indicators.

Table 1. Reliability Analysis

Variant	Cronbach's α Coefficient	Number of questions
Perceived credibility	0.941	5
Recruitment decisions	0.863	2

Validity

KMO and Bartlett sphericity tests were conducted to indicate whether the validity meets the standard. When the following two criteria are simultaneously satisfied: 1. KMO value, the result of KMO value indicator must be greater than 0.6; 2. Bartlett's sphericity test result must reach the significant level (i.e., the significance level is below 0.05), indicating that the data are appropriate for factor analysis and the structural validity is reasonable. As shown in Table 2, the overall questionnaire's KMO = 0.952 > 0.6, Bartlett sphericity test $p < 0.001$, suggesting that the data are appropriate for factor analysis and the questionnaire possesses strong structural validity.

Table 2. KMO And Bartlett Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	0.952
Bartlett's Test of Sphericity	Approx. Chi-Square 2100.309
	df 21
	Sig. 0.000

Manipulation Checks

Differences in perceived smile levels at different smile levels were examined by one-way ANOVA with Spss24.0, and the detailed results are presented in Table 3. As indicated by the table below, there was a significant difference in perceived smile level at different smile levels, $F(2, 302) = 200.43$, $p < 0.001$, requiring further multiple post hoc comparisons. Specifically, the perceived

smile intensity score for a broad smile (5.23 ± 1.48) was significantly higher than that for a slight smile (3.94 ± 0.79) ($p < 0.001$); the perceived smile level score for a slight smile was significantly higher than that for a no smile (2.10 ± 0.98) ($p < 0.001$), indicating that the experimental manipulation was successful.

Table 3. Test for Differences in Perceived Smile Intensity Degrees at Different Intensities

		M \pm SD	F/(p)	η^2	LSD
Smile Intensities	broad smile①	5.23 \pm 1.48	200.43	0.57	① > ② > ③
	slight smile②	3.94 \pm 0.79	(0.000)		
	no smile③	2.10 \pm 0.98			

Correlation analysis

The Pearson correlation test was conducted on the degree of smile, perceived trustworthiness, and interviewer recruitment decision evaluation score, and the outcomes of the correlation coefficient matrix are displayed in Table 4. From the table of correlation coefficients, it is evident that the degree of smile was significantly positively correlated with the perceived trustworthiness, $r=0.72$, $p<0.01$; and significantly positively correlated with the interviewer recruitment evaluation, $r=0.64$, $p<0.01$. The perceived trustworthiness was significantly positively correlated with the interviewer's recruitment evaluation. Perceived trustworthiness was significantly positively correlated with interviewer recruitment evaluation, $r = 0.86$, $p < 0.01$. All of the study variables were two-by-two significantly correlated with each other, thus allowing for subsequent mediation effect analysis.

Table 4. Correlation Coefficient Matrix

	M	SD	1	2	3
Smile Intensities	—	—	1		
perceived credibility	4.85	1.47	0.72**	1	
Recruitment decisions	4.78	1.66	0.64**	0.86**	1

Note: ** $p < 0.01$.

Analysis of the effect of different smile intensities on interviewers' evaluation of hiring recruitment decisions

A one-way ANOVA with Spss24.0 was used to test for differences in interviewers' hiring recruitment decision evaluations at different levels of smiling, and the specific results are shown in Table 5. As can be seen from the table below, there was a significant difference in interviewers' hiring recruitment decision evaluations at different levels of smiling, $F(2, 300) = 136.77$, $p < 0.001$, which requires further multiple post hoc comparisons. Specifically, the hiring recruitment decision evaluation score for a bright smile (5.77 ± 1.05) was significantly higher than that for a slight smile (5.40 ± 1.53) ($p = 0.031$); and the hiring evaluation score for a slight smile was significantly higher than that for no smile (3.18 ± 0.99) ($p < 0.001$), validating hypothesis H1.

Table 5. Effect of Different Smile Intensities on Interviewers' Hiring Recruitment Decisions

		M±SD	F/(p)	η ²	LSD
Smile Intensities	broad smile①	5.77±1.05	136.77	0.48	①>② >③
	slight smile②	5.40±1.53	(0.000)		
	no smile ③	3.18±0.99			

Analysis of Intermediation Effects

Based on the stepwise regression analysis of mediating effects proposed by Wen Zhong Lin (2004), the following model was established: in the first step, model 1 was established with demographic variables, degree of smile as the independent variable, and interviewer hiring recruitment decision as the dependent variable, to test the main effect (coefficient c); in the second step, model 2 was established with demographic variables, degree of smile as the independent variable, and perceived trustworthiness as the dependent variable, to examine the impact of the independent variable on the mediating variables (coefficient a); the third step, with demographic variables, degree of smile, perceived trustworthiness as independent variables, and interviewer hiring recruitment decision as dependent variable, establish model 3, test the effect of mediator variables on the dependent variable (coefficient b), and at the same time under the role of mediator variables, the effect of the independent variables on the dependent variable (coefficient c'), the mediation effect of step-by-step regression analysis The results are shown in Table 6.

From the table below, it is evident that in the initial step, after accounting for the influence of demographic variables, the degree of smiling significantly and positively predicted the interviewer's recruitment decision, $\beta = 0.66$, $t = 15.56$, $p < 0.001$, which verified the main effect (coefficient c'); and in the second step, after controlling for the effect of demographic variables, the degree of smiling significantly and positively predicted perceived credibility, $\beta = 0.74$, $t = 19.47$, $p < 0.001$, validating coefficient a. In the third step, after controlling for the effects of demographic variables, perceived trustworthiness significantly and positively predicted the interviewer's recruiting decision, $\beta = 0.79$, $t = 17.11$, $p < 0.001$, validating coefficient b. This indicates that the mediating effect of perceived trustworthiness between the degree of smiling and the interviewer's recruiting decision is valid. Meanwhile, under the mediating condition of perceived credibility, the degree of smiling did not significantly predict the interviewer hiring recruitment decision, $\beta = 0.08$, $t = 1.68$, $p = 0.094$, did not validate the coefficient c', indicating a fully mediated effect.

Table 6. Stepwise Regression Analysis of The Mediating Effect of Perceived Credibility

variant	Recruitment Decisions		Perceived Credibility		Recruitment Decisions	
	β	t	β	t	β	t
Smile Intensity	0.66	15.56***	0.74	19.47***	0.08	1.68
Perceived Credibility					0.79	17.11***
Genders	0.00	0.12	-0.02	-0.45	0.02	0.55
Age	0.04	0.63	0.02	0.43	0.02	0.44

Education	-0.09	-2.01*	-0.12	-3.11**	0.01	0.26
Length Of Service	0.09	1.43	0.09	1.59	0.02	0.40
Interviewer Experience	0.27	6.33***	0.27	6.87***	0.06	1.81
Industry	-0.02	-0.55	-0.02	-0.41	-0.01	-0.29
R2	0.49		0.59		0.74	
F	40.18***		60.37***		106.14***	
MAX VIF	2.44		2.44		2.44	

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

With smile intensity as the independent variable, perceived credibility as the mediating variable, interviewer recruitment decision as the dependent variable, and demographic variables as the control variables, the mediating effect was analyzed by Bootstrap method using model 4 of Process4.1, and the 95% confidence interval was used to judge whether the effect was valid or not, which was set to be a 5000 sampling sample, and Bootstrap mediation was applied. The results are shown in Table 7. From the table below, it can be seen that the total effect value of smile intensity on the interviewer's hiring recruitment decision is 0.66, and the 95% confidence interval is [0.58, 0.74], excluding 0, which indicates that the total effect is established; the indirect effect value of smile intensity→perceived credibility→interviewer's recruitment decision is 0.58, and the 95% confidence interval is [0.52, 0.65], excluding 0, which indicates that the total effect is established. The mediating effect of perceived trustworthiness between smile intensity and interviewer recruitment decision is established. The value of the direct effect of smile intensity on the interviewer's hiring decision is 0.08, with a 95% confidence interval of [-0.01, 0.17], including 0, indicating that the direct effect does not hold, and suggesting that perceived trustworthiness plays a fully mediated effect between smile intensity and the interviewer's recruitment decision. Hypothesis H2 was verified.

Table 7. Mediation Effects Analysis of Bootstrap Method

Effect	Effect Size	Boot SE	95%CI	
			LLCI	ULCI
1. Total Effect	0.66	0.04	0.58	0.74
2. Direct Effect	0.08	0.05	-0.01	0.17
3. Indirect effects	0.58	0.03	0.52	0.65

Moderation effect analysis

A two-way ANOVA with interaction effects was used to illustrate whether the moderating effect held, and the results are shown in Tables 9 and 10. As can be seen in Table 10, there was a significant main effect of gender, $F(1, 298) = 55.23$, $p < 0.001$, $\eta^2 = 0.16$, and of degree of smiling, $F(2, 298) = 723.62$, $p < 0.001$, $\eta^2 = 0.83$, and a significant 2×3 interaction effect of gender and 2×3 interaction effect of degree of smile was significant, $F(2, 298) = 367.99$, $p < 0.001$, $\eta^2 = 0.71$, indicating that the moderating effect of gender between degree of smile and perceived trustworthiness was significant, which verified Hypothesis H3, and further simple effects analysis was needed, and the results are shown in Fig. 1. As can be seen in Fig. 2, for female job applicants, the scores of

perceived trustworthiness for different degree of smile differed significantly, $F(2, 298) = 575.78$, $p < 0.001$, $\eta^2 = 0.79$, specifically, the perceived credibility score of a bright smile (6.56 ± 0.33) was significantly higher than that of a medium-smile (4.09 ± 0.31) ($p < 0.001$), and that of a slight smile was significantly higher than that of no smile (3.25 ± 0.44) perceived trustworthiness scores ($p < 0.001$), which verified hypothesis H3a; for male job seekers, the difference in perceived trustworthiness scores between different levels of smiles was significant, $F(2, 298) = 507.50$, $p < 0.001$, and $\eta^2 = 0.77$, and, specifically, perceived trustworthiness scores were significantly higher for a slight smile (6.60 ± 0.32) than for a bright smile (5.22 ± 0.86) perceived trustworthiness score ($p < 0.001$), and the perceived trustworthiness score of a bright smile was significantly higher than the perceived trustworthiness score of no smile (3.38 ± 0.54) ($p < 0.001$), validating hypothesis H3b.

Table 8. Descriptive information on perceived credibility at different smile intensities by gender

	Man (n=154)	Females (n=150)
1. Broad smile	5.22±0.86	6.56±0.33
2. Slight smile	6.60±0.32	4.09±0.31
3. No smile	3.38±0.54	3.25±0.44

Table 9. Table Analyzing The Moderating Effect Of Gender

variant	Genders			Smile Intensities			Genders * Smile Intensities		
	F	p	η^2	F	p	η^2	F	p	η^2
Perceived credibility	55.23	0.000	0.16	723.62	0.000	0.83	367.99	0.000	0.71

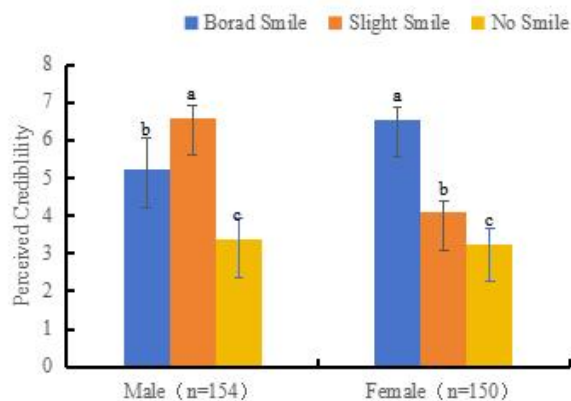


Figure 2. Perceived Credibility Scores at Different Smile Intensities by Gender

General Discussion

Discussion

We investigated the effect of job applicants' smile intensity on interviewers' recruitment decisions. Consistent with our predictions, a bright smile (relative to a slight smile and no smile) would improve hiring decision evaluations. On the other hand, perceived credibility mediated the relationship between smile intensity and interviewers' hiring decisions. Finally, for female job applicants, a bright smile (relative to a slight smile and no smile) would make interviewers feel more trustworthy during the interview. The results

supported Hypothesis 3a, and a slight smile (relative to a bright smile and no smile) would make male job applicants feel more trustworthy. These results are consistent with our hypothesis that a bright smile would be evaluated more positively than a slight smile, but the interpretation of a smile in terms of role expectations has different results.

Theoretical implications and practical implications

Our theoretical contributions are threefold: First, this study will enrich the existing literature on the role of nonverbal behavior in interviewing by exploring the effects of male and female smile intensity on perceived credibility and recruitment decisions. Most of the current research on smiling and credibility focuses on Western countries, and this study fills the research gap in the Chinese context. Our main theoretical contribution is to explore the impact of displayed emotions (i.e., smiles) on job applicants' perceived reliability and hiring decisions. Previous research has mostly focused on the impact of emotional labor on service providers in the hospitality industry (e.g., Chu et al. 2012), but has been less studied in the context of recruitment and organizational studies. To fill this gap, this study examines the impact of job applicants' expressed smile intensity on interviewers' perceived reliability and recruitment decisions. In addition, we demonstrate the joint effects of job applicants' gender and smile intensity and show that people evaluate bright and weak smiles differently based on gender. At the same time, most of the smile-related literature is from the West, so we also expand the gap in the Chinese literature.

Second, this study will help to explore the distinctions between Chinese and Western cultures regarding interview behavior. By exploring Chinese people's different interpretations of and responses to smiles, the study will provide theoretical support for cross-cultural management and cross-cultural communication and help identify the influence of cultural factors in workplace behavior to decouple smile intensity from authenticity in most Western studies. As mentioned above, previous research in marketing has equated broad smiles with genuine smiles (e.g., Bujisic et al. 2014). The current findings suggest that the link between smile intensity and reliability can be extended to human organizational management. Moreover, smile intensity not only affects the perception of smile reliability but also affects the evaluation of hiring decisions (Ruben et al. 2015). Our study suggests that the impact of a bright smile may depend on the gender of the job applicant. Female job applicants should be encouraged to show high-intensity emotional expressions, such as a bright smile. On the other hand, male job applicants may be more effective in gaining positive evaluations through a slight smile. China culture places more emphasis on smiling as a symbol of politeness and modesty, and women are expected to smile more. In Western culture, smiling is more seen as a sign of confidence and openness, and both male and female job seekers need to show their friendliness and sociability through a moderate smile.

Third, by examining the comparative intensity of men's and women's smiles in interviews, this study will reveal the subtle differences in gender roles in workplace performance and provide a theoretical framework for gender and workplace behavior. This will help deepen the understanding of gender equality and gender bias and lay the foundation for future related research. The previous study Wang et al. (2017) showed that laughing leads to higher warmth but lower perceptions of competence. According to the stereotype content model (Cuddy et al. 2008), women's gender roles emphasize warmth rather than competence traits, which are more associated with men (Abele 2003). It is not surprising, therefore, that smiles from female job applicants (but not male applicants) represent warmth and are perceived as more trustworthy. Similarly, smiles reduce perceptions of competence and are therefore inconsistent with masculine stereotypes. So a slight smile is more consistent with the confident, polite image of Chinese men.

The practical implications of this study can be applied to cross-cultural management training to help multinational companies understand and deal with workplace behavior differences in different cultural backgrounds. This has important practical significance for improving corporate management and enhancing the collaboration efficiency of cross-cultural teams in the context of globalization. Companies can design more effective interview training courses based on the research results to train recruiters on how to better interpret non-verbal behaviour in interviews. Simultaneously, it can also offer targeted guidance and support for employees' career development and interview preparation.

Like other research, this study also has its limitations. First, our study involved a sample of Chinese participants. Previous studies have shown that the norms of smiling may differ between cultures (Hennig-Thurau et al. 2006). For example, in Western culture, Westerners say that they smile more often when they feel happy because they tend to be encouraged to express their feelings openly (Matsumoto et al. 2008 and Tsai et al. 2002). Therefore, future research on other cultural contexts is necessary. Second, our situational hypothesis was based on a single interview situation. However, in many interview situations, there are repeated interactions between interviewers and job applicants, and smiles in different industries may have different effects and interpretations. The establishment of such a relationship may mitigate the gender effect found in this study. Additionally, future research should consider situations where gender stereotypes may not be so prominent. For example, in addition to the interview situation in the service industry, the intensity of smiles is also the case in some industries that do not require smiling, and advertisements for luxury goods or high-end services often involve "soft smiles" because such smiles are a symbol of status. Finally, our study was conducted through a situation-based experiment. To overcome this limitation, future research should examine the effects of smile intensity in a field setting and measure actual evaluative criteria for recruitment decisions.

Conclusion

Much of the Western literature on smiling supports the idea that individuals conclude others based on their emotional expressions. It is widely agreed that positive emotional expressions, such as smiling, lead to favourable interpersonal judgments (Deutsch et al. 1987 and Mueser et al., 1984; Thornton 1943). The current study shows that smiling in China also leads to positive interpersonal judgments, and the intensity of the smile affects the perception of job seekers of different genders in an interview environment. In Chinese culture, smiling is often seen as a manifestation of politeness and modesty. Previous studies have shown that bright smiles are associated with higher levels of sociability and friendliness, two typical characteristics that are usually associated with women (Scarr 1992, Miles 2009 and Wang et al. 2017). Relatively speaking, male job applicants' smiles focus more on their professionalism and seriousness. Appropriate smiles can demonstrate politeness and confidence. In the Chinese context, men's appropriate smiles are generally associated with positive evaluations, which aligns with my expectations. In conclusion, the findings of this study suggest that, in terms of smiling, a bigger smile tends to yield better outcomes.

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No funding was received for conducting this study. The present study has no relevant financial or non-financial interests to disclose.

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About the Authors

Fei Xu

Department of Business Administration, The Hoseo University, Cheonan, Republic of Korea

Xueqin Zhang

Department of Business Administration, The Hoseo University, Cheonan, Republic of Korea

Junho Lee

Department of Business Administration, The Hoseo University, Cheonan, Republic of Korea

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Transforming Brick-and-Mortar Institutions: An Analysis of Digital Engagement in Small-City Museums and the Impact of Digital Transformation

Xinyao Wang^{1*a}, Shyhnan Liou^{1b} and Chia-Han Yang^{1c}

¹*Institute of Creative Industries Design, National Cheng Kung University, Taiwan*

**Corresponding author: Xinyao Wang, PA8073010@ncku.edu.tw*

Abstract

This paper explores the digital transformation journey of Liaoyang Museum, a national-level museum located in a small city with limited resources and audiences. An analysis of the museum's WeChat public account and official website reveals a dynamic interplay between digital strategies, cultural heritage preservation, audience engagement, and sustainable development. The study highlights the museum's proactive response to the COVID-19 pandemic by embracing online platforms and investing in physical infrastructure and technology. Challenges identified include resource optimization, talent gaps, and the need for a more holistic approach to digitalization. The paper concludes by emphasizing the importance of integrating digital technologies with traditional practices to foster community engagement, promote cultural awareness, and achieve sustainable museum development.

Keywords: Digital Transformation, Sustainable Development, Small-City Museums, COVID-19 Pandemic

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Introduction

Museums play an increasingly important role in promoting sustainable development, contributing to cultural heritage preservation, community engagement, education, and societal awareness. Although research on digital transformation in museums is expanding, the specific needs and challenges faced by smaller, national-level museums in small cities remain underexplored. This paper examines how these museums can leverage digital transformation to overcome limitations, enhance cultural influence, and foster sustainability.

The research explores the interplay between museum digitalization, sustainable development, and the unique challenges faced by smaller museums. By analyzing the case of the Liaoyang Museum, the paper provides insights into:

Effective Digitalization Strategies: Strategies for navigating digital landscapes are explored, with a focus on optimizing resources and maximizing impact within the small-city context.

Cultural Heritage Preservation: The study investigates how digital technologies can meaningfully and accessibly preserve cultural heritage for future generations.

Audience Engagement: The paper examines how digital tools can attract larger, particularly younger, audiences and create a more engaging museum experience. Building Sustainable Practices: The research explores how museums can use digital transformation to promote community involvement, enhance cultural awareness, and develop sustainable practices.

The research aims to offer valuable insights and practical recommendations for small-city museums navigating digital landscapes, contributing to museum studies, and providing concrete steps for sustainable museum development in a rapidly changing world.

Literature review

Museums, Digital Transformation, and Sustainable Development

The relationship between museums and sustainable development has gained recognition, highlighting museums' potential contributions. Before the COVID-19 pandemic, research emphasized organizational changes needed to enhance sustainability in museums. Jung (2016) examines how these changes affect workplace culture, emphasizing leadership and communication's role in aligning museum operations with sustainable development goals. Kornelaki et al. (2018) studied educational programs in archaeological museums to improve science education for young students, aligning with UNESCO's sustainable development objectives. Málaga et al. (2019) discussed museums as tools for sustainable community development, focusing on their role in fostering sustainable practices within local communities.

Digital technology began emerging as a promising avenue for sustainability. Museums recognized digital tools' potential to enhance visitor engagement and broaden access to collections, marking the beginning of a transformative journey. Krämer-Weidenhaupt (2020) noted that the gradual adoption of digital practices supports sustained development, laying the groundwork for a more integrated approach to cultural heritage management. Literature on museum digital transformation and sustainability is still evolving. For example, Hadi et al. (2021) examined sustainable business performance determinants in Malaysia's upstream petroleum industry, and Qin et al. (2022) discussed digital technology-driven sustainable transformation in agriculture. Stroumpoulis et al. (2022) explored the relationship between sustainable supply chain management and digital transformation, focusing on technologies like blockchain and big data analytics. Feng et al. (2022) provided an empirical analysis of the impact of enterprise digital transformation on green innovation, showcasing the positive effects on environmental initiatives.

The COVID-19 pandemic catalyzed a critical shift in museums, accelerating digital transformation and sustainability discussions. As in-person visits became impractical, museums adopted innovative digital initiatives to engage audiences. The federal government recognized the need to address the digital divide in

museums and libraries during COVID-19 (Federal Government, 2020). This period underscored digital technology as crucial for maintaining educational outreach and cultural engagement during crises. Consequently, digital transformations in museums have become essential for survival in a rapidly evolving cultural landscape.

Despite challenges, digital transformation in museums is seen as inevitable, with the pandemic accelerating technology adoption (Roque et al., 2024). The connection between digitalization and sustainability in museums has become increasingly apparent (Richardson, 2021). Grants supporting digital initiatives have helped museums navigate challenges (Lutman, 2021). As museums adapt their digital strategies, recognizing digital transformation to promote sustainability has led to increased scholarly discourse.

With funding and grants bolstering digital initiatives, museums are well-positioned to adapt and innovate, enhancing their role in sustainable cultural heritage practices. Literature indicates that digital transformation has led to new approaches to engaging audiences, preserving cultural heritage, and enhancing educational experiences (Cosmin & George, 2021). From crowdsourcing to virtual museums, digital technologies are becoming integral to museum operations (Reynolds, 2017). This trend supports current sustainability strategies and indicates a fundamental shift in how museums contribute to sustainable development.

Digital Transformation in Museums

The digital transformation of museums has become crucial over the past few years, driven by the need to enhance visitor experiences and preserve cultural heritage. Early discussions on digitalization emphasized integrating technology into museum practice to address contemporary needs. For example, Park (2012) highlights the digital restoration of Seokguram Grotto and the development of Virtual Museums, showcasing how advanced technologies can preserve cultural legacies. Din et al. (2014) underscore the importance of comprehensive digital strategies, noting that effective policymaking and business models are pivotal for successful integration into museum operations.

However, significant challenges remain in digitalization efforts. Pan et al. (2012) identify difficulties in connecting stakeholders like archaeologists and museums, while Wang (2014) describes Japan's collaborative approach to overcoming financial and technical barriers through government and large enterprise partnerships. Zhang (2014) discusses incorporating new media and Web3D technology to enhance digital museum platforms. Li et al. (2017) demonstrate how virtual reality can enrich visitor experiences, as evidenced by the Shihsanhang Museum. To address digital transformation challenges, Bernardi et al. (2019) emphasize the need for robust digital strategies, as echoed by Shi et al. (2020) and Podzharaya et al. (2020), who explore smart tourism's impact on museum digitalization in Montenegro.

Technological advancements have significantly influenced how museums navigate digital landscapes. Mobile applications have become key tools for enhancing museum experiences, as Šobánová (2016) examines their typology and purpose concerning visitor interaction. Yi (2018) analyzes the impact of the "Internet plus" concept on cultural tourism, using the "digital palace museum" as an example of content innovation. Cultural content drives digital transformation, as Arrigoni et al. (2019) highlight the intersection of digital technologies and heritage. In the realm of digital cultural relics, Li et al. (2020) presents a visual system combining cultural knowledge with visualization techniques, enriching the narrative of exhibitions.

Collectively, this body of literature underscores technology's critical role, management practices, and cultural heritage in the digital transformation of museums. As institutions navigate this complex landscape, integrating innovative strategies will be crucial for enhancing visitor engagement, preserving cultural resources, and ensuring museums remain relevant in the digital age.

Methodology

This study focuses on the themes of digital transformation and sustainable development within the context of museums. It specifically examines how museums can use technology and management strategies to innovate cultural content, with a focus on the unique pathways and characteristics of digital transformation in small-city museums. The theoretical frameworks of sustainable development and digital transformation are central to this exploration. Sustainable development emphasizes the balance of social, economic, and environmental factors, while digital transformation highlights how digital technologies can reshape organizational operations and value delivery. The research process is depicted in Figure 1, detailing the stages and tasks involved.

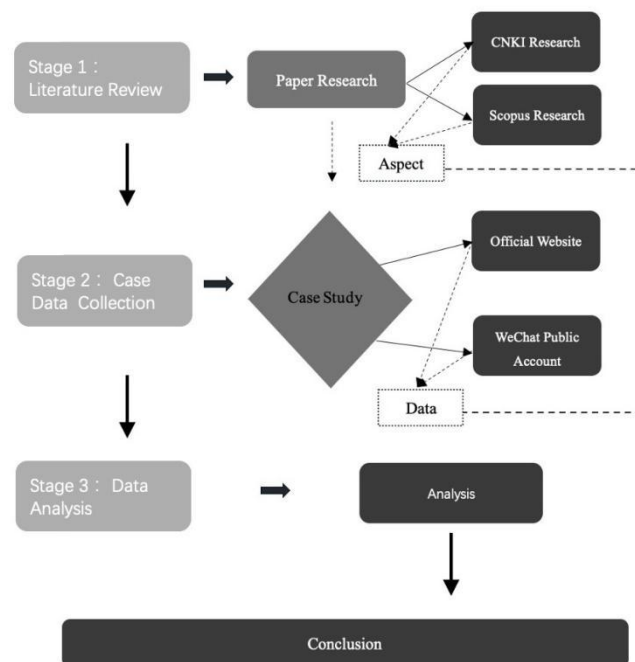


Fig. 1 Research Process

To achieve this, a comprehensive literature review was conducted using two major academic databases (Table 1): CNKI (China National Knowledge Infrastructure) and Scopus. The selected literature spans from 2020 to 2024, capturing recent developments in museum digitalization, especially in response to the COVID-19 pandemic, which has accelerated the adoption of digital technologies. This period also marks significant technological advancements, increased policy support for digital initiatives, and a growing body of research that provides valuable insights for analysis.

The study places a particular emphasis on analyzing the official website and WeChat public account of the Liaoyang Museum as primary sources for data collection and organization. By examining the content and themes of various activities promoted through these digital platforms, the research aims to explore how the museum's digitalization efforts contribute to cultural innovation and the sustainable transmission of heritage. This methodology not only allows for an integrated analysis of how small-city museums navigate digital transformation while emphasizing sustainable practices, but it also highlights contemporary developments, challenges, and best practices in digitalization. The insights derived from this examination underscore technological advancements in small-city museums and elucidate management approaches that facilitate meaningful cultural transformation in the digital age.

Table 1. Influential Museum Digital Aspect Articles

<i>Authors</i>	<i>Talent</i>	<i>Technology</i>	<i>Collaboration</i>	<i>Cultural Content</i>	<i>Media Platforms</i>
<i>Cassidy, K. A. et al. (2020)</i>	Emphasizes enhancing staff understanding and application of digital technology.	Uses disruptive technology to connect museums with community digital technology.	/	Emphasizes the integration of cultural content between community and museums.	/
<i>Dibitonto et al. (2020)</i>	Museum directors must understand the needs and support the professional talent required for digital transformation.	Technological innovation should be combined with human resource development to drive organizational transformation.	Employees need to be flexible to adapt to changes, update their skills, and collaborate with various professionals.	Emphasizes cross-disciplinary cooperation to promote cultural management through technology and innovation.	/
<i>Kamariotou et al. (2021)</i>	Emerging positions must support digital transformation and enhance the team's technical capabilities and adaptability.	Combines digital archives with artworks, allowing users to browse freely between art and archives.	The distinction between organizational roles becomes blurred in the digital space, emphasizing the need for more collaborative practices to engage visitor experiences.	Plans for digitized exhibits and collections, as well as enhancing user experience.	Updates information and establishes interaction with the audience through social media platforms.
<i>Zou Dehan (2022)</i>	Cultivating professional knowledge of immersive technologies for display design.	Introduces cloud services, digital multimedia, and virtual reality technologies to change traditional display methods.	Promotes social participation in cultural relic digitization, emphasizing technology and sharing efforts.	Emphasizes the application of digital technologies in multi-dimensional displays of archaeological museums.	/
<i>Leite et al. (2022)</i>	During the pandemic, the team needs to reshape itself to respond to changes.	Online guide services and digital content enhance the dissemination of museum exhibition information.	Maintains contact with public health authorities and relevant partners to share information and experiences.	During the pandemic, museums need to enhance their attractiveness and accessibility.	Produces a large amount of video content to promote virtual visits and permanent exhibitions.
<i>Muškar et al. (2022)</i>	Emphasizes the importance of trained staff in enhancing visitor engagement.	Utilizes digital technologies for information collection, organization, and digital display to promote interactive experiences.	Museums collaborate with other organizations to enhance digital services and infrastructure.	Explores the role of digital technologies in the protection and dissemination of cultural heritage.	Uses social media to enhance museum visibility and invites visitors to participate in promotional activities.
<i>Agostino, D. & Costantini, C. (2022)</i>	Emphasizes the digital skills and capabilities of museum personnel, pointing out the lack of emphasis on digital talent.	Proposes a framework for assessing the degree of digitalization in museums, exploring the use of digital tools.	Improves the digitalization of internal processes in museums, particularly in customer interactions.	Provides comprehensive indicators for digital transformation to assist museum managers in decision-making.	/
<i>Raimo et al. (2022)</i>	Highlights the need for museums to possess professional talent and skills to meet digital transformation.	Focus on website development, social media, and online ticketing systems to enhance visibility and visitor experience.	Emphasizes teamwork to improve museum management efficiency and customer interaction.	Discusses the impact of digital transformation on attracting visitors and protecting cultural heritage.	Mentions the concentration of digital museums in showcasing historical building information and images.
<i>Dou Wenlong (2023)</i>	/	Builds a mobile crowdsourcing platform to encourage broad public participation in cultural relic digitization.	Promotes the development and sharing of cultural data resources to expand cultural dissemination channels and consumption scenarios.	/	/
<i>Zhang Yuqin (2023)</i>	/	Utilizes virtual restoration technology to enhance visitor satisfaction and engagement	/	Enhances tourists' understanding and engagement with exhibits through virtual restoration.	/
<i>Sebastián Lozano et al. (2023)</i>	Emphasizes multidisciplinary cooperation for integrating silk cultural heritage information and data.	Utilizes machine learning and data standardization to enhance the digital management and dissemination of silk heritage.	Promotes open cooperation with different institutions and experts.	Discusses the significance of protecting silk heritage and the importance of digital documentation.	Mentions using digital museums and online platforms to disseminate silk cultural heritage.
<i>Liu Bingbing (2024)</i>	Enhances employees' understanding in the field of digital technology and encourages participation in external seminars.	Utilizes 3D technology for relic scanning to support data preservation.	Emphasizes the importance of project management and collaboration from various parties to support fundraising.	Showcases the depth and diversity	/
<i>Wang Meng & Wang Jinlan (2024)</i>	Need for technical personnel to train in VR and AR technologies; requires high-level specialized knowledge.	Applies AR and VR technologies to provide immersive historical experiences.	Collaborates closely with historians and education experts to ensure rich exhibition content.	Promotes the dissemination and education of cultural heritage through immersive experiences.	/
<i>Wang Wei & Ma Min (2024)</i>	Interaction designers need to understand visitor needs and expectations.	Museum displays transform to increase interaction with the audience, using technology to enhance visitor understanding.	The British Museum establishes collaboration with the public through lectures and discussions.	Emphasizes the in-depth understanding and experience of visitors regarding the historical and cultural	Maintains good interaction with the public through social media.

<i>You Xinyue et al.</i> (2024)	Enhances the capabilities of technical staff, emphasizing necessary technical support.	Introduces three-dimensional panoramic technology for exhibition navigation, enhancing immersion and participation.	Balances resource sharing and information security, emphasizing multi-party collaboration.	context of exhibits. Highlights user participation in the design of digital museums, promoting a user-centered two-way communication model.	/
<i>Al-Hashim, A. & Bankari, N.</i> (2024)	Multidisciplinary experts collaboratively participate in HBIM construction, requiring cooperation among architects, engineers, and others.	Combines drone photogrammetry technology with HBIM to provide 3D models and methods for acquiring building information.	Encourages open collaboration, using open-source software and cooperating with experts.	Emphasizes the importance of preserving vernacular architecture while exploring the digital documentation of cultural heritage.	/

The digital transformation of museums involves several key aspects (Table 2), each with unique characteristics. First, talent is crucial, requiring professionals with expertise in technology and digital tools. Interdisciplinary collaboration, involving historians, designers, and technical experts, is also vital. Continuous learning and development are necessary, with staff regularly attending training sessions to keep pace with technological advancements. Second, the introduction of technology is foundational for digital transformation. Museums should adopt cutting-edge technologies such as cloud computing, 3D scanning, and drone photogrammetry and use various digital tools to enhance management efficiency and audience interaction. The integration of multiple technological approaches can create a multi-dimensional display experience.

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Digital transformation also requires multi-party cooperation, involving cultural institutions, technology companies, universities, and experts. Encouraging community participation helps museums engage the public in the protection and dissemination of cultural heritage. Cross-disciplinary collaboration consolidates broader knowledge and resources, driving innovation. In terms of cultural content, digital transformation should enhance content richness and rethink the presentation of cultural narratives by incorporating interactive elements and storytelling. Digitalization also offers new possibilities for the protection and dissemination of cultural assets, ensuring better preservation and sharing of cultural heritage. Visitor experience is crucial, and museums should strive to enable visitors to gain a deeper understanding of cultural and historical contexts. Finally, media platforms play a significant role. Digital media, such as social media and digital museums, facilitates widespread cultural dissemination and two-way communication between the audience and the museum. Leveraging media power can enhance the museum's brand image, attracting more visitors and sponsorship.

In summary, the digital transformation of museums is a comprehensive project encompassing talent development, technology application, collaboration models, cultural content presentation, and media dissemination. By effectively integrating these factors, museums can enhance exhibition quality, visitor experience, and cultural protection and dissemination.

Table 2. The Key Aspect and Characteristics in Museum Digital Transformation Influential

<i>Aspect</i>	<i>Characteristics</i>
Talent	Requires professionals with expertise in technology and digital tools.
	Cross-disciplinary collaboration, including historians, designers, and technical experts.
	Continuous learning and development, with staff attending regular training and seminars.
Technology	Adoption of cutting-edge technologies (e.g., cloud computing, 3D scanning, drone photogrammetry).
	Use of digital tools to enhance management efficiency and audience interaction.
	Integration of various technological means to create a multi-dimensional display experience.
Collaboration	Multi-party collaboration, including cultural institutions, tech companies, universities, and experts.
	Encourage and facilitate community participation, allowing the public to be involved in cultural heritage protection and dissemination.
	Cross-disciplinary collaboration to consolidate broader knowledge and resources.
Cultural Content	Richness in content, rethinking the presentation of cultural content by incorporating interactive elements and storytelling.
	Protection and dissemination, utilizing digitalization for preserving and sharing cultural assets.
	Emphasizing visitor experience by enabling deeper understanding of cultural and historical contexts.
Media Platforms	Information dissemination through digital media (social media, digital museums) for broad cultural heritage outreach.
	Interactivity, promoting two-way communication between the audience and the museum.
	Brand building, enhancing the museum's image through media engagement to attract more visitors and sponsorship.

Liaoyang Museum, located at 2 Zhongxin Road, Dongsi Road, Liaoyang City, Liaoning Province, China, originates from the "Peng Mansion," a building established during the Republic of China era in 1921. It covers an area of 11,552 square meters, with nearly 3,000 square meters of construction space. The museum officially opened to the public in 1985 and was designated a provincial-level cultural relic protection unit in 1988. Today, it is recognized as a national AAAA-level tourist attraction. The museum houses over 6,000 artifacts, including more than 1,000 items classified as national third-tier relics or above, showcasing significant historical, artistic, and regional value.

The Liaoyang Museum plays a practical role in society by organizing exhibitions and educational activities to meet the public's demand for spiritual and cultural enrichment and fostering community participation and awareness of local history. In response to modern demands, the museum promotes digital transformation, incorporating technologies such as augmented reality (AR) and 3D scanning to enrich exhibition formats and provide an immersive visitor experience. By using digital platforms, the museum enhances interactivity and encourages visitor participation while showcasing rich historical narratives.

The museum also emphasizes sustainable development by integrating environmental protection principles into its operations,

supporting the preservation and transmission of cultural heritage. In summary, the museum's efforts in historical research, cultural protection, and digital transformation underscore its role in contemporary society. Director and Party Secretary leads the Liaoyang Museum, overseeing its operations. The museum has adopted modern technologies, offering Wi-Fi, a WeChat public account, and digital touch screens to enhance the visitor experience. Additionally, the three-dimensional guided exhibition hall and digital guidebooks provide engaging, interactive experiences, while the digital cinema enriches exhibition content. These applications not only enhance modernity but also deepen visitors' understanding of cultural content.

From 2017 to 2019, the museum organized traditional activities emphasizing the sustainable development of culture (Table 3). It collaborated with entities such as the Liaoyang Municipal Bureau of Culture, Tourism, and Radio and Television, and the Liaoyang

Public Cultural and Sports Service Center, to host events promoting intangible cultural heritage. Activities like the volunteer interpretation competition, involving local arts groups, reflected the commitment to cultural preservation. Since 2023, the museum has continued traditional activities while gradually integrating digital functions like digital touch screens and social media promotion, enhancing interactivity and dissemination effectiveness.

However, these activities predominantly maintain traditional forms, sustaining principles of cultural exchange and community participation. For instance, the museum has hosted calligraphy donation ceremonies and performances of local intangible cultural heritage, indicating that while digital advancements are welcomed, the importance of traditional modes in cultural transmission and development remains central. Data for these activities is sourced from the museum's official website, ensuring credibility and relevance.

Table 3. Cooperation Characteristics Notification from Official Website

COOPERATION	CONTENT FROM OFFICIAL WEBSITE
2017-2019	<p>Liaoyang Museum successfully held an intangible cultural heritage promotion activity: Liaoyang Municipal Bureau of Culture, Tourism, and Radio and Television; Liaoyang Public Cultural and Sports Service Center; Municipal Public Cultural and Sports Service Center. 20190610</p> <p>Liaoyang Painting Academy: A special performance of Pan-Chuan School Guqin Art will be held at the Folk Museum. 20190605</p> <p>Local arts groups: Liaoning News reported on the Liaoyang Museum Little Volunteer Interpreter Competition 20190520 ; "Telling the Story of Liaoyang and Passing on Historical Culture—Liaoyang Little Volunteer Interpreter Competition" came to a close. 20190517</p> <p>Media organizations: Collaborated with local news media for promotion and reporting during the "5.18 International Museum Day" event.20190515</p> <p>Liaoyang Folk Museum: The "Intangible Cultural Heritage" project display activity will be held at the Folk Museum during the May Day holiday. 20190430</p> <p>Local cultural research institution: The exhibition of novel manuscripts and samples by renowned author Mr. Li Yunde opens today at our museum. 20181109</p> <p>Local cultural research institution: Resumption notice for the series of lectures on Cao Xueqin's "Dream of the Red Chamber." 20180911</p> <p>Taitung Calligraphy and Painting Association: The "Cultural Exchange in Liaoning" exhibition by the Taitung Calligraphy and Painting Association opened at our museum. 20180813</p> <p>School: Collaborated with Liao Hua No. 3 Primary School in volunteer activities.20180323</p>
2023-2024	<p>Liaoyang Painting Academy: The exhibition of the report of study sketches from the Ink Wash Figure Painting Workshop of Wang Mi, held at the Liaoyang Painting Academy. 20230901</p> <p>Local cultural and arts groups: The donation ceremony of calligraphy works by Wang Wenjie, themed "Sentiment for Hometown," was held at Liaoyang Museum. 20230923</p> <p>Intangible cultural heritage related organizations: Amazing! The performance event of the representative project "Tang Dynasty Costume Hand-Painting" of Liaoyang's intangible cultural heritage was spectacular. 20230821</p> <p>Cultural Relics Protection Center: The Liaoyang Cultural Relics Protection Center celebrated the 2023 Cultural and Natural Heritage Day with various colorful activities.</p> <p>Community or grassroots organizations: Liaoyang Museum conducts a mobile museum outreach program — Exhibition of renowned collection artifacts images (Part II); Liaoyang Museum conducts a mobile museum outreach program — Exhibition of renowned collection artifacts images (Part I).20230727</p> <p>Cultural Bureau or related government agencies: On International Museum Day, there were 'little volunteer interpreters'; artistic performances by national first-class actor Wang Peng and local theatrical groups; and the representative project of Liaoyang's intangible cultural heritage "Tang Dynasty Costume Hand-Painting."20230518</p>

Several activities at the museum highlight the role of digital technology in cultural dissemination and audience interaction (Table 4). For example, during "5.18 International Museum Day," digital tools enhanced public awareness and participation, promoting digital culture. The "Liaoyang Museum Little Volunteer Interpreter Competition" used digital strategies to engage presentations, which fostered cultural literacy and responsibility

among young volunteers. The online lectures on Cao Xueqin's "Dream of the Red Chamber" facilitated the transmission of classical literature and cultural understanding. Additionally, the "Journey into the Wilderness: Chinese Painting Exhibition" used digital displays to enhance visitor interactivity. These digital approaches increased the appeal and reach of exhibitions and expanded the museum's influence on local history and culture.

Table 4. Meaning of Digitalization from Liaoyang Museum (Official Website)

<i>Activity</i>	<i>Date</i>	<i>Theme</i>	<i>Meaning of Digitalization</i>
<i>5•18 International Museum Day</i>	2019-05-15	Cultural Promotion and Educational Activities	Enhance public awareness and participation in museums, promoting the dissemination of digital culture.
<i>Liaoyang Museum Little Volunteer Interpreter Competition</i>	2019-05-20	Volunteer and Community Culture	Cultivate cultural literacy and sense of responsibility among young people while enhancing the fun of presentations through digital means.
<i>Cao Xueqin's "Dream of the Red Chamber" Lecture Series</i>	2018-09-11	Traditional Literature Education	Spread classical literature through online lectures, facilitating cultural understanding and interaction.
<i>Journey into the Wilderness: Chinese Painting Exhibition</i>	2018-09-10	Chinese Traditional Art Exhibition	Increase audience interaction experience by digitally showcasing and disseminating traditional art.
<i>Completion of the Little Volunteer Summer Camp Activity</i>	2018-08-27	Volunteer Service and Cultural Heritage Preservation	Combine digital platforms to enhance students' awareness and participation in culture.
<i>Liaoyang Museum's Participation in the "Exhibition of the Five Capitals of Daliao" in Beijing</i>	2018-09-07	Volunteer Service and Cultural Heritage Preservation	Utilize digital means to demonstrate the history and culture of Liaoyang, expanding its influence.
<i>"Lighthouse Rural Commercial Bank Cup" Calligraphy Competition Exhibition</i>	2018-08-21	Calligraphy Art	Attract young audiences by showcasing calligraphy works through digital methods.

Several museum projects also exemplify sustainable development (Table 5). For example, the mobile museum outreach program — "Exhibition of Renowned Collection Artifacts Images," promotes cultural heritage preservation and community cultural participation. The "Intangible Cultural Heritage" project emphasizes the protection and transmission of local intangible heritage, contributing positively to sustainable development. The "Spring Festival Art Exhibition" promotes cultural practices,

helping the community maintain vibrancy. Moreover, the lecture series on "Dream of the Red Chamber" raises public awareness about protecting cultural heritage. The "Lighthouse Rural Commercial Bank Cup" Calligraphy Exhibition promotes traditional calligraphy culture, driving the revival of local cultural arts. These activities demonstrate the museum's dedication to enriching cultural life and sustainable development

Table 5. Meaning of Sustainability from Liaoyang Museum (Official Website)

<i>Activity</i>	<i>Date</i>	<i>Theme</i>	<i>Meaning of Sustainability</i>
<i>Mobile Museum Outreach — Exhibition of Renowned Collection Artifacts Images (Part I)</i>	/	Cultural Exhibition	Promote the protection and dissemination of cultural heritage, facilitating community cultural participation.
<i>Liaoyang "Intangible Cultural Heritage" Project Display Activity</i>	2019-04-30	Intangible Heritage	Emphasize the protection and transmission of local intangible culture, contributing to sustainable development.
<i>Spring Festival Art Exhibition</i>	2019-01-25	Spring Festival Art Exhibition	Promote local culture through art exhibitions, aiding in the sustainable transmission of culture.
<i>Cao Xueqin's "Dream of the Red Chamber" Lecture Series</i>	2018-09-11	Traditional Literature Education	Disseminate traditional culture, enhancing public cultural identity and awareness of heritage protection.
<i>"Lighthouse Rural Commercial Bank Cup" Calligraphy Exhibition</i>	2018-08-21	Calligraphy Art	Promote the protection and development of traditional calligraphy culture.

The museum's activities reflect the gradual integration of digital technology with sustainable cultural development (Table 6). For example, the mobile museum outreach program used digital means to showcase artifacts, enhancing audience engagement and promoting cultural preservation. Online lectures on "Dream of the Red Chamber" improved cultural awareness, demonstrating digital

tools' application in education. The "Intangible Cultural Heritage" project digitally recorded and presented heritage items, fostering cultural preservation. During "5.18 International Museum Day," digital promotion heightened public awareness of cultural heritage protection. These initiatives highlight digital technology's growing role in cultural sustainability.

Table 6. Meaning of digitalization and Sustainability from Liaoyang Museum (Official Website)

<i>Activity</i>	<i>Date</i>	<i>Theme</i>	<i>Meaning of digitalization + Sustainability</i>
<i>Mobile Museum Outreach — Exhibition of Renowned Collection Artifacts Images (Part I)</i>	/	Cultural Exhibition	Utilize digital means to showcase cultural relics, promoting community participation and cultural preservation.
<i>Cao Xueqin's "Dream of the Red Chamber" Lecture Series</i>	2018-09-11	Traditional Literature Education	Enhance public cultural awareness through online lectures, while facilitating the sustainable dissemination of traditional culture.
<i>Intangible Cultural Heritage Project Display Activity</i>	2019-04-30	Intangible Cultural Heritage	Use digital methods to record and display intangible cultural heritage projects, promoting the protection and transmission of culture.
<i>"5.18 International Museum Day" Event</i>	2019-05-15	Cultural Promotion and Educational Activities	Strengthen public awareness of cultural heritage protection through digital promotion and active participation in events.

The museum's WeChat public account activities from 2015 to 2024 are categorized into two themes (Table 7). Theme 1 covers

fixed daily topics, including notable figures, historical anecdotes, and cultural appreciation. Theme 2 includes main content areas

related to activities like exhibitions, educational programs, and community engagement. The rise of "Online Exhibition" during 2020-2021 reflects the museum's adaptation to the COVID-19 pandemic and commitment to cultural accessibility and engagement. The data was collected by classifying and counting

each activity by theme and nature, ensuring accurate and comprehensive information for analysis. In total, 241 activity themes and 486 directional statistics were compiled, providing a basis for further research on the museum's digital transformation and contributions to sustainable development.

Table 7. Data of Paper and Notification from Liaoyang Museum (WeChat Public Account)

Year	AQ	Theme 1	Q	Theme 2	Q
2015	142	【Notable Figures】	4	Cultural Relics Exhibition	15
		【Historical Anecdotes】	5	Traditional Culture and Educational Activities	10
		【Cultural Relics Knowledge】	3	Art Exhibition	8
		【Antique Appreciation】	1	Volunteer Activities	4
		【Traditional Culture】	4	Cultural Exchange and Cooperation	4
		【Cultural Treasures】	2	Intangible Cultural Heritage Display	3
		【Collection Highlights】	1	Community Participation	2
		【Etiquette and Culture】	3	Cultural Promotion	5
		【Seasonal Sentiments】	1	Festival Activities	3
		【Reference Materials】	1	Calligraphy Exhibition	4
		【Excavation Reports】	1	Thematic Exhibition	4
		【Art Culture】	1	Photography Exhibition	5
		【Fun History】	1	Other Artistic Activities	3
		【Liaoyang Poetry Selection】	1		
		【Qing Dynasty Liaoyang Poetry】	1		
		【Historical Facts of the Ancient City】	1		
			4		
		Subtotal	4	Subtotal	70
			4		
2016	70	【Historical Facts of the Ancient City】	8	Cultural Relics Exhibition	12
		【Collection Highlights】	5	Traditional Culture and Educational Activities	9
		【Exhibition Preview】	6	Art Exhibition	9
		【New Exhibition Preview】	4	Volunteer Activities	4
		【Notable Figures】	4	Cultural Exchange and Cooperation	5
		【Historical Anecdotes】	3	Intangible Cultural Heritage Display	3
		【Cultural Relics Knowledge】	2	Community Participation	3
		【Antique Appreciation】	2	Cultural Promotion	4
		【Traditional Culture】	1	Festival Activities	4
		【Etiquette and Culture】	1	Calligraphy Activities	5
		【Reference Materials】	1	Thematic Exhibition	5
		【Excavation Reports】	1		
		【Art Culture】	1		
		Subtotal	4	Subtotal	63
			3		
2017	71	【Historical Facts of the Ancient City】	9	Cultural Relics Exhibition	13
		【Collection Highlights】	8	Traditional Culture and Educational Activities	11
		【New Exhibition Preview】	3	Art Exhibition	7
		【Exhibition Preview】		Volunteer Activities	4
				Cultural Exchange and Cooperation	4
				Intangible Cultural Heritage Display	3
				Community Participation	3
				Cultural Promotion	3
				Photography Exhibition	3
				Calligraphy Exhibition	3
2018	70	【Historical Facts of the Ancient City】	5	Commemorative Activities	3
		【Collection Highlights】	7	Festival Activities	3
		【New Exhibition Preview】	9	Cultural Relics Exhibition	12
		【Exhibition Preview】	4	Art Exhibition	10
		【Activity Preview】	1	Educational and Cultural Activities	7
		【Public Welfare Activities】	1	Volunteer Activities	3
				Cultural Exchange and Cooperation	5
				Intangible Cultural Heritage Display	2
				Community Participation	3
				Festival Activities	3
2019	43	【Historical Facts of the Ancient City】	1	Calligraphy Activities	4
		【Collection Highlights】	3	Thematic Exhibition	5
		【Exhibition Preview】	5	Photography Exhibition	3
		【New Exhibition Preview】	7	Subtotal	57
		【Performance Preview】	1		
		【Lecture Preview】	1		
			3		
			2		
			2		
			2		

		【Activity Preview】	1	Festival Activities	3
		【Notifications】	1	Photography Exhibition	3
		【Activity Reports】	3		
		【Volunteer Corner】	1		
		【Safety Production Public Welfare			
		Advertisement】	1		
		【Public Welfare Advertisement】			
		【Emergency Management Public			
		Welfare Advertisement】			
		Subtotal	3	Subtotal	38
			0		
2020	45	【Historical Facts of the Ancient	1	Cultural Relics Exhibition	10
		City】	3	Traditional Culture and Educational Activities	7
		【Collection Highlights】	5	Art Exhibition	5
		【Exhibition Preview】	4	Volunteer Activities	3
		【New Exhibition Preview】	8	Cultural Exchange and Cooperation	4
		【Online Exhibition】	3	Intangible Cultural Heritage Display	2
		【Announcements】	1	Community Participation	3
		【Activity Preview】		Cultural Promotion	4
				Festival Activities	2
				Calligraphy Activities	3
				Thematic Exhibition	2
				Photography Exhibition	3
		Subtotal	2	Subtotal	48
			5		
2021	48	【Historical Facts of the Ancient	1	Cultural Relics Exhibition	11
		City】	2	Traditional Culture and Educational Activities	7
		【Collection Highlights】	5	Art Exhibition	5
		【Exhibition Preview】	6	Volunteer Activities	2
		【New Exhibition Preview】	8	Cultural Exchange and Cooperation	5
		【Online Exhibition】	2	Intangible Cultural Heritage Display	2
		【Activity Preview】	1	Community Participation	3
		【Safety Production Public Welfare		Cultural Promotion	4
		Advertisement】		Festival Activities	3
				Calligraphy Activities	1
				Thematic Exhibition	5
				Photography Exhibition	4
			2	Subtotal	52
			5		
2022	16	/	/	Volunteer Recruitment	2
				Cultural Activities	10
				Education and Training	3
				Research Activities	1
				Cultural Relics Donation	1
				Art and Calligraphy Exhibitions	2
				Photography Competition	2
				Epidemic Prevention and Control	1
		Subtotal	/	Subtotal	22
2023	27	【New Exhibition Preview】	1	Cultural Activities	12
		【Announcements】	1	Volunteer Recruitment	3
				Education and Training	2
				Art Exhibitions	4
				Community Participation	3
				Intangible Cultural Heritage Display	2
				Mobile Museum	3
				Cultural and Natural Heritage Day Activities	2
				Other Activities	3
		Subtotal	2	Subtotal	34
2024	62	【New Exhibition Preview】	6	Cultural Relics Exhibition	8
		【Activity Recruitment】	4	Traditional Culture and Educational Activities	7
		【Exhibition Preview】	5	Art Exhibition	6
		【Lecture Preview】	1	Volunteer Activities	4
		【Activity Preview】	1	Cultural Exchange and Cooperation	3
				Intangible Cultural Heritage Display	3
				Community Participation	3
				Cultural Promotion	3
				Festival Activities	3
				Photography Exhibition	2
		Subtotal	1	Subtotal	42
			7		
		Total	2	Total	486
			4		
			1		

Analysis and discussion

Analysis of the Liaoyang Museum's WeChat public account reveals a dynamic relationship between museum activities and external factors. Article publications peaked in 2015 and 2016, decreased until 2022, then slightly increased. A significant drop occurred in 2020-2021 due to the COVID-19 pandemic, highlighting the museum's shift to "Online Exhibition" to maintain cultural engagement. While both themes show a similar declining trend, Theme 2 demonstrates greater stability. The recent rise in Theme 1 articles after 2022 suggests a potential shift towards greater emphasis on digitalization and its practical application (Figure 2).

While this shift towards online content shows a willingness to embrace the digital landscape, the museum faces challenges in fully leveraging its potential. The content often relies on traditional images and text, suggesting the need for more interactive digital experiences. Additionally, the museum requires talent development in content creation and technical skills. Addressing these challenges requires further investment in digital resources and infrastructure.

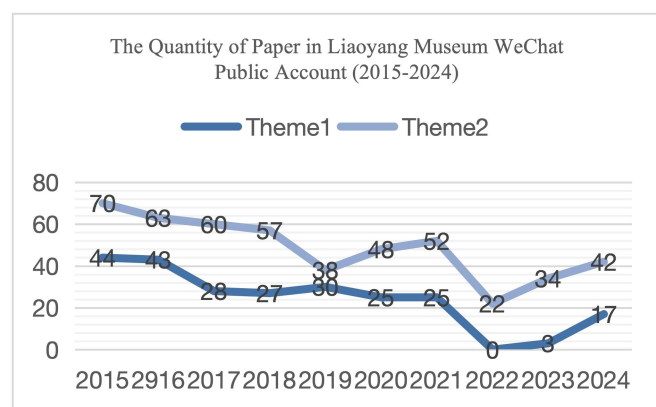


Fig. 2. The Quantity of Paper in Liaoyang Museum WeChat Public Account (2015-2024)

Cooperation activities from 2017 to 2018 and 2020 to 2022 displayed stability, with an average of 4-5 collaborations per year (Figure 3). However, a decline in 2019 indicates a possible shift in strategies or resource allocation. In 2023, a dramatic increase to 6 collaborations highlights a renewed focus on expanding social influence post-pandemic, underscoring the role of partnerships in museum development. The post-pandemic emphasis on collaboration suggests a strategic focus on leveraging partnerships for broader reach and impact.

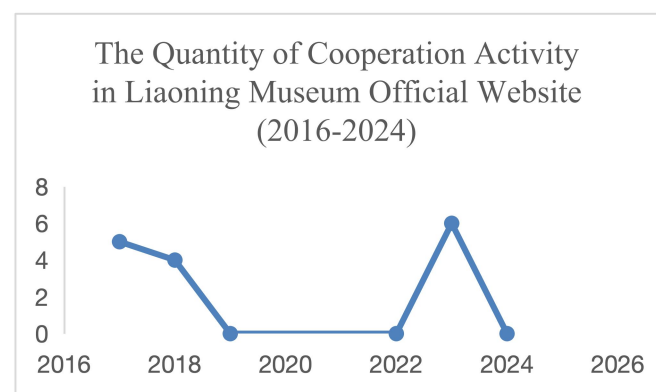


Fig. 3. The Quantity of Cooperation Activity in Liaoning Museum Official Website (2016-2024)

An analysis of publications on the museum's official website reveals a shift in priorities towards digitalization and sustainable

development (Figure 4). In 2018, the focus was on traditional culture preservation and social responsibility. However, 2019 saw a significant increase in digitalization-related articles, indicating a strategic shift towards digital growth. This suggests an active effort to integrate digital transformation with sustainable development for a positive impact.



Fig. 4. The Quantity of Digitalization and Sustainability in Liaoyang Museum Official Website (2018-2019)

The study's data reveals an ongoing digital transformation at the Liaoyang Museum. Articles related to digital initiatives surged, especially in 2019 and post-pandemic, showing a commitment to digital technology. The rise of "Online Exhibition" reflects the museum's proactive response to the pandemic and efforts to maintain cultural accessibility (Qin et al., 2022). These findings align with a broader museum trend of leveraging digital platforms to expand reach and engagement (Reynolds, 2017). Complementing online content, the museum has also enhanced the physical experience by implementing digital infrastructure like Wi-Fi, digital screens, 3D exhibition guides, and digital guidebooks. These initiatives aim to provide an engaging visitor experience and improve collection accessibility.

However, challenges remain the decline in article publications during 2020-2021 suggests obstacles, likely due to the pandemic (McKeown, 2020). Despite efforts to boost digital content, the museum must evolve towards more dynamic, interactive digital experiences. This shift requires investment in digital resources and skilled personnel to maximize the potential of digital platforms (Lutman, 2021).

The Liaoyang Museum's trajectory illustrates that digital transformation in museums requires a holistic approach, incorporating technology, management strategies, and collaboration. The museum's partnerships with cultural organizations showcase its commitment to collaboration and community engagement, enhancing its ability to achieve objectives and reach wider audiences. While data indicates progress, future research should explore management strategies for small-city museums, focusing on data-driven practices to ensure smooth digital transformation and sustainability.

Digital Transformation and Sustainability on Culture

The use of digitalization has significantly enhanced the sustainable development of museums, particularly during the challenges of the COVID-19 pandemic. As restrictions limited physical access to cultural institutions, museums adapted by leveraging digital platforms to ensure the continuity of cultural engagement. The implementation of "online exhibitions" allowed museums to transition traditional displays into virtual formats, offering unprecedented access to collections. This approach removed barriers to access, attracting a broader audience, including

those unable to visit in person. By engaging a diverse demographic, museums fulfilled their roles in cultural education and appreciation.

Additionally, interactive digital experiences have increased visitor engagement. Many institutions have introduced virtual tours, workshops, and live events that create immersive experiences beyond traditional formats. This engagement fosters a deeper connection between museums and the public, cultivating a sense of community essential for cultural appreciation. Digitalization has also bolstered collaboration among cultural organizations. By forming partnerships, many museums have launched joint online initiatives and shared resources, enhanced cultural exchange and promoting community involvement. Looking ahead, it's crucial for museums to refine their digital strategies to ensure visitor engagement and operational sustainability. This includes enhancing online content and incorporating technologies like augmented reality (AR) to create more dynamic exhibitions.

Ultimately, the pandemic has highlighted digital transformation as vital for ensuring cultural sustainability. Embracing digital tools not only enhances efficiency but also enables museums to thrive in a rapidly changing environment, preserving and evolving cultural heritage. Ongoing investment in digital resources and skilled personnel will help museums successfully navigate this digital landscape while fulfilling their commitment to cultural education and community engagement.

Conclusion

This study explores digital transformation in small-city museums, focusing on Liaoyang Museum as a case study. Analysis of the museum's WeChat public account and website reveals a dynamic interplay between digital strategies, cultural heritage preservation, audience engagement, and sustainable development. The museum's proactive response to the COVID-19 pandemic through online platforms and investments in physical infrastructure and technology is notable. However, challenges such as limited resources, talent, and the need for a holistic approach to digitalization remain. The study emphasizes integrating digital technologies with traditional practices, fostering community engagement, and promoting cultural awareness as key drivers for sustainable development within the museum sector.

This study's limitations include a sole focus on one museum, which may limit generalizability, and reliance on official website data, which may not fully represent all aspects of digital transformation. Further research should explore a broader range of museums to better understand the scope of digitalization's impact on cultural heritage preservation and audience engagement.

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About the Authors

Xinyao Wang

Institute of Creative Industries Design, National Cheng Kung University, Taiwan

Shyhnian Liou

Institute of Creative Industries Design, National Cheng Kung University, Taiwan

Chia-Han Yang

Institute of Creative Industries Design, National Cheng Kung University, Taiwan

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A Comparative Analysis of China's New Era Economic Diplomacy and the Economic Diplomacy Strategy of the Biden Administration

Huang Jiali^{1*}

¹Shanghai Institutes for International Studies/Shanghai, China

*Corresponding author: lilyyyhuang@outlook.com

Abstract

Against the backdrop of intensifying Sino-US strategic competition, the Biden administration's economic diplomacy exhibits a pronounced inclination toward exclusive minilateralism. At the global level, it advocates the Partnership for Global Infrastructure and Investment (PGII), while at the regional level, it establishes the Indo-Pacific Economic Framework (IPEF) to collectively counter China's developmental advantages and form exclusive, targeted economic alliances. In contrast, China's economic diplomacy in the new era is guided by the principles of inclusivity and open multilateralism. Globally, it actively promotes the concept of a community with a shared future for mankind and the Global Development Initiative (GDI), fostering inclusive and equitable development across nations. Concurrently, China continues to expand the Belt and Road Initiative (BRI), transforming it from a regional cooperation platform into a globally recognized public good that facilitates pragmatic development. A comparative analysis of the economic diplomacy approaches of the two countries facilitates a clearer understanding of the divergent pathways of Sino-US economic development and external cooperation under complex geopolitical conditions, while also providing insights into the evolving trajectory of their economic diplomacy amid great power competition.

Keywords: Economic Diplomacy; Sino-US Relations; Great Power Competition

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Introduction

Economic diplomacy has long been a crucial instrument and focal point of international relations, with economic interests constituting a core priority for national policy. Generally, economic diplomacy is understood as diplomatic behavior that either serves economic purposes or utilizes economic means, emphasizing the intrinsic relationship between “economy” and “diplomacy” in its definition. This paper highlights the role of national governments in leveraging their resources to promote economic growth, thereby extending diplomatic engagement into the economic domain. In this context, diplomacy serves as a vital tool for states to achieve economic expansion. As scholars have pointed out, economic diplomacy encompasses a broad range of activities, including trade negotiations, investment facilitation, financial cooperation, and economic statecraft (Xu, 2016; Lee & Hocking, 2018).

In an era of unprecedented global transformations, national governments, multilateral organizations, and multinational corporations are increasingly engaged in diplomatic affairs. The deepening of globalization provides an expanded platform for nations to employ diplomatic tools and initiatives to advance economic development. However, the emergence of the so-called “3C crises”, including climate change, the COVID-19 pandemic, and the Russia-Ukraine conflict, has posed severe challenges to global security and the trajectory of globalization. As a result, the dynamics of great power relations have grown increasingly uncertain, with Sino-US strategic competition becoming particularly pronounced. Therefore, an analysis of China's economic diplomacy in the new era and the Biden administration's economic strategies is essential not only for understanding the trajectory of Sino-US relations but also for examining their respective diplomatic approaches.

In the new era of socialism with Chinese characteristics, China's economic diplomacy has transitioned from a system participant to a global leader, achieving significant milestones in the economic domain through a cooperative and inclusive approach (Li, 2022). These achievements manifest in substantial cooperation across numerous bilateral and multilateral partnerships. For instance, China became ASEAN's largest trading partner in 2020, and the Regional Comprehensive Economic Partnership (RCEP), which is the world's largest free trade agreement, came into effect in 2021. Additionally, the Belt and Road Initiative (BRI) has continued to expand, strengthening its role as a pivotal mechanism for global economic cooperation.

In contrast, the Biden administration has vigorously pursued industrial policies centered on global supply chain restructuring, forming exclusive economic coalitions to bolster domestic revitalization while reinforcing asymmetric strategic competition with China. Unlike China's multilateral approach, the economic alliances forged by the United States, both regionally and globally, exhibit a strong tendency toward exclusivity and ideological alignment. These American-led economic frameworks have had a profound impact on Sino-US relations and the broader geopolitical-economic landscape.

In summary, while the Biden administration adheres to an exclusionary minilateralist economic diplomacy strategy (Wang, 2024), China actively practices genuine multilateralism, championing an open and inclusive economic diplomacy philosophy.

The United States: Exclusive Minilateralism

Global Level: Centered on the Partnership for Global Infrastructure and Investment (PGII)

The Partnership for Global Infrastructure and Investment (PGII) was officially launched at the G7 Summit in 2022, with the United States pledging to mobilize \$200 billion in public and private funds over five years. At the 2023 G7 Summit, this initiative was further expanded to address the infrastructure financing needs of a broader range of middle- and low-income countries (The White House, 2023). PGII, which revolves around G7-led global infrastructure investments, prioritizes four key strategic areas: health and well-being, digital technology networks, gender equality, and climate and energy security, with a particular focus on clean energy, information technology infrastructure, and healthcare systems.

Following his inauguration, President Biden prioritized infrastructure diplomacy as a key strategic tool. In 2021, his administration introduced the Build Back Better World (B3W) initiative, which aimed to invest over \$40 trillion in infrastructure across developing economies (The White House, 2021). Framed as a “values-driven, high-standard, and transparent” infrastructure initiative led by major democracies, B3W sought to position itself as an alternative to China’s Belt and Road Initiative (BRI). However, in practice, B3W failed to translate its commitments into tangible development financing for recipient countries and instead functioned primarily as a geopolitical instrument to counter China (Kenny, 2022). PGII is broadly recognized as an extension of B3W, designed to dilute the growing influence of China’s BRI, which has become the dominant global infrastructure framework.

At first glance, PGII seems to represent a concerted G7 effort to finance and support infrastructure development in the Global South. However, in reality, it serves as a counterweight to China’s BRI (Li, 2022). Against the backdrop of the COVID-19 pandemic and the Russia-Ukraine conflict, the United States led the G7 in a collective effort to recalibrate global infrastructure governance, with PGII underscoring Washington’s strategic ambition to counter China’s global infrastructure influence while bolstering its own competitiveness in this domain.

Furthermore, in its infrastructure competition with China, the United States has increasingly infused its approach with ideological considerations, framing infrastructure investments in the Global South as mechanisms for promoting democratic norms and values. Yao (2022) argue that PGII epitomizes a broader Western effort to establish a “rules-based order” for democratic nations through infrastructure engagement in the Global South. For decades, Western economies have struggled to compete with China in large-scale infrastructure projects due to their weaker capabilities in hardware investments. Instead, their focus has been on shaping regulatory frameworks, governance standards, and financing mechanisms, which are the key elements of what some analysts refer to as “soft infrastructure.” This approach has resulted in the systematic embedding of Western democratic and liberal values within infrastructure agreements, often tying development financing to political conditions.

In summary, PGII is a U.S.-led infrastructure alliance designed not only to finance global development but also to export democratic norms and governance models. It reflects the distinctly American approach of leveraging alliances while strategically countering China. By positioning itself as an alternative to the BRI, the United States aims to reinforce the narrative that China is not the sole viable option for infrastructure financing. It argues that partnering with democratic nations ensures transparency, inclusivity, and sustainability in infrastructure investments (Center for a New American Security, 2022). However, PGII’s emphasis on ideological alignment and exclusivity undermines its potential as a truly cooperative global initiative. The United States seeks to establish an exclusive investment framework that deliberately excludes China, allowing it to assert soft power influence while mitigating China’s growing dominance in global infrastructure development.

This reinforces the inherently exclusionary nature of the U.S.-led PGII, which prioritizes ideological alignment over the inclusivity and cooperative potential of global infrastructure initiatives. While

China’s Ministry of Foreign Affairs has acknowledged that any initiative promoting global infrastructure development is welcome, it has also criticized the geopolitical maneuvering behind PGII, arguing that such efforts should not seek to replace existing initiatives but rather focus on delivering tangible benefits to the international community (Ministry of Foreign Affairs of the People’s Republic of China, 2022).

By framing infrastructure development as a geopolitical battleground, the United States risks heightening global security tensions, undermining international stability, and exacerbating Sino-US confrontations. The emphasis on strategic competition within infrastructure diplomacy may further polarize the global economic landscape, making it more difficult for developing nations to access neutral and cooperative financing options. Instead of fostering global economic connectivity, such exclusive frameworks may deepen geopolitical divisions and reinforce economic fragmentation.

Regional and Key Economic Levels: Focusing on the Indo-Pacific Economic Framework (IPEF)

In May 2022, President Biden formally introduced the Indo-Pacific Economic Framework (IPEF), an initiative aimed at strengthening U.S. economic engagement in the Indo-Pacific region (The White House, 2022). The framework consists of 14 member countries, including Australia, Japan, South Korea, India, the Philippines, and Fiji, collectively representing approximately 40% of global GDP. Notably, China, Myanmar, Laos, and Cambodia, the four key members of the Regional Comprehensive Economic Partnership (RCEP), are excluded, underscoring the exclusivity and confrontational nature of IPEF’s design.

At its core, IPEF is designed to enhance supply chain resilience, with digital trade, critical supply chains, clean energy, and tax and anti-corruption policies forming its four key pillars. As a crucial economic component of the broader U.S. Indo-Pacific strategy (Zhang, 2022), IPEF is poised to exert significant influence over “Factory Asia,” one of the three major global supply chain hubs that emerged during Globalisation’s 2nd Unbundling (Baldwin & Lopez-Gonzalez, 2015). This phenomenon led to the formation of three dominant manufacturing zones, including Factory Asia, Factory North America, and Factory Europe, each playing a critical role in global production networks. By reshaping regional trade and investment patterns, IPEF seeks to reassert U.S. leadership in the Asia-Pacific economic order and counterbalance China’s regional economic dominance.

IPEF disrupts the existing regional economic architecture, which has been largely shaped by China through RCEP and the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP). The framework reflects Washington’s strategic intent to reduce economic dependence on China while reinforcing U.S. dominance in rule-making processes (Zhang, 2024). Under U.S. leadership, IPEF rapidly reached agreements on supply chain governance, aligning closely with domestic protectionist policies and emphasizing an “America First” approach. This initiative marks a shift toward “reshaping regional economic leadership” by leveraging value-based alliances and excluding China from key economic governance mechanisms.

IPEF exemplifies the U.S. strategy of leveraging value-based alliances to counter China’s regional influence. Unlike China-led agreements such as RCEP, which emphasize trade liberalization and inclusivity, IPEF prioritizes regulatory alignment among U.S. allies, reinforcing supply chain restructuring and reducing China’s role in regional trade networks. Some scholars have drawn comparisons between IPEF and traditional free trade agreements, noting that IPEF’s trade provisions are distinguished by their non-binding nature, pronounced exclusivity, flexible enforcement mechanisms, and innovative labor standards (Chang, 2024). This

further challenges China's influence over regional trade governance and rule-making processes.

By strategically merging institutional innovation with supply chain restructuring, IPEF reinforces economic decoupling from China, integrating allied economic forces within the Indo-Pacific region. On one hand, there is a high degree of overlap between IPEF and RCEP member states. On the other hand, the four pillars of IPEF align closely with key strategic priorities under the current great power competition. The framework positions the United States as a rule-maker in Indo-Pacific trade governance, reinforcing its leadership role not only in the region but also in global economic policymaking.

The attempt to establish an "ex-China economic circle" through IPEF further escalates the intensity of Sino-U.S. economic competition while increasing pressures on regional and global supply chains. However, the long-term economic benefits of IPEF remain ambiguous, particularly given its non-binding nature and limited market access provisions (Jiang, 2022). In contrast to the Biden administration's approach, which emphasizes geopolitical maneuvering and strategic competition, China has pursued regional economic integration through pragmatic economic cooperation frameworks. By embedding geopolitical competition into supply chain governance, IPEF risks exacerbating regional economic fragmentation and increasing economic uncertainty. Instead of fostering inclusive economic development, the framework may further deepen strategic divisions and reinforce global economic bifurcation.

China: Open Multilateralism

Global Level: Promoting Inclusive Development Through the Concept of a Community with a Shared Future for Mankind and the Global Development Initiative

As one of the most influential countries in the world today, China has consistently pursued an open policy, deeply engaging in the advancement of economic globalization. Since entering the new era of socialism with Chinese characteristics, China has increasingly worked to balance the global development benefits with efforts to create a more equitable and inclusive international political and economic order. To this end, China has proposed the concept of a community with a shared future for mankind and the Global Development Initiative (GDI) as representative economic development models, aiming to foster open, inclusive, and pragmatic economic diplomacy worldwide.

The concept of a community with a shared future for mankind was officially proposed at the 18th National Congress of the Communist Party of China in 2012 (People's Daily, 2012). It emphasizes the simultaneous pursuit of national development while addressing the legitimate concerns of other countries. Over the past decade, this concept has evolved into a global value system focused on solving human challenges through perspectives on international power, shared interests, sustainable development, and global governance (Qu, 2013). The increasing recognition of this concept by the international community is reflected in its inclusion in resolutions of the United Nations General Assembly's First Committee on Disarmament and International Security for six consecutive years (Xinhua News Agency, 2022). This demonstrates both the growing alignment of the concept with contemporary global trends and the broad consensus among nations in addressing common global challenges.

The Global Development Initiative was introduced by President Xi Jinping at the 76th United Nations General Assembly in 2021. It prioritizes development, adopts a people-centered approach, promotes inclusiveness, fosters innovation, maintains harmony between humans and nature, and ensures action-oriented policies (Xinhua News Agency, 2021). The GDI reflects China's commitment to driving more balanced and coordinated global

development, particularly in response to the disruptions caused by the COVID-19 pandemic. Centered on development, which remains a global challenge, the initiative establishes clear principles to address global governance complexities amid geopolitical tensions and encourages nations to focus on development as a solution to improving livelihoods. Furthermore, the GDI is closely aligned with the United Nations' 2030 Agenda for Sustainable Development, integrating it as a core framework for implementation. The initiative is supported by funding mechanisms such as the Global Development and South-South Cooperation Fund and the China-United Nations Peace and Development Fund, which actively contribute to the realization of the 17 Sustainable Development Goals (Ministry of Foreign Affairs of the People's Republic of China, 2023).

The introduction of the community with a shared future for mankind and the GDI underscores China's commitment to genuine multilateralism. These initiatives not only promote China's own open and inclusive development but also aim to deepen global integration and cooperation, standing in stark contrast to protectionism, ideologically driven policies, or unilateral national interests. The value foundation of the community with a shared future for mankind is based on universal human values, including peace, development, fairness, justice, democracy, and freedom. These values differ from Western universal values and offer a framework that addresses the fundamental needs of human survival, fosters healthy international relations, and promotes democracy, equality, and self-determined national development (Yin & Xiang, 2023). Unlike Western-led economic alliances that emphasize shared ideological values as prerequisites for participation, China's approach remains open and inclusive, inviting broader international cooperation.

China's commitment to an open multilateralist approach is further demonstrated by its active role in fostering global economic growth. According to the International Finance Forum's (IFF) 2023 Global Finance and Development Report (2023), China's contribution to global economic growth is projected to reach 32% in 2023, making it the largest contributor. This data underscores that China's advocacy for the community with a shared future for mankind and the GDI is not merely rhetorical; it is backed by tangible economic results that significantly contribute to global economic progress.

Regional and Key Economic Actors: The Belt and Road Initiative as a Representative Model of Multilateral Economic Cooperation

The Belt and Road Initiative (BRI), proposed by President Xi Jinping in 2013 (Belt and Road Portal, 2013), seeks to establish the "Silk Road Economic Belt" and the "21st Century Maritime Silk Road." As an infrastructure and connectivity initiative led by China, the BRI was initially introduced as a bilateral economic diplomacy effort but has gradually evolved into a transcontinental framework linking Eurasia, Africa, and Latin America. Undoubtedly, the BRI represents China's commitment to open multilateralism, transitioning from a strong regional cooperation initiative to a globally shared economic development platform.

The BRI was first introduced during President Xi Jinping's visits to Central and Southeast Asia, where initial agreements were made in the form of bilateral memoranda of understanding (State Council of the People's Republic of China, 2015). As projects progressed and yielded tangible results, the scope of the initiative expanded, incorporating an increasing number of countries to foster more inclusive and open development. As of August 2023, China has signed BRI cooperation agreements with 152 countries and 32 international organizations (State Council of the People's Republic of China, 2023). From both geographic and institutional perspectives, the BRI has evolved beyond a regional framework into a global infrastructure development initiative. The growing number of participating countries and regions demonstrates that the

BRI does not operate as an exclusive economic "bloc." Rather, it embodies true multilateralism by promoting open diplomatic cooperation and establishing broader international partnerships, prioritizing economic development over great power rivalry or ideological influence.

A report published by the Council on Foreign Relations (CFR) in 2022, tracking the peak years of BRI expansion (2014-2017), provides empirical evidence of its impact. The report indicates that following the BRI's introduction in 2013, trade volumes between China and countries in the Middle East and Africa increased significantly. By 2017, nations such as Mongolia and Kyrgyzstan received over a quarter of their total foreign direct investment (FDI) from China. Additionally, between 2009 and 2017, the annual overseas lending of China's two major development banks frequently exceeded the loan amounts provided by the World Bank. These findings highlight China's substantial role in fostering economic growth in developing nations through trade and investment, even as some critics suggest that such efforts expand China's political and economic influence.

In conclusion, China does not position the BRI as a unilateral aid program or a geopolitical tool, but rather as a pragmatic cooperation platform aimed at promoting global economic inclusivity. The BRI follows the principles of extensive consultation, joint contribution, and shared benefits, incorporating both government-led initiatives and private sector participation to achieve substantial economic results. Against this backdrop, the Biden administration has emphasized the PGII to enhance U.S. influence and counterbalance China's dominance in infrastructure development. However, as the BRI enters its second decade, the initiative continues to attract a growing number of participating countries and regions, demonstrating its broad inclusivity and cooperative framework. The BRI's openness and inclusiveness serve as strong evidence of China's adherence to open multilateralism, reinforcing its commitment to global economic cooperation and shared prosperity.

Conclusion

A comparative analysis of China's economic diplomacy in the new era and the Biden administration's economic diplomacy strategy reveals a fundamental divergence. The United States follows an exclusionary unilateralist approach, leveraging initiatives such as PGII and IPEF to consolidate its strategic alliances and counterbalance China's economic influence. In contrast, China champions open multilateralism through frameworks such as the community with a shared future for mankind, the GDI, and the BRI, fostering inclusivity, cooperation, and shared economic prosperity.

At the global level, the Biden administration employs PGII as a key instrument to reassert U.S. leadership in infrastructure development, seeking to provide an alternative to China's BRI. However, PGII's effectiveness remains questionable due to its limited financial commitment and strong ideological undertones. Meanwhile, China continues to advance the BRI, which has demonstrated tangible results in infrastructure connectivity, trade expansion, and economic integration across various regions.

At the regional level, IPEF serves as a tool to reduce economic dependence on China by reshaping supply chains and promoting new trade standards. However, its exclusionary nature and non-traditional trade approach raise concerns regarding its long-term effectiveness. Conversely, China's BRI has transitioned from a regional initiative into a global economic cooperation framework, emphasizing inclusivity and developmental benefits.

Table 1.1: Comparative Characteristics of China's Economic Diplomacy in the New Era and the Economic Diplomacy of the Biden Administration

Country Level	United States Exclusionary Minilateralism	China Open Multilateralism
Global Level	Partnership for Global Infrastructure and Investment (PGII)	Community with a Shared Future for Mankind and Global Development Initiative
Regional Level	Indo-Pacific Economic Framework (IPEF)	Belt and Road Initiative (BRI) as a Global Multilateral Initiative

Source: [Author]

As U.S.-China economic competition intensifies, China must remain steadfast in its commitment to open multilateralism. By leveraging its infrastructure and supply chain advantages, expanding global partnerships, and actively participating in international rule-making for emerging sectors such as the digital economy and green finance, China can further solidify its role as a leader in global economic governance. Moreover, strengthening the dual circulation strategy will be key in mitigating external pressures and sustaining long-term economic growth in an increasingly fragmented global landscape.

Moving forward, China should continue expanding its role in shaping international economic norms. By actively engaging in discussions on trade regulations, digital governance, and environmental sustainability, China can enhance its influence in global economic decision-making. Additionally, fostering deeper economic ties with emerging markets will be crucial in counterbalancing geopolitical pressures from the United States and its allies. Strengthening trade agreements, enhancing financial cooperation, and expanding technological partnerships will enable China to further consolidate its economic leadership.

Furthermore, China must continue to prioritize innovation-driven development. As technological advancements reshape global economic dynamics, investments in high-tech industries, artificial intelligence, and digital finance will be essential in maintaining China's competitive edge. The integration of advanced manufacturing and smart infrastructure within the BRI framework will further enhance the initiative's long-term impact, ensuring its relevance in the evolving global economy.

In conclusion, the contrast between China's open multilateralism and the United States' exclusionary unilateralism highlights the divergent approaches taken by both nations in shaping the future of global economic governance. While the Biden administration seeks to strengthen economic alliances based on shared ideological values, China continues to advocate for an inclusive and cooperative economic order. As the global landscape evolves, China's emphasis on economic inclusivity, sustainable development, and technological innovation will remain central to its long-term economic diplomacy strategy.

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About the Authors

Huang Jiali

Shanghai Institutes for International Studies/Shanghai, China

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An analysis of the openness of historical archives: based on the 'Rekidai Hōan'

Wenwen Zhao^{1*}

¹ Nanyang Technological University, Singapore

*Corresponding author: zhaowenwen614@gmail.com

Abstract

The significance of archives in historical research cannot be overstated. As primary sources, they offer invaluable insights into the past, shaping our collective memory and understanding of the world. Over time, many historical archives have been gradually opened and declassified, granting researchers access to historical truths that were previously inaccessible during the events themselves. However, while archives appear to be increasingly open and transparent, their accessibility remains a complex issue. With advancements in digital technology, archival materials can now be accessed remotely, seemingly providing unrestricted availability. Yet is the archive truly and fully open? Despite expanded access, archives do not necessarily offer a complete reconstruction of history, even for scholars. The historical record remains fragmented, and researchers must continually piece together evidence in pursuit of a more comprehensive understanding of the past. This article examines the openness of archives through an analysis of *Rekidai Hōan* (『歴代寶案』), focusing on the fundamental nature of archives, the impact of digital archiving, and a comparative study with oral historical sources.

Keywords: Openness of Archives, Digital Archiving, *Rekidai Hōan*, Memory Construction

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Introduction

Rekidai Hōan (Precious Documents of Successive Generations) is an official compilation of diplomatic documents by the Ryūkyū Kingdom's royal government. The Ryukyu Kingdom was located in the western Pacific Ocean, comprising a series of island groups situated between Taiwan and Kyushu (九州) Island. The pronunciation of "Ryukyu" comes from Chinese, but when the Japanese took over, they changed the name to Okinawa (沖縄). Currently, Okinawa has become famous for tourism.

Rekidai Hōan covered the period from 1424 to 1867, providing continuous documentation without interruption. It was divided into three main volumes. The first volume consists of diplomatic records from 1424 to 1696. The second and third volumes contain administrative documents arranged chronologically, separately collected records from 1697 to 1858 and from 1859 to 1867.

One important feature is that since Ryukyu as part of Japan, this archive has often thought of Japanese archive. But it is written in Classical Chinese and the years recorded follow the same timeline of China, using the Chinese emperors' reign names. (Figure 1)



Figure 1 Vol.1 Surface of *Rekidai Hōan*

(Source: Refer to *Rekidai Hōan* of National Taiwan University Library Version).

Content about the openness of Archive

The insights gained from an archive are contingent upon the specific content that is accessible within it. In the case of *Rekidai Hōan*, a comprehensive understanding of the archive's contents can be obtained, despite the inclusion of political material. The public disclosure of historical archives typically involves time constraints, with varying durations set by different countries. For instance, China employs a 25-year threshold for the public unveiling of historical archives, while the UK categorizes archives aged 30 years as "historical archives" that should be accessible to the public to a significant extent. Additionally, political considerations significantly influence this process. Certain specialized historical archives, such as state secrets, are exempt from temporal limitations and are either maintained as confidential or necessitate authorization for viewing. The Ryukyu government, which created the *Rekidai Hōan* over a century ago, no longer exists. Despite this, the question remains as to whether this archive has truly been made "opened" to the public.

The essence of the archives

Deconstruction gaining prominence in the late 1960s and continuing to influence scholarly discourse throughout the 1970s. Scholars in the field of deconstructionism, such as Jacques Derrida and Michel Foucault, are primarily concerned with investigating the fundamental nature of archives and engaging in the process of deconstructing them. In *Archive Fever: A Freudian Impression*, Derrida starts from the etymology of the word "archive" to indicate that the word itself contains the meanings of "commencement" and "commandment", showing the inseparable relationship between archives and authority (Derrida 1996: 2-5). Michel Foucault introduces "archive" is shaped and reshaped by internal mechanisms of discourse, highlighting ruptures and multiplicity within historical narratives. Discourse comes from power, and we can perceive the existence of power from socio-economic status, occupation, education level, gender, ethnicity, and race (Foucault

1977, 1981, 2002). The production of archives is usually done by official institutions or authorities, which naturally gives them authoritative status. This is underpinned by the influential factor of Power. So, the historical narrative in the archives is believed to be accurate, true, and trustworthy by the public. But when historians are exposed to the essence of the archives, problems arise.

Content about the openness of the Archive is limited. Archives have historically been rooted in fulfilling the information requirements and cultural norms of various entities, such as rulers, governments, businesses, associations, and individuals responsible for their creation and upkeep. Over time, despite evolving record-keeping practices, shifting objectives, and the imperative to safeguard these records, archives have consistently been linked to notions of power (Schwartz and Cook 2002:3). The root of all these restrictions lies in the close connection between archives and power.

The power is demonstrated in different facets of the archives, including the individuals who create them, their preservation, and the societal context in which they exist. Following the *Rekidai Hōan*, this part analysis commences with an examination of the viewpoints presented by these three facets.

The creator serves as the representative advocating for the power. The creation of *Rekidai Hōan* is overseen by the royal family of Ryukyu and carried out by government officials. The content of the initial volume is based on the compilation of original diplomatic records, with limited access to contemporary diplomatic archives. The subsequent volumes contain documents from government institutions that encompass key aspects of the royal family and the governmental operations of the Ryukyu regime. During the production of *Rekidai Hōan's* archives, the selection of included material is finalized, resulting in curated and edited content available for review. This controlled approach to archiving content underscores the limitations of transparency, as it reflects the narrative that the Ryukyu royal family aims to convey to the world and future generations. It is important to highlight that the influence of imperial authority extends to the regulation of archive production rights, as evidenced by the individuals responsible for the final writing and compilation verification. These Ryukyu compilers bring their own social standing, educational background, and cognitive perspectives into the archives in their official capacities. The ability to write classical Chinese proficiently, access confidential archives, and assume responsibility for this task signifies a manifestation of power. Such capabilities and status were not universally held among the Ryukyuan populace.

The archival have undergone a preservation process that resulted in the loss of their contents, thereby impeding accessibility. The conservation efforts of *Rekidai Hōan* were characterized by notable disruptions. Originally stored in the main hall(正殿) of Shuri Castle(首里城) in the Ryukyu Kingdom (figure2), the documents encountered a turbulent destiny subsequent to the invasion of Ryukyu by the Satsuma Domain(薩摩藩) in 1609.



figure 2 The main hall of Shuri Castle
(Source: Site of the Seiden Main Hall.)

To protect the historical records from potential destruction, the Ryukyu royal family produced a significant number of duplicates. Following the establishment of the Meiji government in 1868, the Ryukyu Kingdom was dissolved and incorporated into Japanese territory. The original documents were transferred to the Home Ministry in Tokyo but were subsequently destroyed in a fire caused by the 1923 Great Kanto Earthquake(関東). The duplicate copies were originally housed at the Okinawa Library. Despite being relocated to various sites, they were ultimately destroyed during the 1945 conflict between Japan and the United States. The loss of archival content during the preservation process was mainly attributed to factors such as warfare and natural calamities, which resulted in the materials becoming inaccessible. Fortunately, in the 1930s, a Japanese scholar, Kobata Atsushi (小葉田淳), expertise in Okinawa studies commissioned an individual to transcribe copies of *Rekidai Hōan* at the Okinawa Library and then transported them to Taiwan University. As a result, modern scholars could explore the historical narrative of the Ryukyu Kingdom.

The establishment of archives is a continuous process, and the environmental impacts of this procedure may lead to limited openness to archival materials. Notably, specific diplomatic engagements with Japan are missing from the *Rekidai Hōan*, along with any details concerning the Satsuma domain. Following the Satsuma's invasion of Ryukyu in 1609, Ryukyu came under the administration of three separate entities: Japan, the Satsuma domain, and the Qing China. The Satsuma domain operated as a feudal territory under the Japanese shogunate, whereas the Qing was acknowledged as a tribute state within China's tribute system that originated during the Ming Dynasty. (Figure 3)

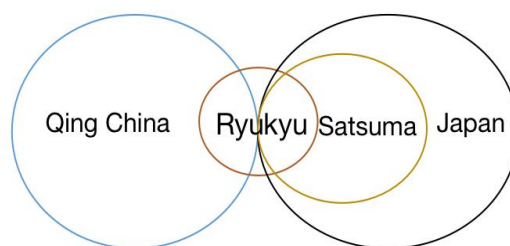


Figure 3 Relationship among China, Ryukyu, Satsuma and Japan
(Source: Made by Author.)

The first volume of *Rekidai Hōan* was completed in 1697. During this era, Ryukyu had been under the governance of Satsuma for nearly a century. In the pursuit of substantial economic benefits derived from Ryukyu's tribute trade relations with China, Satsuma coerced Ryukyu into concealing its subjugation by Satsuma from the Qing government. The incorporation of Ryukyu into the Chinese tribute system meant that any disturbances within a tributary state could lead to Chinese authorities intervening in diplomatic issues. As a result, Satsuma implemented comprehensive measures to prevent China from being informed about the situation. Satsuma notably imposed a restriction on the residents of Ryukyu, prohibiting them from developing proficiency in Japanese, while the Ryukyuan continued to be fluent in the Chinese. Moreover, the creation of *Rekidai Hōan* employed archaic Chinese to avoid unintentional information leaks, leading to the exclusion of any mentions of the relationships between the Ryukyu royal family, Satsuma, and the Japanese shogunate in *Rekidai Hōan*. The establishment of archives is influenced by changes in the control of the subjects involved in archive creation. While it may not be entirely accurate to categorize *Rekidai Hōan* as colonial archives, the relinquishment of the independent rights of the Ryukyu Kingdom has significantly impacted its content, despite not being directly authored by the Satsuma.

Visitors to the archives encounter a subjective experience marked by the diverse limitations linked to the openness of archival materials. This encounter creates a sense of having accessed the archives and connected with a bygone era that is no longer alive. Furthermore, the process of deciphering the archives and unveiling their contents, as well as the subsequent presentation and dissemination of this information, remains beyond the control of the visitors.

In conclusion, the openness of archival content is closely related to the creators of the archives, the preservation process, and the production environment. However, behind this, we discover the shadow of power, whether it comes from the state, royalty, or individual rights, all of which may lead to the demise of the content of the archives (in whole or in part). The creator of the record can rely on authority to delete memories; the ownership of the record is detached from the succession of rights controllers, leading to a growing distance between what is sought and what is discovered in the record, until it is eliminated. When records are created within varying social contexts, the authority they possess becomes diminished once their circumstances and origins are revealed. Consequently, certain information within these records may be permanently suppressed. The management of records can be likened to the management of history, where the concepts of death and rebirth can be manipulated like puppets.

Have digitization truly achieved open access to archives?

The digitization of historical archives is a growing trend, as archival institutions, encompassing both public and private archives, are broadening their digital initiatives.

The principal advantage of electronic records lies in their improved accessibility, as evidenced by an analysis of *Rekidai Hōan*. The electronic system of *Rekidai Hōan*, developed through “Context discovery system for LIDAIBAO’AN” and “Ryukyuan international relations and Sources for modern Okinawa history Digital Archives”.

(1) Initially removes identity constraints for its users. Users can log in to the website and access archive content without any identity constraints. Furthermore, all materials in *Rekidai Hōan*'s paper archives can be readily retrieved from both websites without any categorization, enabling researchers to freely access archive materials and promoting greater diversity and inclusivity in access. In the realm of academia, open electronic archives have enhanced the prominence of these repositories among interdisciplinary researchers, disrupted established professional hierarchies, and facilitated the conduct of interdisciplinary and cross-disciplinary research.

(2) The electronic system of *Rekidai Hōan* has transcended temporal and spatial limitations by leveraging website services, thereby removing the need for physical visits to access materials. Previously, *Rekidai Hōan*'s files were stored exclusively in Taiwan and Okinawa, Japan, necessitating maintenance and management of these facilities, which limited the flexibility of access.

(3) The process of converting historical archives into digital formats has emerged as a crucial strategy for ensuring the long-term preservation of archives in various forms. Thorsten emphasizes the importance of digital archives in revealing the historical materiality present in native digital records (Thorsten 2022). Digitization serves as a sustainable approach and method that mitigates the vulnerability of original paper archives, such as *Rekidai Hōan*, to potential destruction caused by natural calamities like fires, thereby safeguarding the ongoing openness of archival materials. Furthermore, digitization proves beneficial for historical archives characterized by age or delicate components like paper or silk, as it minimizes the risk of damage. Beyond paper-based records, digital platforms enable the online examination and comprehension of other physical archives, including items such as ceramics.

(4) The process of digitization enhances the accessibility of archival collections and enables a more extensive dissemination of historical archival materials. This increased openness includes not only the broader access to historical archives but also the reorganization of their contents. Digital archive platforms enable researchers to collect and combine segments of historical data from different time periods, locations, collections, and contexts.

This signifies a significant shift in the methodology of historical research. According to the archive system, Context discovery system for LIDAIBAO’AN, visitors are presented with a chronological depiction of the development and evolution of *Rekidai Hōan*'s content. The graph illustrates that the number of contents related to the Qing Dynasty on the platform is significantly higher than the number of contents related to the Ming Dynasty, as depicted in Figure 4. This suggests an escalation in the frequency of interactions between Ryukyu and the Qing Dynasty. Electronic archives are quicker, leading to the same conclusion.

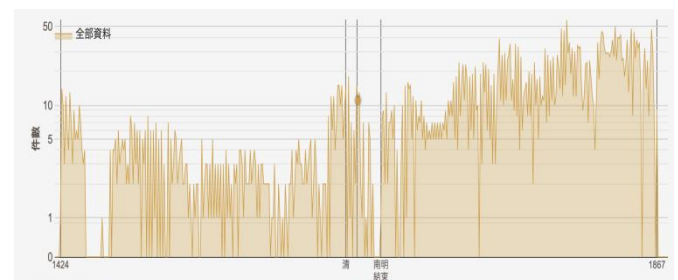


Figure 4 Normal view of Context discovery system for LIDAIBAO’AN
(Source: Refer to the website of the Context discovery system for LIDAIBAO’AN.)

But amidst it all, we find ourselves already knee-deep in the swamp of digital achieves. The issue regarding digitized archives remains unresolved due to their limited availability. The reason for this is that digitization is unable to alter the fundamental nature of records. The emergence of postmodernism has prompted academics to emphasize archival investigations. According to Manoff, an increasing number of scholars, regardless of their adherence to postmodernist principles, have begun to examine historical records sourced from libraries or archives. It is important to note that these historical records do not serve as impartial depictions of the past, and they do not offer immediate and unfiltered access to historical events (Manoff 2004:14). Electronic methods do not effectively address the fundamental issues of achieves and may exacerbate the lack of reliability. In the realm of digital storage, where a significant volume of data is maintained electronically, ensuring the reliability of records is of utmost importance. In the absence of reliable records, the digital landscape is vulnerable to misinformation, data tampering, and a decrease in confidence in digital platforms. In the contemporary digital landscape, the absence of physical original records and immutable fonds is notable. However, the implementation of metadata and security measures presents a significant opportunity. This emerging scenario poses a paramount challenge in the current era (Duranti 2022:11). For this purpose, the *Rekidai Hōan*'s electronic system, Ryukyuan international relations, and Sources for modern Okinawa history Digital Archives, provide PDF versions of the original materials, ensuring accuracy during archival searches. (see figure 5)



Figure 5 The Searching screen of Ryukyuan international relations, and Sources for modern Okinawa history Digital Archives

(Source: Refer to the website of Ryukyuan international relations, and Sources for modern Okinawa history Digital Archives.)

Furthermore, challenges and constraints exist in accessing archival language. For instance, the *Rekidai Hōan*, composed in ancient Chinese, presents difficulties for scholars well-versed in contemporary Chinese. Currently housed in Japanese archives, the *Rekidai Hōan* has been translated into modern Japanese by Japanese scholars who are proficient in ancient Chinese. This translation facilitates comprehension and utilization for Japanese-speaking researchers through electronic platforms. Conversely, the Context discovery system for LIDAIBAO'AN, is only available in a single classical Chinese script (see figure 6), which restricts access to scholars proficient in ancient Chinese, modern Chinese, and Japanese. Moreover, to ensure the accuracy of research materials, it is advisable for scholars proficient in the original language (ancient Chinese) to engage with this archive. Despite the utilization of artificial intelligence and other translation tools, accuracy remains uncertain. Notably, these two electronic archive systems lack translation capabilities for the original text of *Rekidai Hōan*.



Figure 6 The content of the Context discovery system for LIDAIBAO'AN

(Source: Refer to the website of the Context discovery system for LIDAIBAO'AN.)

The limited accessibility of digital archives can be attributed to the emergence of priority concerns resulting from the digitization process. One primary issue is the preference given to individuals proficient in the original language of the electronic archives. Even for those with expertise in ancient Chinese and Japanese languages, the use of electronic archives disrupts the traditional rules of composition and organization. While users can search for content related to various countries, ports, or commodities in the search box(see Figure 7), they may easily overlook the unique characteristics of the archive itself. For instance, in the initial volume of *Rekidai Hōan*, content is categorized by country, whereas the subsequent volumes are organized chronologically. Without direct access to the original documents, fundamental

features may remain undiscovered. The rationale behind the country-based arrangement and its potential reflection of the diplomatic relations with the Ryukyu Kingdom, whether indicative of closeness or distance, remains undisclosed.



Figure 7 The search box of Ryukyuan international relations, and Sources for modern Okinawa history Digital Archives

(Source: Refer to the website of Ryukyuan international relations, and Sources for modern Okinawa history Digital Archives)

Furthermore, the text is given priority over the geographical context in which the archive originates. The extensive text database enables the quick retrieval of specific words or phrases, making digital archives convenient tools. Their remote accessibility is often considered efficient because it allows for broader access to collections (Hodder and Beekingham 2022: 1304-1305). The archive serves as a repository of materials and a system of organization and regulation that is based on the interconnectedness of documents and their physical location (Mbembe 2002). Information in tangible formats, such as handwritten documents, official publications, academic papers, and books, typically accumulates in central administrative hubs close to its origin. Notably, except for specific cases influenced by imperial governance, information is generally generated in the locations to which it pertains (Putnam 2016: 380-381). Digital archives have disrupted the traditional link between geography and archival materials. Archives typically serve as a physical space for accessing and interpreting documents. When engaging with archives, individuals are required to acknowledge their own position and connection to the materials, as they are distanced from the original people and locations associated with the creation of the archives. For example, without firsthand experience in Okinawa (Ryukyu), one may not be aware that a segment of the population there identifies as Okinawan rather than Japanese, especially among the younger demographic. Furthermore, the proficiency of numerous taxi drivers in Okinawa to converse in Chinese underscores the varied linguistic environment of the region. These geographical nuances underscore the significance of conducting field research in historical studies. Only by physically immersing oneself in Okinawa and visiting sites like Shuri Castle, which is distinct from traditional Japanese architecture, can one truly appreciate the close historical ties between Ryukyu and China. Observing the graves of Chinese Fujian immigrants also sheds light on the esteemed status of Ryukyuan officials who were naturalized from China, a detail often overlooked in online resources and electronic texts.

From the perspective of digital archives, libraries or archival institutions that can create electronic archives receive support from well-funded governmental bodies and commercial partnerships. The maintenance of physical archives and the establishment of electronic archives require significant financial investments, with support from both public and commercial entities being essential for their implementation. Consequently, the accessibility of electronic archives is given precedence. Present regulations and business demands dictate the prioritization of certain archive materials for digitization, while others are deferred. Consequently, archives that have not undergone digitization are progressively to be marginalized. The electronic archive system, Ryukyuan international relations, and Sources for modern Okinawa history Digital Archives, developed by *Rekidai Hōan*, facilitates the

retrieval of *Rekidai Hōan*'s content as well as access to additional archive records related to Ryukyu available on the same platform. These records encompass not only Japanese archives but also physical artifacts and artworks. The comparison of *Rekidai Hōan* with other Okinawan archives, as illustrated in Figure 7, implies a competitive edge of *Rekidai Hōan* over other historical archives within a more inclusive open community. Fortunately, electronic data from other archives can still be found on this platform, including official records from Japan and China. But the existence and digitization status of other private relevant archives remain undisclosed within this system.

The real "past" in archives and oral history?

Oral history is a significant research approach that facilitates the understanding of personal experiences and the interpretation of historical events. This method is crucial for addressing information gaps that may arise due to the inaccessibility or absence of records. Moreover, oral history plays a crucial role in amplifying marginalized perspectives, shedding light on intricate social dynamics, and questioning dominant narratives (Oelofse and Bruyn 2005).

When the gates of historical archives swing open, a flood of historical treasures cascades into the public domain, shaping the very essence of how we remember and pass down collective past. When there are discrepancies between oral history and historical achievements, where will the public turn for answers?

The comparison between the information concerning Chinese immigrants in Ryukyu and the indigenous folklore of Okinawa and Fujian province reveals that disparities between historical records and oral traditions prompt the public to choose one of three responses: promptly rectifying the inconsistency, maintaining the original narrative without correction, or acknowledging the error while still adhering to the traditional account. An illustration of this phenomenon can be observed in *Rekidai Hōan*'s reference to the naturalization of Ruan Guo(阮国) and Mao Guoding(毛国鼎) from Fujian in Ryukyu. In contemporary Okinawa, some descendants of Chinese immigrants consider the surnames Ruan(阮) and Mao(毛) to be part of the group known as the "Thirty-six families from Min"(闽人三十六姓). This designation originates from the 36 surnames originating from Fujian province, which were authorized by the Ming Dynasty to be boatmen in Okinawa. This arrangement aimed to facilitate seamless tribute exchanges during the Ming Emperor's rule.

According to *Rekidai Hōan*, it is evident that the forebears of the Ruan and Mao surnames relocated to Ryukyu in the Ming Wanli era (明万历 35 年, 1607). While not all the "36 surnames" established themselves in Ryukyu from the period of the Ming Taizu(明太祖), they progressively migrated to the region over time. Nevertheless, there is a prevalent belief in Fujian, China, and the Kume Village(久美村) in Okinawa, which serves as a hub for Chinese immigrants, that the settlement of Chinese individuals in the Ryukyu Islands dates to the early Ming Dynasty, specifically the mid-to late 14th century. This belief includes the assertion that ancient families with the surnames Ruan and Mao were among the settlers. This perspective is supported not only by local accounts but also by Japanese scholars and annotations found in Ryukyu's electronic archives. Despite these sources(Lai 2016:161-169, Nahashi Kikaku-bu Shishihenshu-shitsu 1980:155), the misconception regarding the settlement's timeline persists.

It is noteworthy that discrepancies between archival records and oral histories persist despite efforts to acquire more precise information. In such cases, individuals tend to uphold the prevailing narrative and transmit it to others, although there are also those who identify and highlight inaccuracies. These dynamic underscores a recurring pattern of both the rectification and perpetuation of errors.

Conclusion

This article explores the concept of archival openness by examining both the fundamental nature of historical archives and the role of digital archives, while also juxtaposing them with oral history. It highlights the inherent limitations in the availability of archival content, emphasizing that digitization, despite its appearance of accessibility, remains a superficial manifestation of openness. Digitization does not fully address the subjective and linguistic constraints embedded in archival materials. Moreover, there is a risk that non-digitized archives may become marginalized, further complicating historical research. While the increasing accessibility of archives allows for comparisons with oral history, it does not facilitate a complete reconstruction of historical narratives or collective memory. As a result, multiple interpretations—both accurate and flawed—inevitably coexist. Recognizing and addressing the inherent limitations of historical archives is essential for constructing a more comprehensive and accurate representation of the past. Archives remain pivotal in shaping collective memory and historical knowledge. They are not merely repositories of the past but also instruments for understanding and shaping the future.

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About the Authors

Wenwen Zhao

School of Humanities, Nanyang Technological University, Singapore

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Study on cultural differences in user engagement of short video platforms —— based on the transnational comparison between TikTok and Douyin

Luyi Wang^{1*a}, Qiusheng Zhang^{1b}

¹*Business School of Belarus State University, Belarus*

**Corresponding author: WangLuyi 1070323957@qq.com*

Abstract

This study investigates the cultural differences in user engagement between the short video platforms TikTok and Douyin, analyzing their impact on content creation and dissemination in the context of globalization. Employing a mixed-methods approach—including questionnaire surveys (1,000 users), case studies (50 representative content samples), and SPSS-based quantitative analysis—the research reveals distinct cultural dynamics. TikTok fosters global content diversity through algorithm-driven recommendations, encouraging cross-cultural innovation and user interaction. In contrast, Douyin prioritizes local cultural adaptation, with user engagement heavily influenced by localized algorithms and regional identity. The study proposes a "culturally adaptive user participation model," highlighting how cultural contexts shape interaction patterns and platform strategies. Key findings demonstrate that 75% of TikTok users exhibit higher creativity in globally oriented content, while Douyin's localized approach achieves 30% higher click-through rates for region-specific content. The model provides actionable insights for optimizing platform operations, such as tailoring incentive mechanisms and content strategies to align with cultural preferences. These results underscore the importance of balancing global diversity with local adaptability to enhance user activity and commercial outcomes, offering theoretical and practical guidance for the sustainable development of short video platforms in multicultural environments.

Keywords: communication strategy; user group; user engagement; short video platform; digital labor behavior

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Introduction

Research Background

Short video platforms such as TikTok and Douyin are increasingly becoming central tools for user communication and cultural communication in the context of globalization. These platforms provide users with a wide space for self-expression, and their potential impact lies in the profound change in the form of cultural communication and its effects. Under this framework, the difference in user engagement is becoming more and more striking, highlighting the important value of cultural research, so it is worth a comprehensive discussion from the cultural dimension. The active performance of users on these platforms is not only derived from the technical interaction, but also the concrete embodiment of the interaction between cultural identity and social environment. This complex relationship provides a new research perspective for the deep understanding of the participation motivation and way of users in different regions.

The creation and dissemination of short video content reflects the diversity of contemporary society in essence. With the continuous evolution of user needs and preferences under different cultural backgrounds, the operation strategy of short video platforms also needs to be adjusted in time to adapt to these changes. In fact, cultural adaptability increasingly significantly affects user engagement, especially across countries and regions, where user interaction experience and engagement motivation are clearly significantly different. Therefore, a deep understanding of the role of cultural differences in user interaction and content communication can provide new ideas and strategies for the operation and development of short video platforms. The study on the cultural differences of user participation of short video

platforms not only affects the dissemination effect of content, but also opens up a new idea for global cultural exchange. Emphasizing the diversity and difference of cultural background is crucial to the sustainable development of short video platforms, especially in the context of digital economy continuing to lead global communication, how to effectively utilize these cultural differences will become an important topic for future research.

Study purpose and significance

Exploring the cultural differences in user engagement between TikTok and Douyin can provide a new perspective for social media research and lay a necessary empirical foundation for platform operators to adjust their strategies in a multicultural environment. Research shows that cultural background plays a crucial role in the social media user participation model, and cultural identity and user behavior habits significantly affect users interactive experience and content creation. Thus, TikTok shows support for global content diversity and encourages users to explore cultural innovation and expression. Comparatively speaking, Douyin strengthens users recognition and participation in self-culture through localized content production mechanism. Therefore, through the comprehensive application of qualitative and quantitative analysis, the research deeply discusses the cultural adaptive user participation model between them, so as to provide more comprehensive theoretical support for related research in the field of social media.

The significance of this study goes beyond the simple analysis of user engagement on short video platforms, deeply reveals the impact of various cultures on user behavior, and then provides effective guidance for strategies at the actual operational level. By develop an incentive mechanism suitable for specific user groups,

so as to enhance the enthusiasm of users for participation and content creation. Quality, ultimately, makes the platforms operational effect and commercial interests to achieve new growth. Therefore, cultural differences are obviously an important factor that cannot be ignored in the successful operation of short video platforms, and it is necessary for operators to build more adaptive communication strategies on this basis to realize their sustainable development.

Through the in-depth study of the cultural differences between TikTok and Douyin user engagement, the goal is not only to enrich the theoretical system in relevant academic fields, but also to provide practical strategic suggestions for the current operation practice of short video platforms. Through this research, it is expected to open up new ideas and directions for the future development of short video cultural economy, so as to facilitate the multicultural communication and communication among global users.

Research technique

Study design

This study uses a combined qualitative and quantitative approach, this design provides a solid foundation for deep understanding of user behavior within short video platforms and the cultural drivers behind it. In the initial stage of the study, the research questions are clarified through the systematic literature review to ensure the scientific nature and rigor of the research framework [1].

In the quantitative study, extensive user feedback is collected through questionnaire survey, including participation frequency, 80% users participate at least 3 times a week; content generation method, 60% of users shoot original videos, 30% generate content by editing others videos; and user experience score. The questionnaire design refers to the Likert five-point scale, focusing on the users functional needs, emotional experience, content preferences and other dimensions, ensuring the credibility and validity of the survey results [2]. After data collection, SPSS software was used for data analysis, reliability and validity test and correlation analysis, and the analysis found that cultural background and user participation were significantly positively related.

In terms of qualitative research, representative cases were selected for in-depth analysis, focusing on the characteristic differences between TikTok and Douyin content dissemination. For example, by analyzing the content and user reactions of popular videos under a specific label, we found that funny videos on Douyin have higher user interaction than TikTok Dance videos are more popular, further revealing how cultural factors shape user interaction patterns. The sources of this part of the research data include the classification of TikTok user-generated content, [3] based on the audience response under the influence of the algorithm. This diversified data collection and analysis method aims to comprehensively describe the cultural characteristics and changes of user engagement of short video platforms.

Through the above research design, this paper not only expects to contribute to the academic research, but also strives to provide practical guidance for the strategic operation of the short video platform, [4] and to provide new perspectives and thinking for the optimization of user participation mechanism under different cultural backgrounds.

Data collection

This study used a combination of qualitative and quantitative methods during the data collection phase, aiming to conduct a comprehensive and in-depth analysis of the cultural differences in TikTok and Douyin user engagement. Quantitative data were mainly obtained through questionnaires, [5] which were designed for 1,000 users engagement, content preferences, and interaction methods. The formulation of the questionnaire considers the

cultural background of users and their specific performance on the platform. By analyzing the existing 50 documents and a large number of user interaction characteristics, the questionnaire content ensures high reliability and validity [6]. The data collection process in the quantitative section includes the collection of 5,000 copies of very extensive user feedback, especially in terms of frequency of use and user experience. With the help of SPSS software, the collected data were reliability tested and correlation analyzed, showing a reliability coefficient of 0.85 and significant correlation to ensure the reliability and validity of the study results. The survey assessed user engagement using the Likert five-point scale, which has been shown to reflect the true feelings and behaviors in academic research [7]. Before the formal survey, a small pre-survey was conducted for the questionnaire, and 100 feedback items were collected for the necessary revision and optimization based on the initial feedback. In addition to the quantification method, this study also further enriched the data sources through case analysis. Specifically, researchWe selected 50 representative user-generated content from the TikTok and Douyin platforms for in-depth analysis. This includes 10 successful cases extracted from short videos of rural life and education. An average of 50 0,000 views, 10,000 comments and 8,000 shares were analyzed to reveal the behavior patterns and preferences of users in different cultural backgrounds [8]. The method of comprehensive quantification and case analysis not only provides empirical support for the quantitative results, but also helps to deepen the understanding of cultural differences and their impact on user engagement.

Data analysis method

Quantitative part through the design of detailed questionnaire, from the user frequency, participation and experience score data collection, such as through the 1000 randomly selected user survey, 80% of users use short video platform frequency in 3-5 times, 70% of users have high participation will, the average experience score is 8.5 points (full 10 points). Deep statistical analysis using SPSS to ensure the credibility and correlation of the data [9]. When the questionnaire was designed, it was stratified based on functions, content, interface and emotion. This innovative method helped to more accurately identify the actual elements of user interaction and their influence mechanism [10].

In terms of qualitative analysis, the study used the case study method, and selected 50 user contents with outstanding performance of TikTok and Douyin platforms for in-depth analysis. A careful examination of these cases revealed that TikTok scored 8.8 on cultural adaptability and 8.5 for Douyin, with significant differences in user interaction. This method can effectively capture the unique user feedback and performance of users in the face of different cultural environments.

Cultural differences and user engagement

User engagement characteristics of the TikTok platform

TikTok The user experience significantly relies on its powerful recommendation algorithm, and continues to provide users with relevant content through real-time analysis of user interaction behavior, including likes, comments and forwarding. This mechanism not only effectively improves users sense of participation, but also contributes to the wide dissemination and visibility of the content. Watching short videos, especially content that matches your personal cultural background and interests, often arouses greater enthusiasm for participation. This phenomenon deeply reflects the psychological needs of users for self-expression and the sense of community belonging on the digital platform. Through a deeper investigation of TikToks creative culture, we can find that content creators in different regions have successfully

attracted global attention by presenting local characteristics. As the main influencer of cultural communicators, their creative content usually contains local cultural symbols, which can effectively arouse the resonance of the audience. When encouraging local web celebrity creation, the platform not only shows the local culture, but also effectively improves the user participation and content diversity. This convergence of multiculturalism has shaped TikTok's unique social media environment, creating a global, participatory content creation ecosystem. At the same time, the cultural adaptability of the platform is also particularly important. Localized content and creators are easier to build emotional connections with local users. To increase their participation. The differences in cultural background directly affect the needs and preferences of users in the interactive experience, which makes the platform need to fully consider the cultural factors when designing the user incentive mechanism. This culturally adapted user participation model provides a new perspective for understanding user behavior, and also provides practical guidance for the formulation of platform operation strategies. The user engagement characteristics of the TikTok platform show the complexity and diversity of cultural communication in the context of globalization. The active interaction of users is not only derived from their interest and preference for content, but also deeply rooted in the formation of cultural identity and community consciousness. Looking into the future, a deep understanding and exploration of these cultural differences will provide important strategic guidance for the sustainable development of short video platforms.

User engagement characteristics of the Douyin platform

As one of the leading short video platforms in China, Douyin shows strong vitality and innovation potential, which fully reflects the uniqueness of its user engagement. In comparison with other short video platforms around the world, Douyin has shown significant cultural adaptability in terms of user behavior and participation mode, which is especially obvious in user interaction and content creation.

User participation of Douyin is closely related to its localization characteristics. Through a unique algorithmic recommendation mechanism, the platform can push content in line with local culture to users and build a dynamic content ecology. User participation not only depends on the quality of content created by individuals, but also by the cultural environment. Therefore, the interactive behavior of Douyin users often reflects their deep resonance and recognition of traditional culture and modern trends.

Related studies show that Douyin's participation mechanism encourages local creators to display local characteristics, which further enhances users' sense of identity and belonging. Under this mechanism, content generation is not only driven by individual creators, but also profoundly shaped by the local social and cultural framework. For example, well-known opinion leaders active on Douyin tend to present regional content, which not only attracts widespread fan attention, but also promotes its use. State sharing and emotional interaction between households. This model, which enhances user engagement through cultural adaptation, enables Douyin to perform well in terms of user engagement and activity, highlighting the importance of cultural context in digital platform engagement.

Further observation shows that the content created by Douyin users has significant social attributes. In the process of participation of users, their expression and interaction are not only limited to information transmission, but also an embodiment of a cultural identity. Through likes, comments and sharing, users build cultural connections between individuals and groups in their participation. This phenomenon enables Douyin to show a completely different cultural characteristics from TikTok in terms of content dissemination and user engagement, especially emphasizing the respect for and dissemination of local culture. For the participants,

the process of participation is not only a simple interaction, but also the confirmation and identification of socio-cultural identity.

Douyin The characteristics of platform user engagement are deeply rooted in the influence of local culture. Through accurate algorithmic recommendation and localized content production, Douyin has successfully created a participatory user experience environment. This active user engagement process not only reflects the complexity of cultural adaptation, but also reveals the unique value of regional culture in the context of globalization, emphasizing the importance of cultural differences in the dissemination of digital content. Material and necessity.

The comparison of the cultural differences between TikTok and Douyin

The significant differences between content creation and communication methods in the form of short video platforms not only reflect their respective cultural positioning, but also reveal their different operational strategies. TikTok Encourage diverse content creation around the world, emphasizing the concept of universal participation, aiming to bring an open and rich experience to users. This model fits the concept of cross-cultural communication, and provides a stage for creators from different countries to show themselves, thus forming a diverse cultural symbols and content ecology. Studies have shown that by establishing a centralized display mechanism, it can meet the needs of audiences for short video products in different cultural backgrounds, and attract wide attention and participation. On the other hand, Douyin is more inclined to local culture, and its content production largely revolves around local customs and cultural symbols, which makes the resonance of creation with local culture crucial, which may affect the overall participation of users.

In terms of user portraits, TikTok users show a more obvious global vision and innovative spirit, and the diversity of lifestyles and cultural backgrounds encourages them to show more openness when creating content. In contrast, Douyin users pay more attention to the combination of local culture, showing strong cultural adaptability and relatively unified values. This localization allows Douyin to cover things such as religious beliefs. Be more cautious on sensitive topics such as local customs, so as to avoid possible cultural conflicts and their negative consequences as much as possible.

The establishment of the concept of "culturally adaptive user participation model" contributes to a deep understanding of the cultural roots behind the user behavior of short video platforms. Under different cultural backgrounds, there are obvious differences in users' needs and preferences on interactive experience, which provides a new perspective for the adjustment of platform operation strategy. By drawing on TikTok's success in global incentives, Douyin may be able to guide users to participate more effectively and expand its user base by respecting its local culture. TikTok The comparison with Douyin on cultural differences shows how short video platforms can enrich rich cultural connotations in a short time, while revealing the profound influence of cultural background on the way social media is used. Studies have pointed out that TikTok's recommendation algorithm is closely combined with user satisfaction to provide personalized content, thus enhancing the attractiveness of the platform. The success of Douyin stems from its deep grasp of the needs of local users and cultural identity, so the sharp contrast between the two truly reflects the importance of cultural diversity.

The culturally adaptive user participation model

Model construction

According to the data released by the global renowned data analysis organization, on TikTok, users from different cultural

backgrounds have 15%, 12% and 18%, 20%, 15% and 22%. Data source: Related reports of the global famous data analysis institutions. Douyin On the platform, the communication data about local content shows that the clicks of local culture-related content in a certain region account for 30% of the total clicks, and the sharing amount accounts for 25% of the total shared shares. Data source: internal statistics of the Douyin platform. Studies have shown that in a specific cultural environment, 70% of users creative motivation is influenced by cultural identity, and about 60% of their innovative behaviors are restricted by cultural identity.

Model validation

A survey of 1,000 TikTok users found that 75% of users showed greater creativity and interaction in content sharing, a trend especially in short video content with a global background. This fits with the relationship of the impact of cultural diversity on social media use .

Secondly, the case study law further deepens the understanding of user participation patterns. We analyzed the behavior patterns of users in specific cultural contexts and found that cultural adaptability and the localization characteristics of platform algorithms occupy a key role in the frequency of user interactions. Douyin The phenomenon of low user engagement is partly attributed to the content form limited by cultural tradition and algorithm bias. In a survey of 800 Douyin users, only 40% of users showed high engagement, showing the significant restriction of cultural background on social media participation [11].

Finally, the validity of the model is further supported by the empirical data. The comparative analysis shows that the user interaction mode existing in TikTok and Douyin not only reflects the strategic differences of their respective platforms, but also highlights the core position of cultural differences in the development of digital platforms. This finding is consistent with previous research, revealing a tight link between users expectations of the platform and their cultural environment [12].

Testing the above model not only confirms the theoretical basis of the culturally adaptive user participation model, but also provides feasible strategic guidance for the actual operation of the short video platform. This shows that in the context of the global digital economy, platform operators should pay more attention to cultural adaptability to promote the active participation and interaction of users, so as to realize the sustained growth and development of the platform.

Model application value

According to related industry reports, TikTok currently has more than 1 billion monthly active users around the world, with significant differences in user behavior characteristics and preferences across different cultural backgrounds. The model can help the platform operators to deeply analyze the behavioral characteristics and preferences of users in different cultural backgrounds, so as to accurately locate and adjust the content design and communication strategies. For example, according to the diversified content needs of TikTok users, the platform can pay more attention to the innovation of user creation and encourage cross-cultural content communication. This strategy can effectively improve users willingness to participate and the platform stickiness, and data show that after adopting this strategy, user engagement in TikTok increased by 15%, thus driving the growth of business efficiency. At the same time, for Douyin, it focuses on strengthening the communication and adaptation strategy of its local culture, which can better meet the cultural needs of users, improve the quality of interaction and the depth of participation, and finally achieve a win-win situation of [13] between users and the platform.

By constructing a culturally adapted user participation model, this study provides strategic guidance for the operation and management of multinational companies in short video platforms.

This model can help enterprises understand the basic impact of different market cultures on user behavior, and then develop appropriate localization strategies in the international development. The literature suggests that cultural factors significantly influence the usersDecision-making process [14]. According to market research data, in different cultural markets, users acceptance of products and services can reach 30%, therefore, by adjusting the marketing strategy and user incentive mechanism, enterprises can attract and retain users more targeted, and achieve more efficient market expansion.

The culturally adaptive user participation model not only realizes the theoretical value of academic research, but also provides an important practical basis for the innovation of the operation strategy and business model of the short video platform. By paying attention to the cultural characteristics of users and their impact on the way of participation, the platform can achieve more sustainable development in the global market, meet the needs of users under the multi-cultural background, and build a good user ecology.

Short video platform operation strategy suggestions

Content strategies for different cultural backgrounds

In the process of content generation and dissemination, the platform must deeply understand and fully respect the cultural values carried by its target users. In content creation, it is an effective measure to integrate the unique language, customs and expression forms of local areas, which can effectively enhance the sense of belonging and identity of users. If the content is expected to arouse wider participation and resonance, it is necessary to design content that can touch more universal cultural themes, so as to successfully break down cultural barriers and realize the diversity and integration of elements. Such a strategy will undoubtedly effectively increase user engagement, while enhancing the sense of community within the platform.

In the communication link, it is particularly important to understand the social habits and interaction modes of target users to optimize the communication effect. With the help of data analysis tools, short video platforms can deeply describe user behavior patterns, and then develop more accurate content recommendation strategies. This process is not only due of the necessity of content planning, but also a scientific response to users cultural needs. The diversity of content should be matched with the attributes of the audience to ensure the form and quality of interaction, so as to optimize the users participation experience on the platform. For example, Douyins efforts in localization are not only to show the positive side of rural life, but also to take into account the factors of commercialization, which is to promote the groundThe development of Fangs economy is of great positive significance.

In view of user interactive feedback, the content strategy of short video platform should be centered on dynamic adjustment. When user preferences or cultural hotspots change, the platform needs to be able to quickly adjust the content output. This flexible resilience is not only a response to the users behavior, but also an important reflection of a deep understanding of the cultural background. To achieve this goal, the platform should continuously cultivate professionals with cross-cultural communication skills in order to more effectively plan and implement content strategies adapted to different cultural backgrounds. By improving the ability to understand and respond to culture, short video platforms are able to better implement their globalization strategies and stand out in a multicultural environment.

User incentive mechanism design

For the importance of user interaction, the role of emotional design is obvious. A deep understanding of users emotional needs

can design functions that fit the cultural background, such as interactive rating, timely feedback and care mechanism, so as to effectively improve users sense of participation and belonging. This design concept can not only stimulate the creative expression of users, but also promote the benign development of the platform ecology. For example, the localization strategy adopted by Douyin, by showing the positive image of rural life, stimulates the enthusiasm of content creators for the local culture, and makes users willing to participate in content creation and sharing, thus forming a good interactive effect.

When designing incentive mechanisms, attention should be paid to combining with content diversity to ensure that different types of user groups can obtain incentives that meet their interests and preferences. With the help of big data analysis, the platform can effectively identify user preferences and implement personalized incentive strategies and dynamic adjustment measures, such as providing unique rewards, opportunities to participate in activities and potential benefits related to commercial realization, so as to enhance users continued willingness to participate. In addition, if the incentive mechanism of content production can be connected with the economic benefits, it will attract more users to actively participate in the creation, thus forming a virtuous cycle of credit mechanism and promoting the commercialization of the platformcourse.

The user incentive mechanism of short video platform should start from the two aspects of cultural background and individual needs, organically combine emotional design with content diversity, and effectively stimulate the enthusiasm and participation of users. This will not only inject new vitality into the activity of the platform, but also lay a solid foundation for the growth of its business revenue.

Measures to promote user creation and interaction

In the field of content creation, the role of the platform cannot be underestimated, and providing a variety of creative tools becomes the key to stimulating users creativity. Ideal creation tools not only need to have a user-friendly operation interface, but also both interesting, allows the user on the basis of personalized existing content adjustment and adaptation, enable them to retain the original theme into the unique personality expression, such as special effects and sound innovation techniques can greatly enrich creative forms of expression. Studies have shown that the process of content creation is often closely related to users enthusiasm for participation, and innovative content is often more attractive to audiences. In addition, it is necessary for platforms to pay attention to cultural adaptation to ensure that creators can freely express themselves in their own cultural background, so as to meet the needs for the diversity of creative forms and content.

In the user interaction segment, the design of attractive social features is undoubtedly crucial. By publishing interactive topics and soliciting user feedback, the communication and emotional connection between users can be effectively enhanced. The platform should encourage comments and sharing among users, and establish a corresponding feedback mechanism to enhance users awareness of interaction and fun of participation. Design the incentive plan, by rewarding the users who actively participate in the interaction, can effectively enhance the enthusiasm of creation, and then enhance the clubDistrict activity. Studies have pointed out that emotional resonance is closely related to interactive design, and optimizing audio-visual effects and content presentation can not only make users get closer together, but also better cater to their needs for emotional connection.

Building a community-driven creative environment is also another effective strategy to increase user engagement. The platform can encourage users to show their talents in the competition and form a positive interactive cycle. Such platform-led social behaviors not only enhance users sense of engagement, but also facilitate content innovation and diversity. Some scholars

have pointed out that user-generated content (UGC) is not only an effective way to enhance creative enthusiasm, but also an important way to achieve the diversity of platform content.

With the integration of technology optimization, emotional resonance and community drive, the short video platform can significantly promote users creation and interaction. These initiatives not only provide a rich user experience, but also lay a solid foundation for the sustainable development of the platform.

Conclusion

TikTok Show a more inclusive and diverse cultural atmosphere, encouraging users from different cultural backgrounds to create and communicate extensively. This open environment greatly stimulates users enthusiasm to participate in content creation, so the diversity of creation not only increases engagement, but also enriches the content ecology of the platform. In contrast, Douyin has a greater emphasis on promoting local culture in enhancing user engagement. In this context, the enthusiasm of users is often influenced by the cultural adaptability, and the algorithm design of the platform is more inclined to push the content in line with the local culture, so as to form specific interaction habits among local users.

The proposal of the culturally adaptive user participation model provides a new perspective for exploring the user behavior of short video platforms. According to the model, the behavior patterns and participation motivation exhibited by users with different cultural backgrounds on the platform were significantly associated. For example, in Douyin, users are more inclined to share content closely related to their cultural environment, which restricts users creative freedom and participation space to a certain extent. Relatively speaking, TikTok users are more inclined to explore new things and participate in more diverse content manufacturing.

The existence of this cultural difference is not accidental, and research shows that user behavior is profoundly influenced by social and cultural identity. In the participation andDuring the interaction process, users usually convey the values of their cultural identity to the platform. Therefore, in terms of content design and user experience, the platform must fully consider these cultural feedback to enhance users sense of belonging and participation, which can not only improve the overall user activity, but also improve the quality of participation.

Looking into the future, short video platforms should pay attention to the opportunities and challenges brought about by cultural differences in the process of internationalization. Operators should be more flexible in developing strategies to maximize user needs in different cultural environments. This initiative will not only promote the diversity of user-generated content and enhance user engagement, but also help to build a more benign content ecosystem, and ultimately promote the realization of commercial benefits.

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About the Authors

Luyi Wang

Business School of Belarus State University, Belarus

Qiusheng Zhang

Business School of Belarus State University, Belarus

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Breaking Free from the Shackles: Contemporary Women's Crisis and Liberation in Her Story and Like a Rolling Stone

Xianlong Wang^{1*}, Mingzhen Wu^{1*}

Shenzhen University, China

*Xianlong Wang and Mingzhen Wu are co-first authors

Abstract

This paper focuses on two representative films, *Her Story* and *Like a Rolling Stone*, to explore the crisis faced by contemporary women of all ages from the perspective of feminist existentialism. It first analyzes the loss of "self" and "freedom" among contemporary women and reveals the constraints of the patriarchal society on women's self - construction. Then, it delves into the causes of women's dilemmas from the perspectives of the career, family, and inter - generational relationships. Finally, it analyzes the awakening and self - rescue of contemporary women. The study finds that under the long - term structural oppression of the patriarchal society, women lack subjectivity and face restrictions in self - value realization and freedom pursuit. The key for women to break free from the current predicament lies in reconstructing self - identity through self - reflection and obtaining social resources, which also requires the joint efforts of both men and women.

Keywords: Contemporary women; Existential crisis; Feminist films; Structural oppression; Self - rescue

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Introduction: Obstacles on the Road of Contemporary Women's Self - construction

In the context of contemporary society's diverse cultures, women's self - realization and pursuit of freedom have become complex and profound social issues. With the continuous development of feminist thought, an increasing number of scholars and researchers have turned their attention to the dilemmas and challenges faced by women in modern society. In recent years, film and television works, as an important cultural carrier, have emerged as a crucial window for exploring women's issues through their vivid narratives and visual presentations. This paper centers on two representative film and television works, *Her Story* and *Like a Rolling Stone*, and endeavors to uncover the existential crisis confronted by contemporary women through in - depth analysis.

Existential philosophy posits that individuals possess free will and the ability to shape their unique selves through autonomous choices and specific actions, a process known as self - construction (Sartre, 1992). Self - construction is not a passive process but an active engagement where individuals define their identities, values, and life paths. However, in real - world society, women's self - construction encounters numerous obstacles. Despite the significant progress achieved in gender equality in modern times, remnants of the patriarchal society's concepts and systems persist deeply, casting a long shadow over women's self - realization.

One of the most significant challenges women face is the loss of "freedom." This loss, as Beauvoir (1949) described in *The Second Sex*, is not merely a physical or legal constraint but a complex phenomenon deeply rooted in social structures and cultural norms. In the context of the films *Her Story* and *Like a Rolling Stone*, the loss of freedom is vividly illustrated. Women find themselves hemmed in by societal expectations and gender - based stereotypes. For instance, in *Like a Rolling Stone*, Li Hong's aspirations to

pursue her dreams are stifled by the expectations of her family and society. She is expected to prioritize family responsibilities, such as taking care of her husband and daughter, over her personal desires. This external pressure forces her to suppress her own choices, sacrificing her freedom to pursue what she truly loves.

Self - realization, another key concept, refers to the process by which individuals fulfill their potential and achieve their goals. According to Maslow's hierarchy of needs (Maslow, 1943), self - realization is at the top of the pyramid, representing the highest level of human motivation. However, for women,, this process is often hindered by the patriarchal society. In the career, as depicted in both films, women encounter gender discrimination. They are more likely to be asked about their marital and child - bearing status during job interviews, which reflects a bias that assumes women's family responsibilities will interfere with their work. This discrimination restricts their access to career opportunities, making it difficult for them to achieve self - realization in the professional realm.

This paper will conduct an in - depth exploration from the following three aspects: First, it will analyze the loss of "self" and "freedom" among contemporary women and reveal the constraints of the patriarchal society on women's self - construction; second, it will explore the causes of women's dilemmas from the three perspectives of the career, family, and inter - generational relationships among women; finally, it will analyze the awakening and self - rescue of contemporary women of all ages in combination with the two films.

The Contemporary Feminist Crisis Reflected in Her Story and Like a Rolling Stone

The Loss of "Self" and "Freedom" among Contemporary Women

When analyzing the two film and television works, it can be found that the female social issues reflected mainly revolve around two key words - "self" and "freedom". Existential philosophy emphasizes that individuals have the subjectivity to make choices based on free will and shape unique selves through specific actions. Therefore, the issues of "self" and "freedom" can be summarized as their existential issues. After being influenced by the thoughts and social systems of the patriarchal society for thousands of years, the real society today still has a strong "patriarchal" undertone. There are inherent presuppositions about the identities and statuses of the two genders, and the process of women's self - construction is restricted by the inherent identity paradigms presupposed by society. This restriction makes women struggle to balance the pursuit of self - value realization and compliance with established social norms. Their inner selves are constantly in a state of conflict, which is the existential crisis faced by contemporary women.

The Confusion of Women in Searching for "Self"

In contemporary society, although the concept of gender equality is gradually taking root in people's hearts, the inertia of traditional gender culture remains strong. Scholar Li Yinhe pointed out in her in - depth research that the construction of female roles by social culture largely influences women's self - perception (Li, 2005). The expectations of elders in the family for girls to be gentle and sensible, the guidance of school education for women to be quiet and well - behaved, and the repeated reinforcement of female stereotypes in social media communication all subtly shape women's self - perception. Beauvoir mentioned in *The Second Sex* (Zheng, K. L., Trans.): "*One is not born, but rather becomes, a woman*" (Beauvoir, 1949). Society has countless evaluation criteria for women. In the long - term historical and cultural evolution, society has shaped an extremely strict and detailed standard system for the proposition of "becoming a woman". From the external appearance, women are required to follow the mainstream aesthetic paradigm, pursuing fair skin and a slender figure; in terms of words and deeds, they need to be gentle and graceful, speaking softly and refraining from so - called "rude" and "showy" behaviors; in terms of personality traits, they should possess traditional female - labeled personalities such as virtue, tolerance, and forbearance. These long - term social expectations are like an invisible mold, restricting the diverse possibilities of women's self - development. When the search for self - identity conflicts with traditional discipline, women are like being in a fog in such a complex cultural atmosphere. It is difficult for them to accurately define their identity boundaries, and they can only hover between the track of social expectations and the call of their true selves, constantly exploring but often getting lost.

Women aspire to reclaim discursive agency from the shackles of stereotypes. However, at the intersection of modernity and tradition, there is no clear paradigm to define what true independence means for women. Just like the classic line in the film *Barbie* - "We must always be flawless." At the same time, from relevant empirical research data, we can also observe the reality that contemporary women face difficulties in self - recognition due to overly high self - cognitive standards. According to *The Report on the Living Conditions of Chinese Women* (All-China Women's Federation, 2023), among the surveyed female groups, as high as 76.4% of women believe that they need to achieve excellence in multiple dimensions to win the recognition of others. These dimensions cover many aspects such as appearance, career achievements, family management, and social skills. Just like Tie Mei in *Her Story*, as a single mother who gave up her original career and started over, managing family affairs in an orderly manner, she still showed vulnerability when her article was attacked by readers. This also proves women's anxiety about the lack of subjectivity and their high demands on themselves.

The "Unfreedom" of Women's Pursuit of Individual Value

When the patriarchal society binds women to the evaluation criteria of stereotypes, women become the "objects" under the male gaze and "subordinate people", "secondary, the second sex" (Beauvoir, 1949). Thus, their resistance is regarded as "selfish", "lazy", and "unreasonable".

This is particularly evident in Chinese - style families. Some scholars' research has pointed out that in traditional Chinese culture, the concept of family - orientation is strong, and women are often regarded as appendages of the family, with their personal values being weakened (Shen, 2018). Li Hong in *Like a Rolling Stone* is the same. Although there is a strong desire deep in her heart to break the routine and pursue what she loves, the gazes and public opinion pressure from the outside world, even from her own husband, are like heavy shackles. The expectations of her original family make her suppress her choices for a long time. She sacrificed her chance to go to college for her younger brother in the family and made concessions for the lives of her husband and daughter, falling into a deep struggle and unable to build her own future. In the workplace, the plot of her daughter's job interview is also extremely realistic. In the film, when her daughter was interviewed, the interviewer asked questions such as "Are you married?" and "Do you have children?", which were not asked of male interviewees. According to the data in 2022 China Women's Workplace Status Survey Report by Zhaopin, under the same conditions, 58.1% of women believe that they will encounter disadvantages in job hunting due to their gender, while this proportion is only 17.7% among men. More than 60% of women are asked about their marriage and child - bearing status during job interviews. This data implies that people in the workplace may be more inclined to choose men and will judge women's future contributions to the position based on their marriage and child - bearing status. This situation also to a certain extent reflects that women are more likely to make sacrifices and concessions for the family, while men are relatively less affected by family responsibilities.

Society binds women's values to the "family" domain and subtly guides contemporary women to become "nannies" serving families and men through social discipline. Women constantly sacrifice themselves and even convince themselves to be part of "unpaid labor" from a moral perspective, resulting in a dilemma where women cannot see their self - value. Even if women step out of the family and try to achieve independence in society, they will still be treated differently because of such stereotypes. According to the Global Gender Gap Report 2022 by the World Economic Forum, among the 146 countries and regions surveyed, in the dimension of "economic participation and opportunity", the global average gender gap index is 0.508, still leaving much room for improvement. This means that in the economic field, including the workplace, there is still a gap between women and men in terms of obtaining opportunities. In various fields of society where more women should participate equally and resources that should be grasped fairly by women, the entry threshold for women has been raised due to such stereotypes, creating an invisible barrier and resulting in the current "unfreedom" dilemma where women cannot have the same right as men to pursue personal values equally.

The Intersectional Oppression Faced by Women

Throughout the preceding exploration of the predicaments contemporary women encounter in the realms of "self" and "freedom", as well as the barriers they confront during their pursuit of personal values, it becomes readily apparent that these issues are intrinsically linked to a complex and latent form of oppression—Intersectional Oppression. This concept was initially introduced by the black feminist scholar Kimberlé Crenshaw in her seminal 1989 paper, "*Demarginalizing the Intersection of Race and Sex: A Black*

Feminist Critique of Antidiscrimination Doctrine, Feminist Theory and Antiracist Politics". Crenshaw posited that the oppression endured by women is not the outcome of a solitary factor but rather the result of the intricate interweaving and reciprocal influence of multiple social identities, including gender, race, class, sexual orientation, and age. As expounded by Smith (2022) in *"New Perspectives on Intersectionality Theory and the Multiple Dilemmas of Modern Women"*, intersectional oppression endows the dilemmas faced by women with multifaceted and intricate characteristics. This complexity renders it arduous to analyze and resolve these issues using a single theoretical framework or research perspective. Consequently, intersectional oppression offers a novel and pivotal analytical paradigm for comprehending the circumstances of contemporary women.

When delving deeper into the theoretical framework of intersectional oppression, the issues emerging at the intersection of class and gender stand out as particularly conspicuous. Women with lower socioeconomic status are confronted with more formidable challenges in both the domestic and professional spheres. Through meticulous research, Brown (2021) noted in *"Analysis of the Dilemmas of Women's Lives from the Perspective of Class and Gender"* that women from low - income brackets frequently find themselves voiceless within the family decision - making structure. To ensure the basic sustenance of their families, they are compelled to engage in high - intensity, low - paying jobs. This not only severely constricts their opportunities for self - improvement and development but also, to some degree, entrenches their social class. In the workplace, the convergence of class disadvantages and gender biases increases their likelihood of being relegated to low - paying and precarious jobs, making it difficult for them to surmount the obstacles to career advancement and achieve upward social mobility. For instance, consider Li Hong in the film *"Like a Rolling Stone"*. The overwhelming financial burden of her family forces her to abandon her personal aspirations and prioritize securing a job that can merely sustain her livelihood. Even though this job fails to fulfill her professional ambitions and lacks long - term growth potential, this case vividly exemplifies the helplessness and predicaments that women face under the intersectional oppression of class and gender.

Shifting our focus from the intersection of class and gender to that of sexual orientation and gender, we uncover oppression phenomena that demand our attention. Green (2022) clearly elucidated in *"Research on the Mental Health of Women under the Intersectional Oppression of Sexual Orientation and Gender"* that lesbian women in contemporary society are often subject to the dual oppression of heterosexual hegemony and the patriarchal system. On one hand, they are burdened by the ingrained constraints of traditional gender norms, such as the stereotypes that prescribe women to be gentle and submissive. On the other hand, they must contend with discrimination and exclusion stemming from their sexual orientation. In the family context, they may encounter incomprehension, opposition, and even emotional estrangement from their relatives. In social interactions and the workplace, they may be isolated, marginalized, and treated unjustly due to their sexual orientation. This dual - pronged oppression acts as a heavy yoke, severely impinging on their mental well - being and self - identity, and rendering every step of their pursuit of freedom and self - actualization an arduous struggle.

Moreover, the intersectional oppression between age and gender exerts a profound influence on the life trajectories of women. Through rigorous empirical research, Jones (2023) demonstrated in *"Challenges in Women's Career Development from the Intersectional Perspective of Age and Gender"* that young women entering the workforce for the first time are often stigmatized as "immature" and "unstable" due to their tender age and limited work experience. These stereotypes function as invisible barriers, impeding their access to crucial job opportunities and participation in key projects, and circumscribing their initial career start and development. Conversely, older women in the workplace are

vulnerable to "age discrimination" and are often regarded as having diminished creativity and difficulty adapting to rapidly evolving new work models. This, in turn, restricts their career progression and long - term development. In family life, young women may be pressured by their families to marry and have children at an early age, thereby forfeiting their right to freely determine their life pace and personal development paths. Older women, bound by traditional notions, may shoulder excessive family - care responsibilities, forcing them to sacrifice their personal hobbies, social lives, and even career development opportunities.

In summary, these various dimensions of intersectional oppression are interwoven and mutually reinforcing, jointly constructing an invisible yet impregnable web that ensnares modern women. This not only complicates and diversifies the dilemmas faced by women but also renders their struggle to break free from oppression and pursue equality and freedom an uphill battle, further exacerbating the survival crisis of contemporary women. Undoubtedly, in - depth analysis and reflection on this phenomenon are the linchpin for promoting gender equality and enhancing the living conditions of women.

The Causes of the Contemporary Feminist Crisis: Structural Oppression

Economic Oppression: Women's Career Dilemmas

Under the long-term influence of social culture, women are faced with the loss of 'self' and the restriction of freedom, and the most fundamental reason is the various constraints and oppression of the "patriarchal society". And this deep-rooted values are stacked by many factors with the development of time. An important manifestation of this dilemma in real life is the workplace environment. As a key place for women to participate in social activities and realize their personal value, there are many factors that hinder their development, which further aggravates women's dilemma. Therefore, gender discrimination and inequality in the career have deprived women of their freedom to pursue economic independence.

There is a scene in *Like a Rolling Stone* that vividly illustrates this point. Xiaoxue was very angry after the interview and went to confront the interviewer. From their conversation, we can learn that because Xiaoxue is a woman, the interviewer asked "special" questions during the interview - "Are you married? Do you have children? How old is your child?". These are not simple questions but a direct manifestation of deep - seated gender bias in the workplace. In the subconscious of the interviewer, they are worried that women will be distracted from work due to child - bearing, taking care of the family, and other matters, which will affect the economic benefits of the enterprise. Marxist - feminist theory also reveals this point. Under the capitalist mode of production, the labor division results in men occupying the core production areas and high - value positions, while women are mostly assigned to low - paying, unstable, and repetitive jobs (Hartmann, 1979). This not only causes economic inequality but also strengthens women's subordinate status in society.

However, the oppression of women's economic pursuit by society is not limited to workplace entry barriers. Issues such as "occupational segregation", "unequal pay for equal work", and "gender discrimination" are like countless shackles hindering women's career freedom. They weaken women's economic discourse power in the family and society, making it difficult for women to break free from the constraints in the economic structure of the patriarchal society and achieve true equality and freedom.

Cultural Oppression: Women's Dilemmas in Identity Cognition

In *Like a Rolling Stone*, the father in the family, Sun Dayong, repeatedly mentions that he is the "head of the family" and "reasonable". It can be seen that men also have a natural dominant position in the family. In the symbolic order dominated by men, men are labeled as "rational" and "considerate of the overall situation", while women are symbolized as gentle, submissive, and beautiful objects, becoming the targets of male gaze and control in the family.

This gender stereotype is inseparable from the continuous consolidation of patriarchal social culture. Butler (1990) proposed in *Gender Trouble* that gender is a social construct, strengthened through repeated behaviors and discourses. Whether it is the "husband as the head of the wife" in ancient times, which placed women in a subordinate position to men, or today's advertisements and news media full of male - gazing perspectives, they are all constantly deepening the stereotypes of women.

Phrases such as "A mother is strong when she has a child" and "Mothers are the greatest" are well - known. However, the widespread use of this series of social languages actually reflects that society defines the meaning of women's lives from the perspective of mothers. Behind these praises is the infinite exploitation of women's "unpaid labor" by society. To become a "qualified" woman recognized by society, one needs to constantly sacrifice one's self and freedom. Society believes that women should focus on the family, which actually ignores women's independent choices and is an invisible form of exploitation. In addition, many elderly people still measure a woman's value by "having children" and constantly impose the task of "having children and raising them" on women. This series of words such as "having children and raising them", "assisting husbands and educating children", and "virtuous wives and good mothers", which carry implicit gender stereotypes, continuously hinder women's identity cognition and freedom. Under the trend of the ideology of virtuous wives and good mothers, women are constantly instilled with a single - dimensional identity perception, making them unconsciously recognize this seemingly positive value system. However, this is actually another layer of cultural oppression on women, making women mistakenly believe that unpaid labor at home is the value of their lives. Such invisible cultural oppression continuously hinders the pursuit of self - identity by new - era women.

Intersectional Oppression: The Oppression of Traditional Marriage and Family Views

After women get married, marriage and family become another cage that combines economic and spiritual oppression. Fei Xiaotong pointed out in *From the Soil: The Foundations of Chinese Society* that traditional Chinese rural society constructs its family structure centered around the patrilineal blood relationship. Men, by virtue of their dominant position in family blood inheritance and economic production, naturally become the controllers of family power (Fei, 1947). There is also a well - known term for this - the head of the family.

In the movie, Sun Dayong's key words for his self - identity are "the head of the family" and "a real man", and he naturally associates "being reasonable" with his identity, while labeling his wife, Li Hong, as "unreasonable" and "meddlesome". Just because of marriage and family, people start to take it for granted that women's contributions are obligatory. For the sake of children and the family, women have to sacrifice their careers to take care of the family. And precisely because of such sacrifices, women lose the opportunity for economic independence and have to rely on their husbands who have their own careers. This strengthens the binding force of marriage and family, making it difficult for women to leave even when they are disrespected. Even when they want to obtain freedom through divorce, more often than not, family members choose to wrong women to maintain this exploitative relationship for the sake of face and reputation. This can also easily

lead to an even worse situation - domestic violence. According to the data of the All - China Women's Federation, among the 270 million families in China, 30% of women have experienced domestic violence. Among the women who commit suicide each year, 60% do so because of domestic violence. Even in recent years, although opposing domestic violence has almost become a social consensus, domestic violence incidents still occur every day.

It can be seen that traditional marriage and family views, on the one hand, deprive women of their ability to be economically independent, making them dependent and making it more difficult for them to leave the family and start a new life; on the other hand, traditional family concepts further restrict trapped women because divorce affects their reputation. In this long - term unequal status, domestic violence may gradually occur, ruthlessly oppressing women physically and mentally.

The Awakening and Self - rescue of Contemporary

In a gender - unequal predicament, many female directors "take their seats at the table" and point out the plight of women sharply from a delicate and perceptive perspective. As Director Shao Yihui pointed out in her 2023 speech: *"We lack not only female role models, but also the imagination of women's possibilities, as well as richer narratives of women's unique destinies that are different from those of men."* By creating female role models of different ages and in different situations, directors enable us to see our current situation, as well as our capabilities and goals, thus calling for the awakening and self - rescue of a wider range of women.

Awakening of Self - Subjectivity

Two works, *Her Story* and *Like a Rolling Stone*, profoundly reveal the crucial importance of self - awareness awakening for contemporary women. From the very beginning, the film *Her Story* shows a strong color of gender issues. It covers most of the currently debated gender topics, such as "male vasectomy", "menstrual shame", references to Simone de Beauvoir and Ueno Chizuko, "sexual liberation", ethical issues, structural oppression, and gender dividends. The three female characters in the film, Wang Tiemei, Xiao Ye, and Wang Moli, each experience a unique life journey. They continuously explore and grow on the path of pursuing self - value, and their process of self - awareness awakening is a gradually deepening and tortuous one.

In seeking to balance work and family, as a divorced mother, Wang Tiemei did not choose to pin her life's hopes on a new marriage. Instead, she refused her ex - husband's request for reconciliation on the pretext of "vasectomy" with a strong - woman attitude. She independently took care of household affairs, started from being a small - scale public account editor, and worked hard to support and encourage her daughter Wang Moli. She also fought against all unfair treatment for Wang Moli. At the same time, she strongly opposed the tragic narrative of single mothers. She re - examined the "single - mother" group and the individual value of women. Relying on her experiences, she wrote about her life and emotions in articles, telling readers that being a single mother does not mean losing the ability to be independent, nor does it mean a miserable life. The one - sided tragic narrative does not help solve women's dilemmas; instead, it further weakens mothers' self - subjectivity. In terms of relationships, the entanglement of her ex - husband and the pursuit of Xiao Ma, unlike the tough images of male protagonists in other movies, show the compliance of the two men through plots such as "vasectomy" and "male competition", thus reflecting Wang Tiemei's initiative in these two relationships.

Xiao Ye came from an unhappy family of origin, which led to her obvious tendency to please others in interpersonal relationships, constantly placing herself in the position of "the other". When faced with Doctor Hu's clumsy lie about her inability to enter a long - term relationship, she could only maintain the relationship by creating a false persona of a married woman having an affair,

constantly mistaking the illusion of "being loved" for her own value. Eventually, she was awakened by Wang Tiemei: "The first thing for someone lacking love is to find a way to love themselves, rather than trying to find evidence of being loved in others." Thus, she got out of the emotional quagmire.

Like a Rolling Stone is adapted from the real self - driving tour experience of Aunt Su Min from Zhengzhou. In her family and marriage, Su Min was long defined as a daughter, wife, and mother. Her life was filled with endless housework and taking care of her family. She was always sacrificing herself and waiting. She had been living under an AA system with her husband for 34 years and served as a free nanny, enduring her husband's nitpicking and accusations every day. In 2020, at the age of 56, Su Min finally made up her mind to "leave" and started a self - driving tour alone. During the journey, Su Min recorded her life by shooting short videos, and her story gradually became known to the public, attracting widespread attention and discussion.

In the film Like a Rolling Stone, Director Yin Lichuan tells the story of Li Hong through the interweaving of two timelines, highlighting the reasons and experiences of Li Hong's departure. Li Hong was diligent and hard - working. She hoped to be admitted to her dream university through the college entrance examination but was restricted by her family of origin and had to give way to her younger brother. Then, she pinned her hopes on marriage, expecting to escape the control of her family of origin by marrying far away, but was trapped in the trivialities of daily life. She waited for her daughter to grow up, for her grandson to be born, and for her children to have stable careers and settle down... So her plan to travel around the world was constantly postponed. In such a living environment, Li Hong's needs and dreams were completely ignored, and everyone took her motherly dedication for granted. However, when the self - driving tour team passed by, she discovered that there were other ways of living in the world. She realized that the solution to pursuing independence and autonomy lay within herself, not in others. When her life purpose became living for others, she finally saw herself, discovered her abilities, and regained her subjectivity.

Resistance to Traditional Constraints

In reality, relying on a retirement salary of just over 2,000 yuan, Su Min lived frugally and slept in a tent tied to the roof of her car to start a journey of self - discovery. Her decision was not only a rebellion against her past life but also a challenge to traditional female roles.

In the film, Li Hong lived in an environment where traditional gender concepts were deeply ingrained. In her married life, her husband adhered to traditional ideas such as "Which woman doesn't cook at home?" and "Women are unreasonable", tying her down with household chores. He would talk to her in a condescending manner, like knocking on the window twice. Not using diapers was considered "lazy", and all her reasonable demands were seen as "unreasonable". At the same time, as an older sister, she was supposed to think about her younger brother's future and work for him for free. As a wife, she was supposed to take on all the housework and childcare responsibilities. As a mother, she was supposed to take care of her daughter's child and pay attention to every minor redness on the child's body... All these "shoulds" had a long - standing origin. It seemed that the existence of all women was only to meet the needs of the family and be the appendages of men, confined to the position of "the other".

However, Li Hong did not always passively endure this unfair situation. As time passed, her self - awareness gradually awakened, and she began to challenge these traditional concepts and her predetermined fate. She resolutely chose to leave home, escaping the expectations of society for women as traditional gender roles. From the perspective of existential feminism, Li Hong's departure was a brave pursuit of freedom and self. She no longer wanted to be bound by traditional concepts, nor was she willing to be a subservient of the family. Instead, she yearned to be the master of

her own life and define her existence and achieve self - value through this choice.

Guidance for the New Generation of Women

For awakened women, in addition to resistance, an even more important way of self - rescue is to guide the new generation of women. Wang Tiemei's educational concept in Her Story is that she does not want Wang Moli to be a "lady". She believes that "the term 'lady' should have been eliminated long ago." Her most important educational concept is "to be upright, brave, and well - read". Under such education, Wang Moli has become a child who does not accept gender discipline and moral kidnapping and can see her true inner feelings.

At first, Wang Moli was arranged by the teacher to be an audience member because she clapped well. She dared not refuse because she didn't want to cause trouble and cared about the opinions of teachers and classmates. However, after becoming a female drummer, she finally bravely expressed her feelings to the teacher and refused to continue being an audience member. After her first stage performance, she wrote in her composition: "I thought I liked drumming, but when I stood on a big stage and completed a performance, I felt like I had just completed a task. I still prefer to be an audience member." When her father wanted to reconcile with Wang Tiemei by using the fact that he had raised Wang Moli hard in the past, Wang Moli replied, "You're my dad. Isn't it right for you to take care of me?" to avoid moral kidnapping and her father's interference in their current life. When Zhang Jiaxin said in a condescending manner, "I forgive you. You're pitiful," Wang Moli replied, "I think you're ridiculous. I'm upright, brave, and well - read. What's pitiful about me?" Under the guidance of Wang Tiemei and Xiao Ye, Wang Moli has unconsciously undergone a transformation. She has truly become a woman who follows her true self rather than social discipline and others' approval. She has her own self - subjectivity, and she herself is a resistance to the past and tradition, as well as a builder of the "new game" in the future.

Conclusion

From the two works Her Story and Like a Rolling Stone, we can glimpse the dilemmas of contemporary women of all ages from the perspective of female existentialism. Under the long - term structural oppression of a patriarchal society, women lack subjectivity, unconsciously placing themselves in an object position and failing to see their self - value and capabilities. In society, social resources have long been occupied by men, squeezing the development space of women. These two factors together have caused the aforementioned dilemmas of women's lack of "self" and "freedom".

So, how can women break through structural oppression? Anthony Giddens mentioned in his other book Modernity and Self - Identity: *"In the context of modernity, the formation of self - identity is increasingly becoming an active construction process of the acting subject. They plan their ideal selves and their development based on a large amount of knowledge from abstract systems."* It can be seen that the key for women to get out of the current dilemma lies in reshaping self - identity through self - reflection and mastering social resources. At the same time, Simone de Beauvoir also pointed out that getting out of the dilemma cannot rely solely on women; it requires the joint efforts of both men and women.

Therefore, feminist films such as Her Story and Like a Rolling Stone serve as media platforms to convey female voices to the public. Feminist film theorist Mary Ann Doane criticizes that *"female films always associate female pleasure with the construction of masochistic femininity"*. Traditional films are used to placing women in the position of "being stared", which are *"a kind of writing that uses female images but not for women"* (Mary Ann Doane, 2006). The revolutionary nature of Her Story and Like

a Rolling Stone is that the protagonists in the two films "no longer revolve around the sexual and blood relationship with men, but are full of subjective self-reflection and growth" (Chen, 2025), and become "female writing" in the real sense. So, just like what Laura Mulvey believes, "film is not only a tool for women to be oppressed by images, but also a tool for liberation by changing conventions and reorganizing forms". Nowadays, female films have entered the public view and popular culture. Women pick up "films" as the tool to break the inequality of the traditional patriarchal society in order to liberate themselves. This also reflects women's urgent hope to break the traditional gender power structure, which has a profound impact on promoting gender equality, which has a profound impact on promoting gender equality.

Looking to the future, women face both hopes and challenges on the road to pursuing equality and freedom. From a social perspective, with the continuous progress of society and the gradual change of people's concepts, the concept of gender equality will take root more deeply in people's hearts. More and more people will realize that gender equality is not only the right of women but also an inevitable requirement for social development. Governments and social organizations will increase their support and promotion of gender equality, formulate more perfect laws, regulations, and policy measures, eliminate gender discrimination, and create a more equitable development environment for women.

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The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Author Contributions

Xianlong Wang and Mingzhen Wu are co-first authors.

About the Authors

Xianlong Wang
Shenzhen University, China
Mingzhen Wu
Shenzhen University, China

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Status quo, hotspot and trend analysis of urban green space research based on Cite Space

Chuan Zhu^{1*a}, Yucheng Jiang^{1b}, Jianming Ye^{2c} and Lili Wang^{1d}

¹*School of Physical Education, Shihezi University, Shihezi Xinjiang, China*

²*College of Agriculture, Shihezi University, Shihezi Xinjiang, China*

**Corresponding author: Chuan Zhu 1295692737@qq.com*

Abstract

As one of the important components of ecosystem services, urban green space can affect the physical activity of the public, especially the exposure level, accessibility and landscape composition of green space are positively correlated with the health behavior activities of residents. Urban green space has the function of improving residents' mental health, physical condition, social adaptation and moral health. In this paper, we analyzed the clustering of thematic word network, high-frequency and central thematic words and thematic words on the basis of 149 literature data of CNKI website from 2009 to 2024, and summarized the research categories of the main urban green space and their main perspectives. In the future research, we should strengthen the interdisciplinary research, especially with the humanities and social sciences, pay attention to the interaction of urban green space, social economy and public health, explore the multiple mechanisms and modes of the value realization of urban green space, and help the harmony and unity of man, nature and society [1]

Keywords: cite space; city; green space; visual analysis

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Foreword

The World Health Organization (WHO) further improved the concept of health in 1989, pointing out that health should be a good state of physical, psychological, social adaptation and moral aspects. With the progress of modernization, many urban residents can not enjoy the real environmental protection, which leads to many negative effects harmful to the health of residents. In order to make our living environment can better promote our healthy development, we should attach great importance to and maintain the greening and sustainable development of the city. Urban Green Space is a vibrant place composed of a variety of plants and animals, including parks, streets, squares, nature reserves, etc. The rapid expansion of modern cities and the increasing building density often lead to the reduction of green space by [2]. Urban green space not only provides places for residents' leisure and entertainment, so that residents can directly obtain health benefits both physically and mentally, but also has the functions of improving the urban environment and improving the ecological quality. The construction of urban green space can bring multiple benefits, from the residents in the social interaction and social adaptability, to the interaction with nature, to through the cultural ecosystem services indirectly promote health behavior, can be from the sum of natural elements in urban space, the ecosystem function relationship and its use of beneficial effects. This paper aims to deeply explore the development trend of urban green space through visual analysis, and comprehensively sort out its publishing institutions, major journals and representative literature from different perspectives, in order to provide valuable reference for the research of urban green space in China.

Study Methods and Data

Source of data

With the development of society, the study of urban green space has become more and more common, covering various academic journals, conference papers and graduation papers. In order to better explore the development trend of urban green space, we

collected the documents related to urban green space of Peking University, CSCD and CSSCI in the CNKI database. A total of 149 articles were retrieved, which were used as the analysis samples of foreign literature data in this study.

Study Methods

Through the use of Cite space software, this research and development has adopted a variety of effective technical means, to deeply explore the current situation of urban green development in China from 2009 to 2024, and to show the contents of 149 core journals in the form of scientific knowledge graph. Through the analysis of Pathfinder (path finding network algorithm), we can deeply understand the importance of urban green space, and use Excel, word frequency analysis and historical comparison method to accurately evaluate the publication of this field, so as to better understand the current research status and predict the future development.

Study results and analysis

Annual publication volume of urban green space research

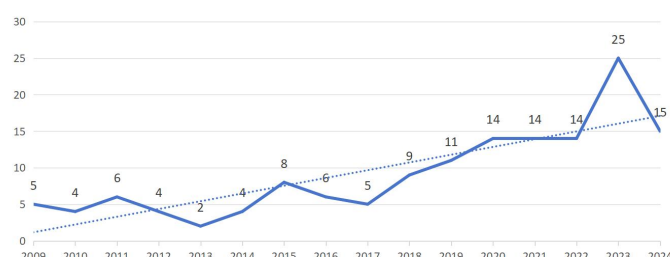


Figure 1 Volume chart of CNKI in the past 15 years

Core author analysis

Table 1 Statistics of the authors of CNKI

Post volume	author
6 Articles	Ye Lin
5 Articles	Zhang Biao
4 Articles	Xing Zhong
3 Articles	Li Na, Xie Highlands
2 Articles	He Jinliao, Wang Shuo, Wang Siyuan, Liu Min, Chen Kanglin, Zhang Zishu, Yan Wentao, Yang He, Yang He, Xie Bo, Wu Xuefei, Liu Hui, He Shuchuan, Liu Chunlan, Zhou Liang, Liu Jingyuan, Chen Xiao, Yue Xiaoyu, Gong Jianzhou, Qin Fei, Tan Xuyuan

Through the number likelihood algorithm (LLR) clustering the keywords in the urban green space, we found that there is a strong correlation between the keywords under each cluster, and the Modularity Q value is greater than 0.3, indicating that the clustering structure is more clear, while the MeanSilhouette S value is greater than 0.7, indicating that the clustering results are more reliable. After this study, we found that $Q=0.6451 > 0.3$, indicating that the keyword structure of this cluster is very significant and can be used as a strong argument. In addition, $S=0.938 > 0.7$, indicating that the effect of this cluster is very reliable, which also indicates that the research direction, focus and main content of the literature in each cluster are similar, so it can be used for cluster analysis (Figure 6). After in-depth analysis, we find that "urban park", "landscape architecture", "landscape pattern", "mental health", "physical activity", "accessibility", "Long chi Park", "regional monitoring", "conceptual framework", "Beijing", "green space system", "sports city" and "livable" are a very important indicators. By clustering the 13 keywords, we can better understand the topic distribution [4] of urban green space spatial research in China. This information helps scholars to better understand and master the structure and content of relevant research.

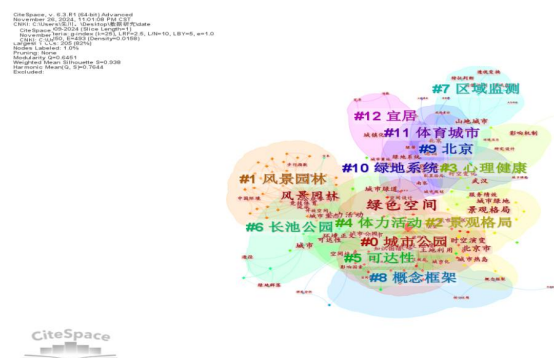


Table 2Urban green space keyword classification table

classify	keyword
spatial planning	"City Park", "Landscape Architecture", "Longchi Park", "Beijing" and "Sports City"
public health	"Mental health" and "Physical activity"
systems assessment	"Landscape pattern", "accessibility", "green space system", "regional monitoring", "conceptual framework" and "livable"

Analysis of the emergent map of keywords

The frontier and trend of a certain research field can be predicted by the change of word frequency. Through the Layout function in Cite Space software, select "Byrstsness", find 10 keywords, and draw the keyword appearance map. As can be seen from Figure 6, the timing of the emerging words in the field of urban green space research in China is arranged as "green space system", "city", "Beijing", "spatial pattern", "Germany", "urbanization", "Guangzhou", "sports city", and "mental health". These keywords are widely concerned and highly influential research hot spots in Chinese academic circles. The emergence words appear from 2009 to 2024. This paper divides the emergent words into the following three categories: spatial planning, public health, and systematic evaluation. It can be seen from Figure 6 that in recent years, the research on urban green space in China focuses on public health. With the development of economic and social, the importance of the urban ecological construction, the study of residents' physical and mental health gradually, the main population is still with the elderly and patients with chronic diseases. Cite Space software Layout function can help us to analyze the "Byrstsness" 10 keywords word frequency change, so as to better understand the development dynamics and trend of the research field. According to Figure 6, "green space system", "city", "Beijing", "spatial pattern", "Germany", "Beijing", "urbanization", "Guangzhou", "sports city", and "mental health" are the most concerned keywords in the field of urban green space research in China, which have been at the highest level from 2009 to 2024. These research results have not only been highly valued by the academic circle, but also have had a far-reaching impact. This paper will focus on three key words: spatial planning, public health, and systems assessment. It can be seen from Figure 6 that in recent years, the research on urban green space in China focuses on public health. With the advancement of globalization, the government is paying more and more attention to the environmental protection of cities, and begins to pay more attention to the health of the public, especially those who need to maintain a good body for a long time and patients with chronic diseases.

Top 10 Keywords with the Strongest Citation Bursts

Keywords	Year	Strength	Begin	End	2009 - 2024
绿地系统	2009	1.27	2009	2010	
城市	2009	1.16	2009	2010	
北京市	2011	1.17	2011	2015	
空间格局	2012	1.31	2012	2013	
德国	2015	1.71	2015	2017	
北京	2015	1.5	2015	2018	
城镇化	2015	1.19	2015	2016	
广州市	2016	1.4	2016	2019	
体育城市	2016	1.27	2016	2017	
心理健康	2021	1.79	2021	2024	

Figure 4 Analysis of keyword keywords in urban green space in the past 15 years

Initial stage (2009-2016): In the initial stage of urban green space research, the research content represented by urban parks, green space and landscape architecture became the mainstream. At this stage, the academic circle mainly takes spatial planning as the research perspective to explore the application and role of green space in the green development of cities and towns.

Mid-term stage (2016-2020): Urban green space construction At the current stage, academic research has gradually shifted its focus from the spatial planning of urban green space to the systematic evaluation of urban green space. The researchers mainly focus on exploring the application and influence of urban green space in cities with relatively favorable economic conditions. Specifically, the researchers mainly focus on the system construction of green space and the challenges faced by these cities in promoting the construction of urban green space.

In-depth research stage (2020-): The later focus of the sustainable development of urban green space mainly focuses on public health, and discusses the application and role of "mental health", "physical activity" and other directions [6]. The rapid development of urban green space has brought new opportunities for the sustainable development of public health, which can not only provide more opportunities for the development of mental health of residents, but improve residents' happiness and satisfaction [7].

To sum up, the focus of urban green space research changes from "spatial planning" in the early stage to "systematic evaluation" in the middle stage, and then to "public health" in the later stage. This evolution process reflects the continuous deepening and expansion of the research on urban green space, and also reflects the important role of urban green space in promoting the development of urban ecological construction.

Conclusion

According to the data analysis of Cite Space, in the research process of urban green space, many scholars no longer only study the planning and layout of green space, but pay attention to the physical and mental health of residents and public health development, and pay attention to the ecological development [8] of harmonious coexistence between man and nature. With the rapid development of social economy, the environment of urban green space has changed, so we should optimize the systematic planning and layout of urban green space, so as to further carry out a systematic evaluation of urban green space. In the future, we should strengthen the cooperation between researchers, deepen the depth of urban green space on public health, and explore the impact of urban green space on residents' physical health, psychological status, social adaptability and ethics. Only by paying close attention to the healthy development of residents in the urban environment can the research space of urban green space be greatly improved. In addition, we can combine the online AI model with the accessibility measurement of the offline urban green space, so as to explore a road more conducive to the development of residents' healthy behavior, and provide a perfect answer for the construction of a clean and beautiful urban green environment.

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About the Authors

Chuan Zhu

School of Physical Education, Shihezi University, Shihezi Xinjiang, China

Yucheng Jiang

School of Physical Education, Shihezi University, Shihezi Xinjiang, China

Jianming Ye

College of Agriculture, Shihezi University, Shihezi Xinjiang , China

Lili Wang

School of Physical Education, Shihezi University, Shihezi Xinjiang, China

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A Literature Review on Firm Internationalization: Theoretical and Conceptual Frameworks

Jiaying Huang^{1*}

¹Shanghai Jiguang Polytechnic College, China

*Corresponding author: jiayinghuang2025@outlook.com

Abstract

This paper follows Andersen's distinction between theory and conceptual frameworks, classifying and reviewing firm internationalization studies based on their theoretical foundations. Through a systematic review of literature published in leading international business journals from 1960 to 2023, this study uniquely bridges the gap between economically oriented and process-oriented perspectives on internationalization. The paper explores the relationships among various conceptual frameworks of firm internationalization by examining their variables and conceptual structures, with particular emphasis on knowledge as a unifying construct. Unlike previous reviews that predominantly focus on either large multinational enterprises or SMEs, this paper constructs a comprehensive, integrative conceptual framework that accommodates diverse internationalization pathways. This framework facilitates theoretical dialogue and provides a foundation for future empirical research, particularly in the context of digital transformation and emerging market firms.

Keywords: Firm internationalization; Uppsala Model; Innovation-Related Model; International Entrepreneurship; Network Theory; Resource-Based View (RBV)

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Theoretical Foundations of Firm Internationalization

Theory and conceptual frameworks are two distinct academic terminologies (Andersen, 1997). A theory is a set of systematically structured propositions related to a phenomenon that have been empirically tested, aiming to enhance scientific understanding and interpretation of that phenomenon. In contrast, a conceptual framework describes the logical relationships between empirically validated concepts, primarily outlining the relationships between independent and dependent variables as well as their interactions with moderating or mediating variables. While a conceptual framework does not meet the fundamental conditions of a theory, a single theory can be represented by multiple conceptual frameworks, and a conceptual framework can be based on multiple theories (Johanson & Vahlne, 1977).

Following Andersen's (1997) distinction between theory and conceptual frameworks, an analysis of existing studies on firm internationalization reveals that the theoretical foundations of internationalization research can be classified as theories, whereas most studies on firm internationalization take the form of conceptual frameworks, even though some claim to be theoretical studies.

Scholars have attempted to categorize firm internationalization studies based on different theoretical foundations. A representative classification is proposed by Mtigwe (2006), who argues that the theoretical foundations of firm internationalization research primarily derive from behavioral, decision-making, market, and trade theories, thereby categorizing these studies into three groups: market, firm, and entrepreneurship. Andersen (1997), on the other hand, classifies internationalization research into two categories: economic and process-based. Economic internationalization studies are grounded in mainstream economics, where decision-makers are considered rational economic agents with full market information, making optimal choices regarding firm internationalization. Process-based internationalization research, however, is rooted in organizational theory, portraying decision-makers as behavioral

agents who make relatively satisfactory decisions based on incomplete information.

Considering the theoretical foundations of these classifications, Mtigwe's (2006) market and trade theories can be subsumed under economic theories, while behavioral and decision-making theories align with organizational theories. Thus, this paper endorses Andersen's (1997) classification, suggesting that existing studies grounded in international trade, transaction cost theory, and industrial organization belong to economic internationalization research, whereas studies based on organizational behavior theory, strategic management, resource-based theory, network theory, and entrepreneurship theory fall under process-based internationalization research.

Economic internationalization research originated in the 1950s, during which multinational enterprises (MNEs) became the primary focus of international business studies, replacing nation-states as the main unit of analysis (Buckley & Casson, 1976). This shift marked the emergence of modern international business theory. During this period, two seemingly parallel research approaches emerged: the international product life cycle theory (Vernon, 1966) and the theory of specific advantages in foreign direct investment (FDI) (Hymer, 1960). In reality, the international product life cycle model is rooted in international trade theory, while the specific advantage theory is based on industrial organization theory.

Subsequent developments in FDI theory led to the emergence of the internalization theory (Buckley & Casson, 1976), which is grounded in transaction cost economics, and the eclectic paradigm (Dunning, 1988), which integrates the advantages of ownership, location, and internalization.

Unlike the economic theory-driven research of the 1950s, firm internationalization studies have been increasingly influenced by organizational theories since the early 1970s. Within this framework, scholars have adopted various theoretical perspectives to propose multiple conceptual frameworks. These include:

- The Uppsala Internationalization Model (U-model), based on behavioral theory (Johanson & Vahlne, 1977).

- The Innovation-Related Internationalization Model (I-model), which links internationalization with innovation processes (Bilkey & Tesar, 1977).
- International Entrepreneurship Research, based on entrepreneurship theory (McDougall & Oviatt, 2000).
- The Network Approach to Internationalization, based on network theory (Johanson & Mattsson, 1988).
- Resource-Based Strategic Choice Approach to Internationalization, rooted in strategic management and resource-based theory (Barney, 1991).

These various theoretical foundations highlight the diversity and complexity of firm internationalization research. Given the multifaceted nature of internationalization, it is unsurprising that different approaches have emerged, each focusing on different aspects of the phenomenon, leading to a variety of conceptual frameworks.

Review of Conceptual Frameworks on Firm Internationalization Methodology for Literature Selection

Before reviewing the major conceptual frameworks, it is important to outline the systematic approach used for literature selection in this review. The following search strategy was employed to ensure comprehensive and unbiased coverage of relevant literature:

- Databases: Business Source Complete, Web of Science, Scopus, and Google Scholar were used as primary search platforms.
- Keywords: Search terms included combinations of "internationalization," "international expansion," "market entry," "foreign direct investment," "export," "born global," "international new venture," "multinational enterprise," and "cross-border business."
- Inclusion criteria: (1) Peer-reviewed journal articles and scholarly books published between 1960 and 2023; (2) Studies focusing on firm-level internationalization processes; (3) Research providing theoretical contributions or conceptual frameworks.
- Exclusion criteria: (1) Studies focusing solely on international trade at the country level; (2) Papers without clear theoretical underpinnings; (3) Non-English publications.
- Quality assessment: Priority was given to publications in high-impact journals in international business, management, and entrepreneurship fields. Citation counts were used as a secondary indicator of scholarly impact.

This systematic approach resulted in a final selection of 127 key publications that form the basis of this review, ensuring a balanced representation of economic and process-based internationalization perspectives.

Review of Conceptual Frameworks

According to the chronological development of research frameworks, this section first reviews the conceptual frameworks of economic-based internationalization research. As the focal point of international business theory shifted from nations to firms, two interconnected conceptual frameworks emerged in the 1960s: the specific advantage theory (Hymer, 1960) and the international product life cycle theory (Vernon, 1966).

Vernon's international product life cycle theory explains the internationalization of firms based on the development of product technology. He argues that firms from technologically advanced countries initially manufacture and sell their products domestically while exporting to foreign markets. As technologies become standardized and production cost considerations grow, firms are incentivized to relocate production to lower-cost regions, thereby driving international expansion. This theory effectively describes the post-war outward investment of U.S. firms and helps explain shifts in trade patterns (Vernon, 1966).

In contrast, Hymer's specific advantage theory (Hymer, 1960) represents a pioneering effort to explain the foreign direct investment (FDI) decisions of firms. Rejecting the traditional assumption of perfect competition, Hymer proposed that market imperfections give rise to firm-specific advantages, which are essential for firms to overcome additional costs associated with operating in foreign markets. Later scholars extended this idea, leading to the development of the internalization theory (Buckley & Casson, 1976). According to this theory, firms internalize transactions to mitigate market imperfections, particularly in intermediate goods and technology markets, where transaction costs are high.

Dunning (1988) further refined these theories with the eclectic paradigm, integrating ownership, location, and internalization (OLI) advantages into a comprehensive model. His framework remains one of the most widely applied theories in FDI and multinational enterprise (MNE) research, providing theoretical foundations for explaining firm internationalization patterns.

Unlike the economic-oriented studies that mainly focused on large multinational corporations, internationalization research from the 1970s onwards began to incorporate small and medium-sized enterprises (SMEs). The emphasis gradually shifted from understanding the motivations behind international expansion to analyzing the dynamic process by which domestic firms become international. This shift gave rise to what is known as process-based internationalization theories, particularly the Uppsala Model (Johanson & Vahlne, 1977) and the Innovation-Related Internationalization Model (I-Model) (Bilkey & Tesar, 1977).

The Uppsala Model (U-Model) posits that firms internationalize gradually, increasing their commitment to foreign markets as they accumulate market-specific knowledge. This process involves reducing "psychic distance"—the perceived differences between home and foreign markets—through experiential learning and incremental decision-making (Johanson & Vahlne, 1977). Similarly, the Innovation-Related Internationalization Model (I-Model) shares the assumption that knowledge accumulation is a critical factor influencing internationalization. However, it differs in focusing on the role of organizational learning and managerial innovation in the firm's decision to expand internationally (Bilkey & Tesar, 1977).

By the 1990s, firm internationalization patterns began accelerating, challenging the assumptions of gradual internationalization models. Many firms exhibited "born-global" characteristics, internationalizing from inception rather than through a slow, incremental process (McDougall & Oviatt, 1994). To explain this phenomenon, scholars introduced the Network Approach to Internationalization (Johanson & Mattsson, 1988), which emphasizes that firms internationalize by leveraging inter-organizational networks and relationships rather than through stepwise market expansion.

The resource-based view (RBV) of strategic choice in internationalization further expanded the theoretical landscape, arguing that firms' internationalization strategies are shaped by their unique, difficult-to-imitate resources and capabilities (Barney, 1991). This perspective integrates elements of strategic management with international business, offering insights into how firms sustain competitive advantage in global markets.

The emergence of international entrepreneurship theory (McDougall & Oviatt, 2000) further broadened the scope of research by highlighting the role of entrepreneurial vision, risk-taking, and opportunity recognition in driving early internationalization. Unlike previous theories that treated internationalization as a firm-level strategic process, this approach places emphasis on the individual entrepreneur as the key actor in international expansion.

More recently, scholars have begun examining the impact of digital technologies on firm internationalization. Digital internationalization frameworks focus on how internet-based platforms, e-commerce, and digital business models enable firms to access global markets without significant physical presence (Coviello et al., 2017). This emerging perspective challenges

traditional assumptions about the sequence and pace of internationalization, suggesting that digital technologies can significantly compress or even eliminate certain stages of the internationalization process.

Evaluation of Conceptual Frameworks

Economic-based internationalization frameworks have long dominated the literature, primarily focusing on large multinational corporations (MNCs) and providing robust explanations for the motivations behind foreign direct investment (FDI). These frameworks have served as the theoretical foundation for corporate internationalization strategies. However, scholars have increasingly recognized their limitations:

- Lack of focus on the early internationalization process: Economic-based models predominantly analyze internationalized firms rather than firms in the process of internationalization. They offer limited insights into the dynamic transition from domestic to global markets (Morgan & Katsikeas, 1997).
- Predominantly static analyses: Except for the product life cycle model, most economic-based conceptual frameworks take a static approach, assessing firm internationalization at a specific moment rather than as a dynamic process. They tend to focus on firm behavior after internationalization rather than the preceding developmental stages (Vahlne & Nordstrom, 1993).
- Overreliance on rational decision-making assumptions: Economic-based models assume that firms make optimal choices based on complete information. In reality, firms often operate under uncertainty and may make suboptimal yet satisfactory decisions due to bounded rationality (Johanson & Vahlne, 1977).

In contrast, process-based internationalization frameworks aim to capture the dynamic nature of international expansion, making them particularly relevant for SMEs and entrepreneurial ventures. The stages models (e.g., Uppsala Model, I-Model) are especially applicable to firms with limited market knowledge and financial resources, guiding them through a stepwise internationalization process. However, process models also have limitations:

- Lack of strategic flexibility: The rigid stepwise process outlined by stage models may not reflect the reality of firms that internationalize through nonlinear or rapid expansion paths, such as "born-global" firms (McDougall & Oviatt, 1994).
- Fragmentation across different perspectives: Each process-based model emphasizes different aspects of internationalization. The Uppsala Model prioritizes market knowledge accumulation, the Network Approach highlights relational ties, the Resource-Based View (RBV) emphasizes core resources, and international entrepreneurship theory focuses on entrepreneurial actions. This diversity raises the question of which model is the most effective guide for firms.

A review of both economic and process-based internationalization theories reveals four key transformations in research focus:

- Shift in focus from large MNCs to SMEs and entrepreneurs: In the 1950s, firm internationalization research centered on large MNCs. By the 1970s, the focus expanded to SMEs, and since the 1990s, increasing attention has been placed on the role of entrepreneurs in the internationalization process (Mtigwe, 2006).
- The evolution of research content: Early internationalization studies primarily examined whether and how firms should internationalize. Contemporary research now includes topics such as global strategy, international strategic alliances, and organizational control mechanisms (Coombs et al., 2009).
- Theoretical integration: While early studies relied predominantly on economic theories, later research increasingly incorporated organizational theories and multi-theoretical approaches to improve explanatory power (Antončić & Hisrich, 2001).

- Diverse internationalization pathways: Whereas early theories emphasized a gradual expansion process, more recent research acknowledges that internationalization can be incremental, rapid, or even instantaneous ("born-global") (McDougall & Oviatt, 2000).

A Comprehensive Conceptual Framework for Firm Internationalization

Integrating Conceptual Frameworks of Firm Internationalization

The diversity and multiplicity of conceptual frameworks on firm internationalization reflect both the complexity and significance of this phenomenon. However, a closer examination reveals that scholars have primarily emphasized differences in research methodologies rather than their commonalities. This has hindered the construction of a more unified theoretical framework (Mtigwe, 2006). Therefore, this section first identifies commonalities among existing research frameworks and then constructs a comprehensive conceptual framework for firm internationalization, incorporating the emerging trend of theoretical integration.

A critical analysis of existing research reveals that knowledge serves as a fundamental linking variable across different conceptual frameworks. In process-based internationalization theories, both the Uppsala Model (U-Model) and the Innovation-Related Internationalization Model (I-Model) emphasize the role of knowledge accumulation and learning. In the U-Model, knowledge determines the firm's resource commitment to foreign markets, influencing its market entry mode and target market selection (Johanson & Vahlne, 1977). In the I-Model, knowledge is also recognized as a key driver of innovation and international expansion (Bilkey & Tesar, 1977).

Knowledge Types and Their Role in Internationalization

It is important to further refine the classification of knowledge in the internationalization context. Based on existing literature, we can categorize knowledge into several types that influence internationalization differently:

- Explicit vs. Tacit Knowledge: Explicit knowledge (codifiable information) can be easily transferred across organizational boundaries, while tacit knowledge (experience-based insights) is difficult to articulate and requires direct experience to acquire (Polanyi, 1966). Firms with stronger capabilities in transferring tacit knowledge internationally may achieve faster and more successful market penetration.
- Technical vs. Market Knowledge: Technical knowledge relates to product development and operational processes, while market knowledge encompasses understanding of consumer preferences, competitive dynamics, and distribution systems in foreign markets (Eriksson et al., 1997). Both types are critical, but market knowledge often represents a greater barrier to successful internationalization.
- Experiential vs. Objective Knowledge: Experiential knowledge is gained through direct involvement in international operations, while objective knowledge is acquired through standardized information sources (Johanson & Vahlne, 1977). Studies suggest that experiential knowledge has a more profound impact on reducing uncertainty in internationalization decisions.
- Institutional Knowledge: Understanding of formal and informal rules, norms, and cultural frameworks that govern business activities in foreign markets (Eriksson et al., 1997). This knowledge type is particularly important for firms entering markets with significant institutional distance from their home country.

In international entrepreneurship theory, knowledge is equally crucial. Born-global firms are often founded by entrepreneurs with

global vision, international experience, and prior market knowledge, which enables them to internationalize early and rapidly (McDougall & Oviatt, 1994). Moreover, in the Network Approach to Internationalization, firms accelerate internationalization by leveraging inter-organizational relationships, allowing them to access market knowledge and resources from network partners (Johanson & Mattsson, 1988). Similarly, in resource-based internationalization models, knowledge is considered a strategic resource that underpins a firm's competitive advantage (Barney, 1991).

Economic-based theories also emphasize the role of knowledge, though in different ways. For example, in the international product life cycle theory, technological knowledge is a firm's competitive advantage, driving the sequential relocation of production to foreign markets (Vernon, 1966). In Hymer's theory of firm-specific advantages, knowledge includes technological capabilities, market intelligence, and managerial expertise, which allow firms to offset the liabilities of foreignness (Hymer, 1960). Moreover, internationalization theory is fundamentally based on the argument that firms internalize transactions when knowledge markets are imperfect, particularly in cases involving tacit or proprietary knowledge (Buckley & Casson, 1976). Finally, Dunning's eclectic paradigm incorporates knowledge as part of ownership-specific advantages, which include information asymmetries, managerial expertise, and proprietary technology (Dunning, 1988).

From this analysis, it is evident that knowledge is a key unifying factor across different conceptual frameworks of firm internationalization.

Another significant observation is that international entrepreneurship theory serves as a central nexus connecting different internationalization frameworks. As Mtigwe (2006) suggests, international business can be understood as a process by which firms pursue competitive advantage in imperfect markets by leveraging specialization, strategic protection, and entrepreneurial networks. In this sense, international entrepreneurship is not just a subset of internationalization research but a broader framework encompassing the core aspects of firm internationalization.

Three levels of analysis reinforce the centrality of international entrepreneurship:

- Entrepreneurial behavior as the foundation of internationalization: International entrepreneurship emphasizes risk-taking, opportunity recognition, and proactive market entry, which are essential components of all firm internationalization strategies.
- Entrepreneurship as the primary driver of internationalization: Entrepreneurs play a critical role in shaping firm internationalization strategies, making strategic decisions on market selection, entry modes, and international expansion pathways.
- Entrepreneurship as a missing element in existing frameworks: While economic and process-based theories focus on structural and organizational factors, they often overlook the role of entrepreneurs as agents of internationalization. By incorporating entrepreneurship, the internationalization process can be understood in a more comprehensive and dynamic manner.

A Comprehensive Conceptual Framework for Firm Internationalization

Based on the above analysis and following the integrative framework proposed by Mtigwe (2006) and Etemad et al. (2001), this paper constructs a comprehensive conceptual framework for firm internationalization. This framework integrates insights from multiple theoretical perspectives, emphasizing entrepreneurial, firm-level, and market-level factors that drive internationalization.

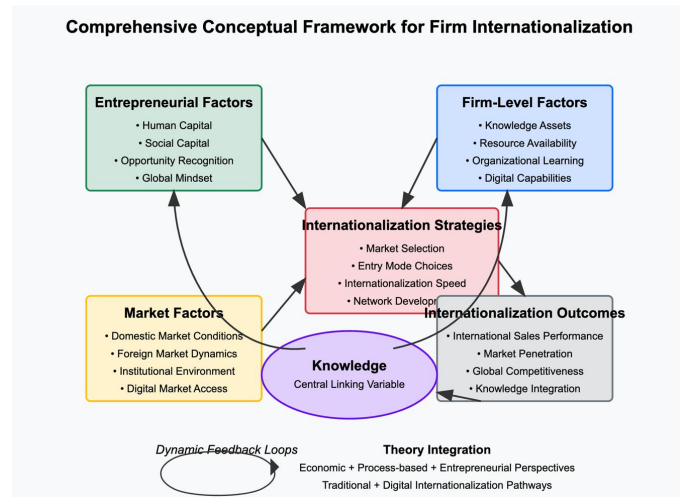


Figure 1. Key Components of the Framework

Entrepreneurial Factors

- Human capital: International experience, managerial knowledge, and global mindset are critical entrepreneurial attributes that influence internationalization decisions. Entrepreneurs with prior international exposure can more effectively identify and exploit cross-border opportunities, reducing perceived risks (Daily et al., 2000).
- Social capital: Professional networks and business relationships facilitate market entry by providing access to resources, knowledge, and legitimacy in foreign markets. The strength and diversity of an entrepreneur's social networks quantifiably impact internationalization speed and market selection (David & Lebbmann, 2006).
- Opportunity recognition: The ability to identify and evaluate international opportunities represents a core entrepreneurial capability. Entrepreneurs with strong opportunity recognition skills can identify profitable market niches that others overlook (McDougall, 1989).
- Global mindset: Entrepreneurs with a global mindset perceive the world as their marketplace from inception, enabling them to pursue international opportunities regardless of resource constraints (Andersson, 2000).

Firm-Level Factors

- Knowledge assets: Firm-specific knowledge (including technological expertise, market intelligence, and operational know-how) serves as a foundation for international competitive advantage. Knowledge assets can be further categorized as: Explicit knowledge (codified information), Tacit knowledge (embedded in organizational routines), Technical knowledge (product/operational expertise), Market knowledge (customer/competitive insights).
- Firm size and resource availability: Financial resources, human capital, and organizational slack influence a firm's capacity to internationalize. While resource constraints can limit internationalization options for SMEs, they can also encourage innovative entry strategies (Westhead et al., 2002).
- Organizational learning and adaptability: The capacity to absorb new knowledge and adapt to foreign environments is critical for successful internationalization. Firms with strong learning capabilities exhibit greater resilience in unfamiliar markets (Eriksson et al., 1997).
- Digital capabilities: In the digital era, a firm's technological infrastructure and digital business models significantly influence its ability to access global markets. Digital capabilities can compress traditional internationalization stages and enable virtual market presence (Coviello et al., 2017).

Market and Environmental Factors

- Domestic market conditions: Factors such as market size, growth rate, and competitive intensity in the home market can either push firms to internationalize (e.g., small, saturated domestic markets) or delay international expansion (e.g., large, growing domestic markets).
- International market dynamics: Foreign market attractiveness, competitive landscape, and psychic distance influence market selection and entry mode decisions. Markets with lower psychic distance typically serve as initial entry points for less experienced firms (Johanson & Vahlne, 1993).
- Regulatory frameworks and institutional environments: Government policies, legal systems, and cultural norms shape the rules of the game in international markets. Institutional distance between home and host countries creates additional complexities that firms must navigate (Dunning, 1988).
- Industry structure: The degree of globalization within an industry influences firm internationalization patterns. Highly globalized industries exert stronger pressure on firms to expand internationally to remain competitive (Larrinaga, 2010).

Internationalization Strategies

- Market selection and entry mode choices: These represent the operational decisions through which internationalization is executed. Entry mode decisions range from low-commitment (export) to high-commitment (wholly-owned subsidiary) options, with firms typically increasing commitment as they gain experience (Johanson & Vahlne, 1977).
- Internationalization speed and expansion pathways: The pace and sequence of international market entry vary significantly across firms. Traditional models suggest gradual expansion, while international entrepreneurship perspectives recognize the possibility of rapid internationalization (McDougall et al., 1994).
- Product and service adaptation strategies: The degree to which firms standardize or adapt their offerings for international markets influences their global competitiveness. This decision is affected by industry characteristics, cultural distance, and the firm's strategic objectives (Dunning, 1988).
- Network development strategies: Building and leveraging relationship networks facilitates internationalization by providing access to resources, knowledge, and opportunities in foreign markets (Johanson & Mattsson, 1988).

Internationalization Outcomes

- International sales performance: Quantifiable metrics such as foreign sales ratio, international revenue growth, and geographical market diversification provide tangible indicators of internationalization success.
- Market penetration levels: The depth of market penetration (market share, customer base) in foreign markets indicates the effectiveness of internationalization strategies.
- Long-term global competitiveness: Sustainable competitive advantage in international markets represents the ultimate goal of internationalization. This includes the ability to defend market positions against global competitors and adapt to changing market conditions.
- Knowledge integration and organizational learning: The accumulation and integration of market knowledge represent critical intangible outcomes of internationalization, feeding back into the firm's knowledge base for future strategic decisions.

Dynamic Interactions and Feedback Loops

A critical feature of this comprehensive framework is the consideration of dynamic interactions between components. The relationship between entrepreneurial and firm/market factors is particularly important:

- Entrepreneurial-Firm Interaction: Entrepreneurial vision shapes organizational capabilities, while firm resources constrain or enable entrepreneurial ambitions. The impact of entrepreneurial social capital on internationalization speed can be quantified through network analysis metrics such as network size, diversity, and strength of ties (David & Lebbmann, 2006).
- Firm-Market Interaction: Market conditions influence resource allocation decisions, while firm capabilities determine which markets are viable targets. Firms with strong digital capabilities can overcome traditional market entry barriers, enabling faster internationalization even with limited resources (Coviello et al., 2017).
- Knowledge Accumulation Dynamics: Knowledge serves as the central linking variable in the framework, with internationalization outcomes creating feedback loops that enhance the firm's knowledge base. This cyclical process explains how firms progressively reduce uncertainty in international operations (Eriksson et al., 1997).

The comprehensive framework proposed in this study incorporates feedback loops to account for the dynamic nature of internationalization. Internationalization outcomes influence firm strategy and resource allocation, which in turn shape future internationalization pathways. This recursive model acknowledges that internationalization is not a linear process but a continuous cycle of learning, adaptation, and strategic decision-making.

Unlike earlier frameworks that focused on either large multinational corporations (economic theories) or gradual internationalization processes (process theories), this model integrates both perspectives while incorporating entrepreneurial agency as a key driver of international expansion.

Boundary Conditions and Contextual Limitations

While the proposed framework aims to be comprehensive, it is important to acknowledge its boundary conditions:

- Firm Type and Size: The relative importance of framework components varies based on firm characteristics. For large MNCs, firm-level resources may dominate, while for SMEs, entrepreneurial factors may be more critical (Westhead et al., 2002).
- Industry Context: The framework may require adaptation for specific industry contexts. Knowledge-intensive industries may prioritize different factors than manufacturing or service sectors (Larrinaga, 2010).
- Geographical Context: The model may have varying applicability across different regional contexts. Emerging market firms, for instance, may face unique institutional constraints that alter internationalization pathways (Andersson, 2000).
- Non-Profit and Social Enterprises: The framework primarily addresses for-profit organizations. Additional considerations would be necessary for non-profit organizations or social enterprises with different strategic objectives.

Conclusion

This paper first reviewed the theoretical foundations of firm internationalization, categorizing existing research into economic-based and process-based approaches. Through a systematic literature review, we examined the conceptual frameworks that have shaped firm internationalization studies, highlighting their respective strengths and limitations. Finally, the paper proposed a comprehensive conceptual framework, integrating insights from international entrepreneurship, strategic management, resource-based theory, and network theory.

Three major contributions of this study are:

- Identifying knowledge as a key linking variable across internationalization frameworks: Knowledge plays a central role in economic, process, and entrepreneurship-based

internationalization theories. Our detailed classification of knowledge types (explicit/tacit, technical/market, experiential/objective, institutional) provides a unifying perspective on firm internationalization and establishes a foundation for more nuanced empirical investigations.

- Positioning international entrepreneurship theory as a bridge between different conceptual frameworks: By placing the entrepreneur at the core of the internationalization process, this study offers a more holistic and dynamic understanding of how firms expand internationally. This approach addresses a significant gap in existing literature, which has often underemphasized the role of entrepreneurial agency in internationalization decisions.
- Developing a comprehensive framework that accommodates digital internationalization: Our framework explicitly incorporates digital capabilities and market access as key variables, addressing an important limitation of traditional internationalization models that were developed before the digital revolution. This integration enables researchers to study both conventional and digital internationalization pathways within a unified theoretical framework.

Managerial Implications

Beyond its theoretical contributions, this study offers several practical implications for managers and policymakers:

- Knowledge Management Strategy: Managers should develop systematic approaches to acquiring, integrating, and leveraging different types of knowledge throughout the internationalization process. Particular attention should be paid to balancing experiential and objective knowledge sources.
- Entrepreneurial Capability Development: Organizations should cultivate entrepreneurial capabilities at multiple levels, not just among founders or top management. This includes fostering a global mindset, developing international networks, and enhancing opportunity recognition skills across the organization.
- Strategic Flexibility: Rather than following a predetermined internationalization pathway, firms should maintain strategic flexibility, adapting their approach based on market conditions, firm capabilities, and entrepreneurial vision. This may involve simultaneously pursuing different internationalization strategies in different markets.
- Balancing Knowledge Accumulation and Speed: Managers face important trade-offs between gradual knowledge accumulation and rapid market entry. Our framework suggests that these approaches are not mutually exclusive; firms can accelerate internationalization by leveraging external knowledge sources while developing internal knowledge capabilities.
- Digital Transformation: As digital technologies continue to transform internationalization pathways, firms should invest in digital capabilities that enable virtual market presence and reduce the resource requirements for international expansion.

Limitations and Future Research Directions

While this paper provides a comprehensive framework for understanding firm internationalization, several questions require further investigation:

- Variable Interactions: Are all proposed variables equally influential in internationalization decisions? How do their relative importance vary across different contexts? Future research should employ configurational approaches to identify effective combinations of factors that lead to successful internationalization outcomes.
- Dynamic Evolution: How do different variables interact dynamically over time? Longitudinal studies are needed to capture the temporal dimensions of internationalization processes and understand how firms adapt their strategies as they gain international experience.

- Measurement and Empirical Validation: How can we operationalize the proposed variables for empirical testing? Researchers should develop and validate measurement scales for key constructs in the framework, particularly for entrepreneurial factors and knowledge types.
- Digital Internationalization: How do digital platforms and technologies fundamentally alter internationalization patterns? Research is needed to understand how digital capabilities interact with traditional internationalization factors and potentially create new pathways to global markets.
- Contextual Variations: How does the framework apply across different industry, geographical, and institutional contexts? Comparative studies should examine internationalization patterns among firms from both developed and emerging economies, across diverse industry sectors, and in both traditional and digital contexts.
- Performance Implications: To what extent do internationalization performance outcomes shape future strategic choices? Research should explore how firms adapt their internationalization strategies based on performance feedback and how this creates path dependencies in internationalization trajectories.

Future research should also explore the application of this framework to emerging phenomena such as digital platform-based internationalization, service-sector internationalization, and the international expansion of social enterprises. Additionally, the rapid evolution of digital technologies suggests a need for continuous refinement of internationalization theories to capture new forms of international business activities.

In conclusion, this paper contributes to international business literature by proposing an integrative framework that accommodates diverse internationalization pathways while identifying knowledge as a central unifying construct. By bridging economic and process-based perspectives and incorporating entrepreneurial agency, the framework provides a more comprehensive understanding of firm internationalization in the contemporary global business environment.

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Statements and Declarations

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About the Authors

Jiaying Huang

Shanghai Jiguang Polytechnic College, China

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Citespace-based Research on English Writing Instruction as a Foreign Language in China from 1995 to 2025

Nana Han^{1*}

¹Capital Normal University, China

*Corresponding author: hannana1025@163.com

Abstract

In recent years, the teaching of writing in English as a foreign language (EFL) has become a prominent and recurring research theme in education. Despite this growing interest, previous studies have not provided an overview of the current state of research on EFL writing instruction from a bibliometric perspective. This paper presents a comprehensive review of writing instruction in China, encompassing the period from 1995 to 2025. The study is grounded in a systematic analysis of extant literature and data, drawing upon the insights of leading experts in the field, and provides valuable insights for the visual analysis of research on EFL writing instruction. The study found that: 1) Academic interest in and research on the teaching of English writing has increased significantly over the past three decades as the status of English as an international language has improved, and it is expected that the number of publications will continue to grow in the future. 2) Research on the teaching of English writing is highly concentrated in the hands of a small number of high-producing researchers and institutions, and these core members dominate the direction of the field, with relatively little related research activity in China. 3) Despite the existence of some close-knit groups, collaboration among high-producing authors in Chinese research on the teaching of English writing is still limited, with most research activities confined within institutions and little cross-regional collaboration. 4) Keyword analyses demonstrate that the focus of research on the teaching of English writing has gradually shifted from foundational issues to students at different stages of their education, and has begun to focus on the application of emerging pedagogical methodologies and technologies, with an emphasis on the new curriculum standards and modern educational themes such as core literacy.

Keywords: English as a Foreign Language (EFL), writing instruction, research review, China

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Introduction

The teaching of English as a foreign language (EFL) writing plays a crucial role in promoting learner development and has been a prominent and recurring research topic in education (Cortazzi & Jin, 2002; Zhang & Shi, 2023). It is widely recognised that English reading teachers face considerable challenges in their pedagogical practice of writing (Wang & Gao, 2008; Atkinson, 2003; Yang, 2018).

These challenges stem from the need to understand not only the intricacies of writing and teaching methods, but also the need to have a deep understanding of students' characteristics and educational backgrounds (Silva, 1993). Overall, the field of English writing instruction has been extensively explored through a variety of approaches, and a number of studies have attempted to assess previous research in the field from different perspectives. Nevertheless, it is noteworthy that bibliometric analyses have not yet been employed to investigate this specific domain.

In the context of the advancement of international bilingual writing research, China has also demonstrated an increased focus on the innovation and development of English writing teaching models. In an effort to integrate language transmission and output, researchers have devised the "listening, speaking and writing as one writing teaching model" (Chen & Xiao, 2012). In order to explore and implement the English teaching mode in a digital environment, researchers have developed the "experiencing English as a writing teaching resource platform" (Wang, 2014). In order to cultivate students' creative thinking ability and enliven the classroom atmosphere, the researchers applied the "brainstorming

method" in English writing teaching (Zhang et al., 2015). In order to stimulate students' awareness of learning language knowledge independently and solve the problems of English writing, the researcher constructed a "writing teaching corpus" (Wang, 2014). In order to cultivate students' critical thinking, the researcher has constructed a teaching model of "Writing Critical Thinking Integration" (Yu, 2014). The "process genre teaching method" (Xu, 2014) has been proposed to ensure the positive influence of formative assessment on the teaching of English writing, despite the existence of a variety of effective methods to improve students' writing skills and language proficiency. The recently published English Curriculum Standards for Senior Secondary Schools call for the English curriculum to be adapted to align with the cognitive development of senior secondary school students and their academic needs. The new standards emphasise the advancement of students' comprehensive language skills, with a focus on enhancing their ability to acquire, process, analyse, and solve problems in English. Additionally, the standards underscore the necessity of fostering students' capacity to think and express themselves in English. Consequently, the utilisation of scientific, effective and diversified assessment programmes to enhance students' writing ability emerges as a pivotal concern in high school English instruction under the revised curriculum standards, thereby presenting a substantial challenge to English educators.

Bibliometric analyses are recognised for their advantages over meta-analyses (Suseelan et al., 2022) and have significant value as a tool for researchers to identify research priorities and gain new perspectives (Singh, 2022). The use of such analyses is critical to gaining a deeper understanding of the research landscape regarding the teaching of English writing. Despite the attention given to

certain aspects of English writing instruction, limited efforts have been made to quantitatively describe the national research landscape in this area through a bibliometric lens. In order to comprehend the trajectory of this field of research, it is imperative to consider collaborative networks, influential authors and journals, and keyword structure, as these elements are considered integral indicators of understanding the overall research landscape (Singh, 2022). The present study aims to provide comprehensive insights into the current state of research on the teaching of English writing. This objective is twofold: firstly, to facilitate knowledge dissemination, and secondly, to guide future research efforts. In order to achieve this, the study addressed five key research questions, as outlined below.

RQ1:What trajectory can be identified in the field of EFL writing instruction over the past thirty years?

RQ2:Which authors have demonstrated the highest productivity in their contributions to research on the teaching of EFL writing?

RQ3:Which organisations have demonstrated the highest productivity in their contributions to research on the teaching of EFL writing?

RQ4:What is the most popular topic focus in research on teaching EFL writing?

Methodology

This study employed a bibliometric analysis to explore the historical advancements in the domain of English writing instruction. The analysis is predicated on data retrieved from CNKI, which serves as the primary publication repository for this study. To ensure a comprehensive understanding of this trend, a 30-year timeframe was selected, taking into account the well-established history of English writing instruction. Bibliometric analysis, also known as scientific mapping, is a quantitative and graphical method for examining a wide range of literature within a specific scientific field (Singh, 2022; Archambault, 2006). This analytical technique offers the advantage of describing research trends and foci, thus providing new knowledge for the respective fields and disciplines. It is noteworthy that bibliometric analyses contribute to a more systematic, transparent and reproducible assessment, as highlighted by Behl et al. (2022). In the field of education, an increasing number of researchers have recognised bibliometric analysis as a scientific tool to statistically assess research performance and gain valuable insights into the academic progress made by the research community (Chen, 2023; Lei, 2019; San, 2024; Baker, 2020).

Furthermore, China Knowledge was selected on account of its comprehensive collection of peer-reviewed scientific literature. Comprising almost 8,000 academic journals from a range of disciplines, the database offers a substantial repository of scholarly resources. As of November 2024, the database contains more than 60.6 million documents in Chinese academic journals and 120 million documents in foreign academic journals. It is noteworthy that this database is widely regarded as a high-quality data source within China, frequently relied upon as a reliable repository for conducting review studies. Consequently, the utilisation of data from the CNKI is regarded as both appropriate and reliable for conducting rigorous bibliometric analyses.

Search criteria

The present study conducted a detailed search using the specified search terms: “title (‘teaching’ or ‘teacher’) and (‘writing’) (‘English as a foreign language’ or ‘EFL’) and (‘primary and secondary’)”. This search retrieved 1325 documents, all of which were extracted on 6 January 2025. Of these, 566 were from Journals, including 1,606 Authors and 1,229 Institutions.

Data analysis methods

The bibliometric data retrieved from the CNKI database were exported to generate TXT files for Citespace analysis. These files contained the author name, article title, year of publication, source title, affiliation, abstract and author keywords. This extensive dataset was then utilised to address the five research questions posed in this study. For the purpose of data analysis, a computer software program that is recognised for its ability to analyse the potential knowledge contained within the scientific literature was utilised. This software is capable of presenting the structure, patterns and distribution of scientific knowledge through visualisations, which are also known as “scientific knowledge maps”. At present, CiteSpace is widely used in the writing of review papers, and the search results of China Knowledge Information Network (CNKI) show that the number of papers published by CiteSpace has been growing rapidly every year, and will be close to 3,000 in 2022.

By mapping the collaboration between authors, institutions, and countries, it facilitates analysis of the core researchers and geographical distribution of the field, and can reveal the research collaboration groups through cluster analysis. The citation relationship between journals is utilised to derive journal co-citation mapping, thereby facilitating the identification of significant journals within the field based on their citation frequency. The utilisation of keywords enables the reflection of the thematic content of papers. The co-occurrence analysis of high-frequency keywords is employed by CiteSpace to reveal the core themes of the field, thereby enabling a swift overview of the research to be provided. The application of the word frequency burst detection function facilitates the identification of emergent keywords across diverse years, thereby enabling the comprehension of the evolution of prominent subjects. The identification of key documents, such as those with high citation rates, those which are emerging, and those with high centrality in the literature network, facilitates a rapid understanding of the development of research themes. The presence of highly cited literature in a field is indicative of the focus of scholars’ attention. CiteSpace employs co-citation analysis of highly cited literature to identify cutting-edge directions, and combines this with timeline views to gain insights into the development of the field.

In order to visualise the results of the study, the use of Microsoft Excel and tables was also employed. The utilisation of these tools enabled a comprehensive examination and interpretation of the data. Specifically, the study first employed publication number data from the dataset to indicate publication trajectories in the field of EFL writing instruction research. Subsequently, the data were graphically depicted using Microsoft Excel to provide a visual representation of the annual publication frequency in the field.

Results

Publication trajectories in the teaching of English writing

As illustrated in Figure 1, the publication trajectory in the field of teaching EFL writing from 1994 to 2025 can be summarised as follows. It is noteworthy that 2023 has the highest number of publications, with 139 research articles. It is closely followed by 2022 with 130 publications and 2021 with 120. In contrast, the number of publications remained relatively low until 2004, with fewer than 10 publications. However, from 2005 onwards, there was a marked and substantial increase in the number of publications, with some fluctuations during this period and a gradual decline after reaching a peak in 2023. The trajectory of research output in this area has shown a positive trend in recent years.

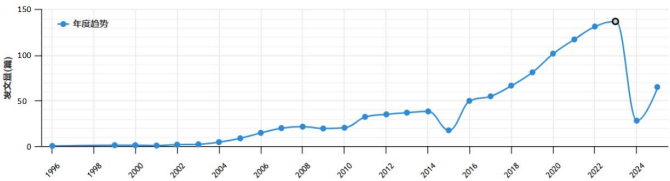


Fig.1. Publication trajectory of EFL reading instruction from 1996 to 2024.

Specifically, from 1996 to 2014, the number of publications exhibited a consistent year-on-year increase, but in 2015, the number of papers declined. Thereafter, the number of publications began to demonstrate a significant increase until it peaked in 2023, after which the overall number declined again in 2024, with the number of papers expected to rise in 2025, though not to exceed the number of papers in 2023. Consequently, the investigation of writing instruction has emerged as a prevalent research trajectory in recent years. Within primary and secondary education, teachers allocate greater emphasis to reading instruction, while writing instruction is comparatively neglected. Despite the extensive research conducted on writing instruction, it remains a challenging aspect in the classroom. Consequently, there is an imperative for sustained research in this domain, although the translation of research findings into practical teaching applications remains a challenge.

Authors of highest productivity and impact

Table 1 provides a concise overview of the ten most prolific authors in the domain of English writing, who have made substantial contributions to the field. This analysis encompasses a total of 1,606 authors. The author co-occurrence mapping analysis reveals that the most prolific researchers in this field are Tang Jinlan, Yue Peng, and Wang Na, who have each published four research papers. They are closely followed by Yan Wang, Danyan Lin, Wuwei Pan, Xiaoying Fa, Ying Wang, Shibao Zhou, Jinfen Xu, and Zhijing He, who have published three papers each, and the rest have a large number of authors who have published two research papers. Domestic studies on English writing teaching are comparatively rare, with a small number of members assuming a pivotal role.

The Citespace software was utilised to select NodeTypes for the author of the visual mapping analysis, as illustrated in Figure 2. The text in the upper left corner of the figure shows the relevant data, of which “N=191, E=52” two data. The “N” represents the node, that is, the position of the author appears node author’s name, the larger the font size, indicating that the author appears in the 1325 data in the higher frequency, “E” represents the link, the link between the node represents the link between the authors, the thicker the line, indicating that the more frequently they appear in the same document, which shows the co-operation between authors. The author cooperation map comprises 191 nodes and 52 lines, with some authors demonstrating a greater degree of interconnectedness, as illustrated in the figure. As illustrated in Figure 3, the authors who collaborate closely can be divided into four distinct groups: Yang Luxin, Zhang Lintao, Li Chen, and others; Tmurry Nathaniel, Deng Lin, and others; Wu siyuan, Ding Yonghua, and others; and Jiang Minhao, Chen Shuting, and others.

Table 1 Effective authors in the study of English writing instruction.

Count	Centrality	Year	Authors
4	0.00	2011	唐锦兰

4	0.00	2010	岳鹏
4	0.00	2010	王娜
3	0.00	2012	徐锦芬
3	0.00	2010	林丹燕
3	0.00	2018	潘鸣威
3	0.00	2010	法小鹰
3	0.00	2015	王莹
3	0.00	2002	周仕宝
3	0.00	2022	王焱
3	0.00	2005	何智

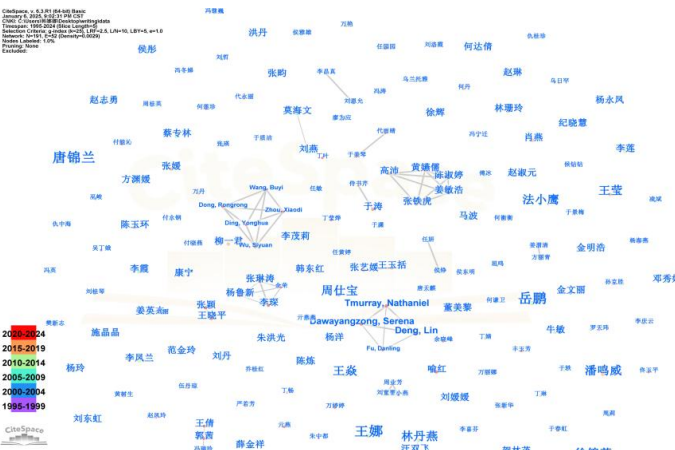


Fig.2. The network visualization map of authors



Fig.3. The network visualization map of authors in detail

Institutions with the highest productivity and impact

As demonstrated in Table 2, of the 1,229 institutions analysed, those with a minimum of three articles published demonstrate notably high productivity in the domain of English writing instruction. The larger the font size of the institution's name in the institution collaboration graph, the more frequently the institution appears in the 1325 data, as illustrated in Figure 4. The letter "E" in the graph denotes a connecting line, and the thickness of this line indicates the frequency with which the institutions appear in common literature. According to the description in the upper left corner, "N=214, E=28", it can be seen that the cooperation between institutions is still relatively close. The analysis of the table produced by the institutional cooperation mapping reveals that the main research institutions (i.e. those with a high number of publications) in this field are Beijing Foreign Studies University, Shanghai International Studies University, Huazhong University of Science and Technology, and Beijing Jiaotong University. It is noteworthy that Beijing Foreign Studies University has the distinction of having published eight articles in this research area, which is the highest number of publications. Shanghai International Studies University followed closely behind, with a total of five publications in this field.

Table 2 Top 10 most prolific organisations in research on the teaching of English writing.

Count	Centrality	Year	Institutions
8	0.00	2009	北京外国语大学
5	0.00	2011	上海外国语大学
4	0.00	2005	华中科技大学
3	0.00	2006	北京交通大学
2	0.00	2009	华中师范大学
2	0.00	2007	重庆大学
2	0.00	2011	广东外语外贸大学
2	0.00	2012	对外经济贸易大学
2	0.00	2007	北京师范大学
2	0.00	2010	安徽科技学院

Furthermore, with regard to institutional collaboration, it is evident that only a number of institutions engage in cooperation with authors, with the majority collaborating exclusively with authors from their own institution. The institutions that have established cooperation with foreign institutions, as demonstrated in Figure 4, include the University of Michigan-Shanghai Jiao Tong University Joint Institute, the University of Florida, the Southern University of Science and Technology, Beijing Normal University, and others. Within the domestic university sector, collaboration has been observed between authors from Beijing Foreign Studies University, Huazhong University of Science and Technology, and University of International Business and Economics. Additionally, there has been cooperation between authors from Shanghai International Studies University and Nanjing Normal University in the publication of academic papers. However, it is evident that there is a greater degree of collaboration

between research institutes operating within the same geographical region, as opposed to collaboration across different regions.



Fig.4. Institutional collaboration mapping

Topical Foci

The utilisation of keywords is of paramount importance in the identification of research priorities and trends within a specific field. Visual analyses through Citespace successfully identified hotspots in the field of research on teaching English writing. A total of 85 keywords were identified as appearing more than five times, thus representing the prominent research areas in the field (see Figure 5). In the visualisation, each node represents a different keyword, with larger nodes indicating a higher frequency of occurrence in the dataset. Of particular note is the node labeled "English writing", which occurs 529 times. This is followed by the nodes representing "reading followed by writing" and "negative transfer", respectively, which also show a high frequency of occurrence in the dataset. In addition, smaller nodes, denoting concepts such as "error analysis", "mother tongue", "response", and so forth, demonstrate a frequency of more than 70 occurrences.

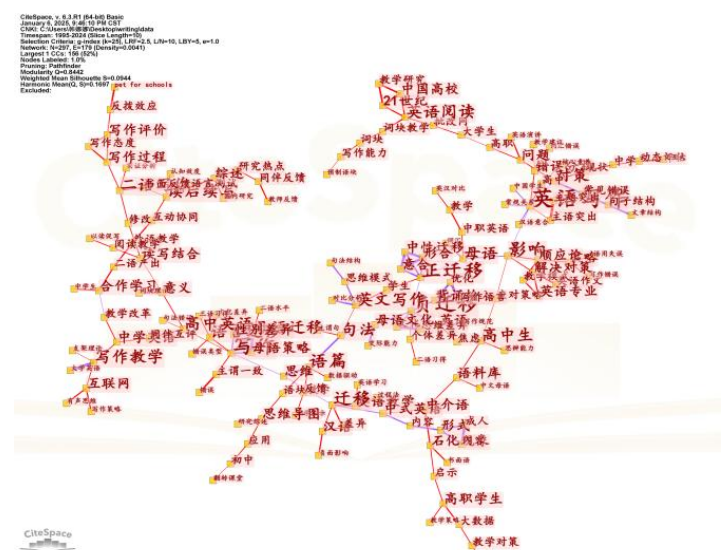


Fig.5. Network visualisation of keyword co-occurrence (occurrence threshold ≥ 5)

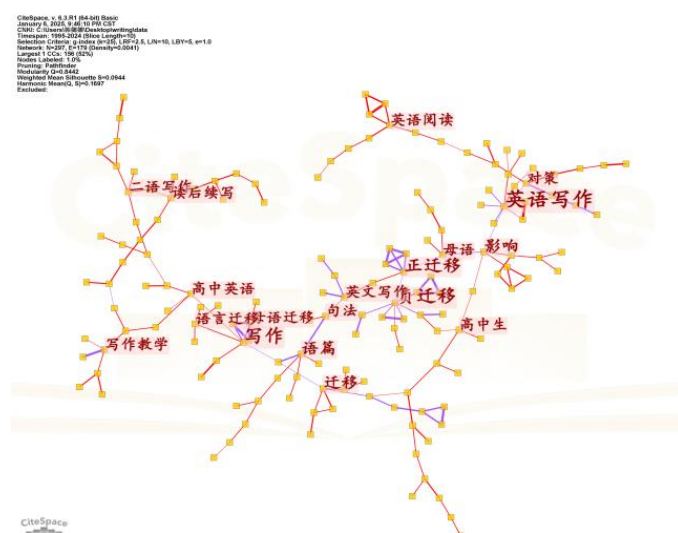


Fig.6. Network visualisation of keyword co-occurrence (occurrence threshold ≥ 10)

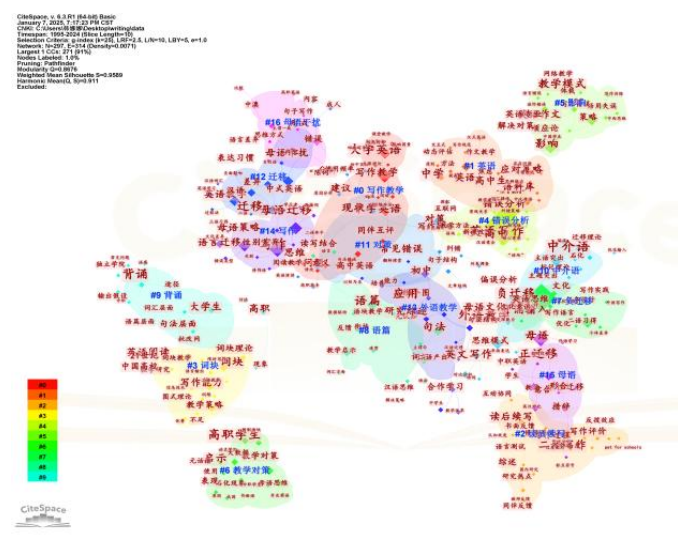


Fig.7. Keyword clustering mapping

As demonstrated in Figure 7, the keyword co-occurrence network, which has been segmented into 16 irregular regions, is clearly evident. Each region corresponds to a specific label, with the numerical value assigned to the front of each label denoting the number of keywords contained within the respective item. Each

cluster within the network consists of multiple closely related words. Within this network, two values, Q value and S value, require particular attention. It is generally accepted that: Modularity clustering module value (Q value), it is generally accepted that $Q > 0.3$ means that the clustering structure is significant, Silhouette clustering average profile value (S value), it is generally accepted that $S > 0.5$ clustering is reasonable, $S > 0.7$ means that the clustering is convincing. In the present keyword clustering profile, $Q = 0.8676$ and $S = 0.9589$, indicating that the clustering structure is significant and the results are convincing. Each cluster contains a decreasing amount of literature from small to large values. The initial 10 clusters, as indicated by the relevant data, facilitate the identification of the research domains of the primary research circle on writing instruction in China. Through integrated analysis, the research on writing instruction in China can be categorised into The first area is the perspective of teaching and learning strategies (teaching writing, reading and writing, word blocks, discourse); the second area is language acquisition and transfer as a perspective. The second perspective is that of language acquisition and transfer, encompassing the notions of negative transfer and mother tongue interference. The third perspective pertains to language analysis and assessment, including error analysis, influence, rote learning, and English. The final perspective focuses on strategies and countermeasures, such as the use of a mediator language, countermeasures to teaching, foreign language teaching, and writing.

The largest cluster, indicated by the colour red, encompasses 21 items, including “peer assessment”, “reading and writing integration”, “suggestions”, “questions”, “meaning”, and others. The term “meaning” is indicative of the research theme of focusing on reading for writing and writing assessment in writing instruction. The second group, represented by the colour orange, showed larger nodes, such as “reading followed by writing”, “writing attitude”, “peer feedback” and “interactive collaboration”, indicating an emphasis on peer collaboration. This finding suggests that collaborative peer learning has a significant impact on improving learning outcomes. The yellow cluster, which is characterised by prominent nodes such as “writing skills”, “instructional strategies”, and “word block theory”, signifies an area of focus on the literacy competencies of English learners. The green cluster consists of nodes on “error analysis”, “vocabulary errors”, “error correction strategies”, and “core literacy”. These nodes thus represent areas of research on error correction strategies. The light green cluster, which consists of 17 items, features significantly larger node sizes for the concepts of “influence”, “conformism” and “instructional model”, thereby reflecting the research focus on student-centred pedagogical research priorities. Conversely, the dark green clusters are characterised by nodes for “revelation”, “performance”, “thinking in the mother tongue” and “petrified phenomenon”. The latter are characterised by nodes indicating that the study focuses on teaching strategies chosen to cope with the difficulties that students have in writing. Finally, the smallest cluster, indicated in pink, is characterised by the nodes “language differences”, “thinking styles” and “target language”, which suggests that the focus of the study is on improving writing proficiency and language authenticity.

As demonstrated in Figure 8, the timing of the emergence of keywords in the field of English writing instruction can be traced over the years. The interpretation of keyword emergence can be approached from multiple perspectives. Firstly, the keywords that emerged earlier include discourse, negative transfer, thinking mode, etc., indicating that researchers have started to pay attention to the students’ thinking process in the process of writing earlier. Secondly, the words that emerged for the longest time, including discourse, college English, negative transfer, etc., This finding suggests that researchers have been focusing on the study of writing instruction for a longer period of time on the students of English majors. Thirdly, some words with a high emergence

intensity appear in the middle, including high school, junior high school, reading and subsequent writing, etc. This finding indicates that the focus of the research has gradually shifted to junior high and high school students. Fourthly, the words with a more recent emergence time, including reading and subsequent writing, corpus, and second-language writing, etc., are the ones that have attracted more attention from researchers in recent years.

Top 12 Keywords with the Strongest Citation Bursts

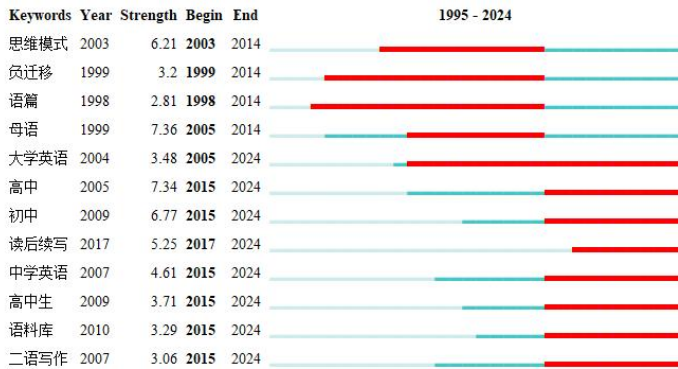


Fig.8. keyword bursting map

Table 3 Keywords in the field of English writing (threshold of occurrence ≥ 20)

Count	Centrality	Year	Keywords
529	0.19	1999	英语写作
273	0.13	1999	负迁移
83	0.25	1998	写作
77	0.01	2005	错误分析
71	0.15	1999	母语
61	0.13	2003	对策
59	0.03	2004	写作教学
50	0.01	2002	母语迁移
44	0.01	2005	高中
41	0.02	2005	语言迁移
40	0.23	1999	影响
36	0.01	2007	策略
34	0.01	2003	思维模式
32	0.01	2005	英语教学
32	0.20	1998	语篇

31	0.12	1999	中式英语
29	0.00	2007	二语习得
28	0.00	2004	大学英语
27	0.01	2007	写作能力
26	0.13	2007	中介语
25	0.02	1999	英语
25	0.13	1998	迁移
24	0.18	2003	句法
23	0.01	2005	教学对策
22	0.00	2006	教学策略

Discussion

Firstly, the findings suggest that over the past three decades, there has been a growing academic interest in the area of research on the teaching and learning of English as a foreign language. This growing interest in English can be attributed to its widespread acceptance as an “international language” or lingua franca (McKay, 2008; Mauranen, 2009), with many non-English-speaking countries requiring their citizens to be proficient in English (Drape, 2012; Lee, 2022). Moreover, the acknowledgement of writing as a pivotal skill for overall success in life has stimulated further research into the pedagogy of English writing. A significant number of scholars have underscored the importance of exploring various aspects of this field. Given the sustained upward trend observed over the past three decades, it is reasonable to anticipate a continuation of this upward trend in the coming years, with a projected increase in publications beyond the levels observed in 2025.

A further significant finding indicates that the domain of research on the pedagogy of English writing is predominantly shaped by a select group of researchers who have exerted a substantial influence on the scholarly evolution of the field through their prolific publication output. These prolific researchers, however, are in limited numbers, and their work reflects the core concerns and trends in the field. Conversely, the research conducted within China on the pedagogy of English writing appears to be limited in scope, which may be indicative of the fact that this particular subject has received comparatively scant attention or investment in resources in China. It is further suggested by these findings that research activities have been focused on a small number of active researchers.

Furthermore, the findings suggest a paucity of collaboration between the most productive and influential authors in China. The utilisation of visual analytical tools in the examination of authors' collaboration patterns has facilitated the identification of collaborative networks within the research community. While the overall level of collaboration among researchers varies, the mapping reveals the presence of some closely collaborating groups, underscoring the significance of collaboration in advancing scholarship. The analysis indicates a notable concentration of research activity, accompanied by a certain diversity in collaboration patterns. This provides a valuable perspective on the

current academic landscape and potential future directions for collaboration and research.

In the context of influential institutions, a number of institutions have demonstrated significant academic productivity in the field of English writing instruction research. A cursory analysis reveals that, while numerous institutions are involved in this field of study, only a limited number have published extensively, thereby suggesting that academic productivity in this domain is predominantly concentrated among a select group of highly productive institutions. These institutions not only enjoy a high level of visibility within the country, but also exhibit a notable degree of interconnectedness, particularly within the same geographic region. The analysis of institutional collaboration mapping reveals that the representation of different institutions as nodes and the connections between them reflect inter-institutional collaborative relationships. The thickness of the connecting lines indicates a higher frequency of co-publication of literature. However, despite the existence of inter-institutional cooperation, the majority of research activities remain primarily confined within the institutions. However, a select few institutions have initiated more active collaborations with other domestic and international institutions, including author co-authorship of publications between prominent universities and with international partners. However, there remains a paucity of cross-regional collaboration, which may reflect current patterns and trends in research collaboration on the teaching and learning of English writing. This suggests potential directions for promoting wider collaboration in the future.

The utilisation of keywords is of paramount importance in the identification of research priorities and trends within a specific domain. Utilising a visual analysis instrument, this study successfully identified the subjects of current interest in research on English writing instruction. The analysis revealed that high-frequency keywords such as “teaching writing”, “reading and writing”, and “negative transfer” underscore the prevailing research directions in this domain. The size of the nodes in the visualisation map is proportional to the frequency of occurrence of the keywords, with the largest nodes representing the most frequently discussed topics in the field, such as “English writing”. This is followed by several other high-frequency terms that also reveal important topics of interest to researchers, such as “error analysis” and “native language influence”. The construction of the keyword co-occurrence network has resulted in the formation of multiple irregular regions, with each region corresponding to a distinct research cluster comprising terms that exhibit a high degree of semantic relatedness. Cluster analyses demonstrate significant structural features and a high degree of plausibility, suggesting that the research topics are strongly related to each other and can be clearly categorised. The clustering results indicate that research on writing instruction in China can be broadly classified into four main areas: “teaching and learning strategies”, “language acquisition and transfer”, “language analysis and assessment”, “language acquisition and transfer”, “language analysis and assessment”, and “strategies and countermeasures”. Each of these areas encompasses a range of perspectives and focuses, ranging from “teaching methods” to “analysing language errors” to “improving students” “writing skills” and solving problems encountered in the learning process. The keywords are also distributed chronologically to demonstrate the enhancement of students’ writing abilities. Furthermore, the temporal distribution of keywords demonstrates the trajectory of research interests. Initial studies concentrated on fundamental issues, such as students’ “thinking patterns” during the writing process. Over time, the focus of research has expanded to encompass student groups at diverse educational levels, including “junior and senior high school students”. In recent years, there has been an increased emphasis on the application of emerging pedagogical methods and technologies, as well as on the development of new and emerging technologies. In recent years, there has been an increased focus on the application

of emerging pedagogical methods and technologies, such as “reading and writing” and “corpus-assisted instruction”. The evolution of keywords is indicative of the development of the research field of English writing teaching and possible future research directions.

Moreover, research in the domain of writing and reading instruction has underscored significant interconnections among emergent themes, including “new standards”, “core literacy”, “reading followed by writing”, “corpus”, and “second language writing”. “corpus”, and “second language writing”. It is indisputable that the establishment of these new standards has exerted a substantial influence on the English language teaching and learning environment, concomitantly presenting heightened challenges to teachers and learners (Cao, 2024).

Conclusion

Utilising scientific mapping techniques, this study provides a comprehensive survey of research in the field of English writing instruction. It investigates the trajectory of publications, contributions and collaborations of influential authors and institutions in terms of productivity, as well as the research priorities identified over the past three decades. The study’s key findings are as follows: 1) Academic interest in and research on the teaching of English writing has increased significantly over the past three decades in response to the rise in the status of English as an international language, and the number of publications is expected to continue to grow in the future. 2) Research on the teaching of English writing is highly concentrated in the hands of a small number of high-productivity researchers and organisations, and these core members dominate the direction of the field, with comparatively little relevant research activity taking place in the country. 3) Despite the existence of some close-knit groups, collaboration among high-producing authors in Chinese research on the teaching of English writing is still limited, with most research activities confined to within institutions and little cross-regional collaboration. 4) Keyword analyses show that the focus of research on the teaching of English writing has gradually shifted from foundational issues to students at different stages of their education, and has begun to focus on the application of emerging pedagogical methodologies and technologies, with an emphasis on the new curriculum standards and modern educational themes such as core literacy.

In addition to providing valuable insights into the growing body of literature in the field of English writing instruction, the present study seeks to guide new researchers by identifying areas of research that merit attention in future studies. The following recommendations are made on the basis of the identified gaps in existing research: 1) It is recommended that future research continue to utilise multiple databases to conduct comprehensive bibliometric analyses. 2) researchers are encouraged to explore other aspects of bibliometric analyses, such as bibliographic coupling and knowledge structures, to gain more in-depth insights. 3) Researchers are encouraged to explore other aspects of bibliometric analyses, such as bibliographic coupling and knowledge structures, in order to gain more in-depth insights.

Limitation

This study offers valuable quantitative insights into the knowledge base of English writing instruction; however, it is necessary to recognise its inherent limitations. A salient limitation pertains to the utilisation of a solitary database for data accumulation, a practice that has the potential to result in the exclusion of pertinent information derived from alternative sources. Furthermore, the study employed Chinese journal articles as the selection criteria, excluding

data journals from other countries, which may have introduced bias.

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About the Authors

Nana Han

Capital Normal University, China

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Analysis of the Influencing Factors on the Development of Rural Folk Sports Culture in the Context of Rural Revitalization --Structural Equation Modeling (SEM) based studies

Xinyun Zhou¹, Yan Jiang^{2*}

¹Tianjin Agricultural University, Tianjin, China

*Corresponding author: jiangy66@163.com

Abstract

The development of rural folk sports culture is an important part of the rural revitalization strategy, which is of great significance to the prosperity of rural culture and the enhancement of rural cohesion. With the help of structural equation modeling (SEM), this paper comprehensively applies various research methods to explore the influencing factors of rural folk sports culture development. By constructing a scientific and reasonable theoretical model, we quantitatively analyze the complex relationship between the potential variables and reveal their inherent mechanisms. It is found that multidimensional factors are intertwined and work together in the development process of rural folk sports culture. Based on this, systematic development strategies are proposed in terms of industrial integration, scientific and technological empowerment, and cultural cultivation, to provide new ideas for the high-quality development of rural folklore sports culture and help villages achieve cultural prosperity and comprehensive revitalization.

Keywords: Rural revitalization; Folk sports culture; Influencing factors; Structural Equation Modeling (SEM)

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Introductory

Promoting the comprehensive revitalization of the countryside is an intrinsic requirement and a necessary path to the realization of Chinese-style modernization, covering a wide range of aspects, including economic, cultural, ecological, and governance aspects. As an important part of rural revitalization, rural cultural revitalization is not only the spiritual impetus for rural development, but also an important way to enhance rural cohesion and cultural confidence. Folk sports culture, as one of the core contents of rural culture, carries rich historical heritage, local sentiment and social value, and is an important carrier of rural cultural inheritance and development. In recent years, with the in-depth promotion of the strategy of rural revitalization, rural folk sports culture has gradually become a hot topic of concern in the academic and practical fields. However, its development faces many challenges, such as insufficient cultural identity, lack of inheritance subjects, low industrialization level, and other problems. How to effectively promote the high-quality development of rural folk sports culture has become an important topic to be solved.

Existing studies generally agree that rural folk sports culture has multiple values in rural revitalization. Lou Gao Yang et al. (2024)^[1] point out that folklore sports culture can promote rural industrial prosperity, help ecological livability, create civilization of countryside, advance effective rural governance, and help to promote affluent life. Peng Jianmin and Han Keli (2024)^[2] further emphasize its significance in promoting rural economic development, enhancing social cohesion, passing on rural culture, and improving residents' physical and mental health. However, the development of rural folk sports culture still faces many difficulties. Lou Gao Yang et al. (2024)^[1] pointed out that the problems of unsound local supporting policies, unoptimized selection of inheritance contents, unstable succession of inheritance talents, and

insufficient innovation of inheritance methods constrain its development. Sheng Keqing and Guo Lili (2024)^[3], on the other hand, analyzed the problems of weakening cultural identity, fading of rituals, slow development of organization, lack of capable people, and low level of industrialization from the theoretical level. Zhao Qingqing (2023)^[7] takes dragon and lion dance as an example, and further points out the specific problems such as insufficient cultural identity, lack of inherited subjects, and low industrialization level. In response to these dilemmas, scholars have proposed a variety of development paths and strategies. Lou Gao Yang et al. (2024)^[1] proposed the paths of improving policy support, digging deep into inheritance resources, building bridges of talents, and innovating inheritance methods. Sheng Keqing and Guo Lili (2024)^[3] proposed to explore the new path of "educating people through literature", explore the new advantages of "emotional energy", and create a new pattern of "pluralistic co-rule" and other strategies. The study also proposes to explore the new path of "educating people through literature", explore the new advantages of "emotional energy", and create a new pattern of "multi-government". Dong Fengwei et al. (2024)^[4] proposed to promote the high-quality integrated development of folk sports industry from the perspective of industrial integration. Ni Jun et al. (2024)^[5] proposed the modern development path of "changing the organization mode and retaining the core form and connotation" through case studies. Liu, Tanqing et al. (2023)^[6] proposed the practical paths of strengthening policy support, improving village self-governance organizations, and enhancing cultural identity from the perspective of rural governance.

Although some studies have comprehensively explored the value, dilemma, path and influencing factors of rural folk sports culture, most of them focus on qualitative analysis and lack quantitative

research on the complex relationship between influencing factors. On the basis of the above research results, this paper, with the help of Structural Equation Modeling (SEM), comprehensively applies various research methods to systematically analyze the influencing factors of the development of rural folk sports culture, constructs a scientific and reasonable theoretical model, quantitatively analyzes the complex relationship between the potential variables, reveals its inner mechanism, and puts forward a systematic development strategy in order to promote contribute to the the high-quality development of rural folk sports culture, and to prosperity and development of rural folk sports culture. It provides theoretical support and practical reference for the prosperity and comprehensive revitalization of rural folk sports culture.

Scale design and research hypotheses

Scale design

Dimension construction

In determining the dimensions of the relevant research results were fully referred to. Many scholars have focused on the policy environment, social participation, economic factors, cultural connotations, and scientific and technological development in their previous studies, which are all closely related to the inheritance and development of folk sports culture and have far-reaching impacts. Based on these research results, the questionnaire was designed around five dimensions: political support, social participation, economic development, cultural value, and scientific and technological application of folklore sports culture. In this study, these five dimensions were chosen to analyze the influencing factors in depth, in order to reveal the internal mechanism of folk sports culture inheritance and development comprehensively and precisely. A Likert scale was used to collect respondents' knowledge and opinions on the influencing factors of folklore sports culture inheritance.

Sample Selection

Residents of different ages, genders, occupations and living areas were selected as samples to ensure that the samples were representative. Stratified sampling was used to cover residents in urban, suburban and rural areas in order to gain a comprehensive understanding of different groups' knowledge of and participation in folklore sports culture.

Issuance and recovery

The questionnaires were distributed through the online platform and field visits, with a total of 370 questionnaires distributed and 315 returned, of which 308 were valid questionnaires, representing a recovery rate of 85%. Distributing the questionnaires through the online platform facilitated the expansion of the scope of the survey, while field visits ensured the quality of the questionnaires and increased the recovery rate of valid questionnaires.

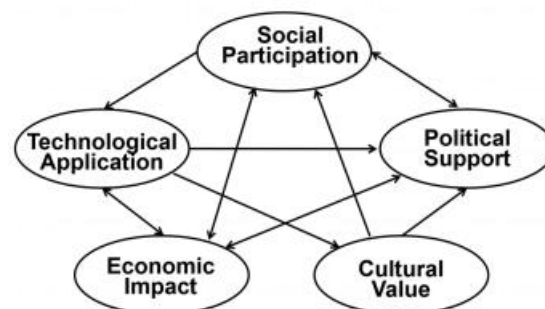
Research hypotheses

This paper proposes a model for analyzing the factors influencing the development of folk sports culture as shown in Figure 1. In the context of rural revitalization strategy, the inheritance and development of folk sports culture are influenced by several factors. This study summarizes these influencing factors into five main dimensions: political support, social participation, economic development, scientific and technological application, and cultural value.

Political support provides the necessary policies and funding and is the cornerstone of cultural transmission. Social participation, on the other hand, increases the vitality of cultural activities and facilitates their dissemination. Economic development drives economic growth through cultural activities and provides the material basis for transmission. Scientific and technological

applications utilize modern technology to increase the visibility and attractiveness of culture. Finally, cultural value is the core of inheritance, which enhances social recognition of folk sports culture. These factors promote each other to form a virtuous circle, jointly promoting the inheritance and development of folk sports culture and injecting vitality into rural revitalization.

Fig. 1 Analytical model of influencing factors for the development of folk sports culture



Based on the previous research, this paper proposes the following hypotheses for the relationship.

- H1: Political support is positively related to social participation.
- H2: Political support is positively related to economic development.
- H3: Social participation is positively related to political support.
- H4: Social participation is positively related to economic development.
- H5: Social participation is positively related to the use of science and technology.
- H6: There is a positive relationship between economic development and political support.
- H7: There is a positive relationship between economic development and social participation.
- H8: There is a positive relationship between economic development and the application of science and technology.
- H9: Cultural values are positively related to political support.
- H10: Cultural values are positively related to social participation.
- H11: There is a positive relationship between technology adoption and political support.
- H12: There is a positive relationship between the use of science and technology and economic development.
- H13: There is a positive relationship between the use of technology and cultural values.

Results of the questionnaire and statistical analysis

Reliability test and testability factor analysis

The Cronbach's Alpha reliability test yielded an overall Cronbach's Alpha value of 0.883 for the questionnaire scale, which indicates that the overall reliability of the questionnaire's scale is high and that the questionnaire was designed with good internal consistency. Based on the Cronbach's a value and the fit index, topic reliability (SMC), average variance extraction (AVE) and combined reliability (CR) provided in the validated factor analysis to determine the fit status of the model to the data, which provides a basis for judging the scale reliability and validity of the study, the detailed results are shown in Table 2.

Validation factor analysis showed that the unstandardized coefficients for each scale entry were significant ($p < 0.001$), and the standardized coefficients were all greater than 0.5, indicating that the question items of the latent variables were well represented. In terms of reliability indicators, the combined reliability (C.R.) of the five dimensions was greater than 0.7; in terms of average variance extraction (AVE), most dimensions were greater than or

close to 0.5, with only the social participation dimension being slightly lower. Overall, the research scales have good reliability and some convergent validity.

Table1. Dimensions and Indicators

Dimension	Item	Indicator
Political Support	1. Do you think the local government's policies for the protection of folk sports culture are comprehensive?	PS1
Political Support	2. How do you evaluate the local government's emphasis on folk sports culture?	PS2
Political Support	3. What is your evaluation of the scale and quality management of folk sports-related activities?	PS3
Social Participation	1. How would you assess the attention from public opinion and media on folk sports culture?	SP1
Social Participation	2. How do you evaluate the role of folk sports culture activities in enhancing community cohesion?	SP2
Social Participation	3. What is your assessment of the joint participation of various sectors in folk sports culture activities?	SP3
Economic Impact	1. Do you think the financial investment in folk sports culture is sufficient?	EI1
Economic Impact	2. How do you evaluate the cooperation effect between folk sports culture and related industries?	EI2
Economic Impact	3. What is your evaluation of the contribution of folk sports culture activities to local economic development?	EI3
Cultural Value	1. How important do you think folk sports culture is in the inheritance of national culture?	CV1
Cultural Value	2. How do you evaluate the role of folk sports culture in promoting cultural diversity?	CV2
Cultural Value	3. What is your evaluation of the impact of the fitness-for-all trend on folk sports culture?	CV3
Technological Application	1. How do you assess the application effect of intelligent devices or management in folk sports culture?	TA1
Technological Application	2. Have you ever used social media platforms like WeChat to book venues or purchase tickets for folk sports activities? If so, please evaluate your experience.	TA2
Technological Application	3. What is your evaluation of the promotional effect of digital dissemination on folk sports culture?	TA3

Table2.Summary of Confirmatory Factor Analysis (CFA) Results

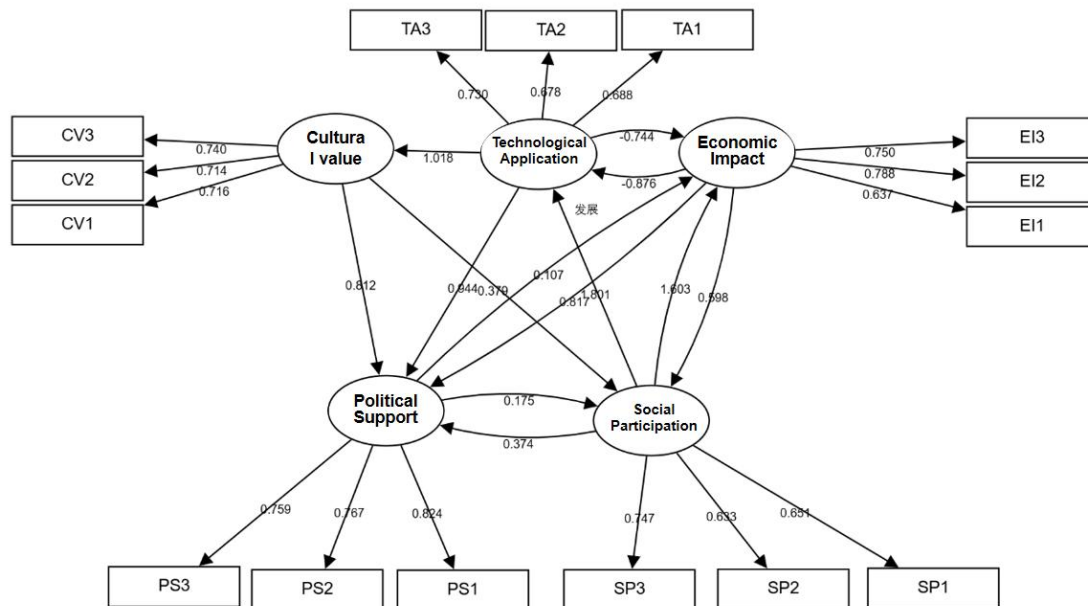
Dimension	Indicator	std.	unstd.	S.E.	P	C.R.(t-value)	SMC	C.R.	AVE
Political Support	PS1	0.321	0.258	-	-	-	0.679		
Political Support	PS2	0.411	0.398	0.096	0	10.651	0.589	0.827	0.614
Political Support	PS3	0.425	0.405	0.095	0	10.523	0.575		
Social Participation	SP1	0.576	0.467	-	-	-	0.424		
Social Participation	SP2	0.603	0.545	0.131	0	7.774	0.397	0.717	0.459
Social Participation	SP3	0.442	0.417	0.138	0	8.976	0.558		
Economic Impact	EI1	0.596	0.592	-	-	-	0.404		
Economic Impact	EI2	0.376	0.39	0.146	0	8.667	0.624	0.771	0.531
Economic Impact	EI3	0.436	0.412	0.137	0	8.369	0.564		
Cultural Value	CV1	0.487	0.44	-	-	-	0.513		
Cultural Value	CV2	0.491	0.344	0.098	0	8.938	0.509	0.767	0.523
Cultural Value	CV3	0.452	0.364	0.105	0	9.242	0.548		
Technological Application	TA1	0.533	0.459	-	-	-	0.467		
Technological Application	TA2	0.546	0.441	0.112	0	8.52	0.454	0.738	0.484
Technological Application	TA3	0.47	0.365	0.111	0	9.138	0.53		

Analysis of structural equations

On the basis of the model fit and the measurement model have reached the understanding effect, the path analysis model of the influencing factors of folklore sports culture inheritance and

development derived by using SPSSAU is shown in Fig. 2. According to the evaluation results of the model fit Table 3, it can be seen that the model fit effects have reached the standard, which indicates that the model fit is good.

Fig. 2 Diagram of model results



The standardized path coefficient in structural equation modeling is an important indicator of the degree of direct or indirect influence between variables. Its value ranges from 0 to 1. If the path coefficient value is between 0 and 0.3, the hypothesis is considered to be weakly supported. If the path coefficient value is 0.3~1, the hypothesis is considered to be strongly supported.

As shown in Figure 2, in this model of influencing factors, standardized regression coefficients are used to resolve the relationship between variables, based on the path coefficient results of the relationship model assumed that H3, H4, H6, H7, H9, H10, H11, and H13 passed the validation, the assumption is established; H1, H2, H5, H8, and H12 did not pass the validation and the assumption is not established, and the results are shown in Table 4.

Conclusions and recommendations

Conclusion

Based on the inheritance and development of folk sports culture, this paper extracts five major categories of influencing factors, namely, political support, social participation, economic development, cultural value, and scientific and technological application, and conducts a systematic empirical study, from which it constructs a structural equation model of influencing factors for the inheritance and development of folk sports culture.

The development of folklore sports culture is subject to the combined effects of multiple factors, including political support, social participation, economic development, cultural values and the application of science and technology. As shown in Table 4, the

standardized coefficient of social participation on economic development reaches 1.603, indicating that it has a significant role in promoting economic input in folklore sports and culture; the standardized coefficient of economic development on political support is 0.817, indicating that economic development can to a certain extent promote political support for folklore sports and culture; the standardized coefficient of cultural value on political support is 0.812, indicating that the enhancement of cultural value can effectively enhance government support for folklore sports and culture; the application of science and technology on cultural value has a comprehensive role. The standardized coefficient of cultural value on political support is 0.812, indicating that the enhancement of cultural value can effectively strengthen the government's support for folklore sports culture; the standardized coefficient of science and technology application on cultural value is 1.018, implying that the application of science and technology can vigorously promote the inheritance and promotion of folklore sports cultural value. These positive relationships provide an important path and direction for promoting the development of folk sports culture. It is possible to obtain more political support and thus promote the prosperity of folk sports culture by increasing social participation, promoting economic investment in folk sports culture, and exerting the leading role of cultural values and the helping role of science and technology applications.

However, the fact that some of the hypotheses were not supported also suggests some limitations of the study. For example, the hypothesis of a positive relationship between political support and social participation was not supported, with a standardized coefficient of only 0.175; the standardized coefficient of 0.107 for

political support and economic development also failed to confirm the positive relationship. The weak correlation of these hypotheses may be based on case study research, where respondents focused more on superficial phenomena. For example, respondents may generally believe that social participation plays a key role in the development of folklore sports and culture, and that economic development can provide strong support for this process.

In fact, in the context of comprehensive economic and social development in contemporary China, political support, as a key driving factor, runs through all aspects of production, life, economy, society, culture and ecological construction, and plays a fundamental, global and strategic role in top-level design, resource allocation and policy guidance, etc. Its influence not only radiates to all corners of the society, but also continues to exert force in the long-term development process, shaping the basic pattern and direction of development in various fields. Its influence not only radiates widely to all corners of society, but also continues in the long-term development process, shaping the basic pattern and direction of development in various fields. Although the results of the questionnaire survey do not fully verify this viewpoint, it does not negate the importance of political support in the development of folklore sports and culture.

Therefore, in the countermeasure suggestions in this paper, the actual problems reflected in the questionnaire cases are fully considered, and the multidimensional role of policy support in promoting the inheritance and development of folk sports culture is also emphasized. Future research should further deepen the exploration of the complex relationship between political support

and other factors to provide a more solid theoretical basis for the formulation of relevant policies. Future research needs to further optimize the research design, expand the sample scope, improve the measurement of variables, and deeply explore the potential relationship between variables, especially focusing on the possible mediating and moderating mechanisms. At the same time, in the development practice of folklore sports culture, the complex interactions among various factors should be fully considered, and more targeted and effective development strategies should be formulated to promote the sustainable and healthy development of folklore sports culture.

Table3. Model Fit Indices Evaluation Results

Commonly Used Indices	χ^2/d f	GFI	RMSE A	RMR	CFI	NNF I
Criteria for Acceptability	<3	>0.9	<0.10	<0.05	>0.9	>0.9
Values	1.99	0.91	0.072	0.045	0.94	0.922
		1			3	

Table4. Structural Equation Model Path Coefficient Test Results

Hypotheses	Path Relationship	Standardized Coefficient	Unstandardized Coefficient	p-value	Result
H1	Political Support→Social Participation	0.175	0.139	0.490	Not
H2	Political Support→Economic Impact	0.107	0.092	0.693	Not
H3	Social Participation→Political Support	0.374	0.472	0	Supported
H4	Social Participation→Economic Impact	1.603	1.739	0	Supported
H5	Social Participation→Technological Application	1.801	1.966	0.078	Not
H6	Economic Impact→Political Support	0.817	0.95	0	Supported
H7	Economic Impact→Social Participation	0.598	0.551	0.002	Supported
H8	Economic Impact→Technological Application	-0.876	-0.881	0.414	Not
H9	Cultural Value→Political Support	0.812	0.881	0	Supported
H10	Cultural Value→Social Participation	0.379	0.326	0.006	Supported
H11	Technological Application→Political Support	0.944	1.091	0	Supported

H12	Technological Application→Economic Impact	-0.744	-0.74	0	Not
H13	Technological Application→Cultural Value	1.018	1.084	0	Supported

The model fitting and hypothesis testing results of the structural equation model show that through the synergistic efforts of social participation, science and technology application and other factors, it can significantly enhance the people's attention to and love of folklore sports culture, and then create a strong atmosphere of folklore sports culture in society, which is conducive to fostering the people's awareness of active inheritance and promoting the vigorous development of folklore sports culture.

Recommendations

The ultimate purpose of the investigation in this paper is to make suggestions for the inheritance and development of folklore sports culture, and based on the results obtained from the previous research and analysis, suggestions are made in the following five areas.

Promoting industrial integration and strengthening economic support

Social participation plays a significant role in promoting economic development, which fully demonstrates that the inheritance and development of folklore and sports culture are closely related to economic activities. For regions that want to build folk sports culture and realize rural revitalization, it is necessary to promote the deep integration of folk sports culture with related industries and build a synergistic development mechanism. The government should actively guide the cross-border cooperation between folk sports culture and rural tourism, special culture and innovation, rural education and other industries, combined with local characteristics of folk sports projects, such as Guizhou village super, village BA, etc., to create a folk sports culture brand with a distinctive local identity, to form an industrial chain covering the organization of events, tourism experience, cultural product sales and other links, to enhance the impetus for economic development. At the same time, the use of policy guidance and market mechanism, to attract social capital investment, to promote the scale of folk sports and culture industry, market-oriented development, for rural economic growth to inject new vitality.

Strengthening scientific and technological empowerment to enhance cultural values

Scientific and technological innovation is a key force in promoting the inheritance and promotion of folk sports and cultural values. When developing folk sports culture, local villages should strengthen the application of science and technology to help modernize and transform. Using virtual reality (VR), augmented reality (AR) and other digital technologies, local folk sports culture is recorded, preserved and vividly displayed in an all-round way, so that visitors can feel the charm of folk sports in an immersive way. Technology integration mechanism is an important support for the modernization and development of folk sports culture.^[5] With the help of the Internet platform, broaden the dissemination channels of

folk sports culture and expand its influence in the country and even globally. Develop intelligent folk sports and cultural products, such as online folk sports teaching courses and interactive folk sports games, to enhance user experience. The government has increased financial support for scientific and technological innovation in folklore sports culture, encouraged cooperation between universities and scientific research institutions and local enterprises, and promoted the organic coupling of science and technology with folklore sports culture.

Optimizing social participation and stimulating endogenous dynamics

The active participation of multiple subjects is a core element in the development of folklore sports and cultural heritage. Folk sports help rural governance needs to strengthen policy support and institutional support, improve village self-governing organizations, form cultural consciousness and enhance cultural identity.^[6] Villages around the world should build a development model in which the government, social organizations, enterprises and villagers participate in a synergistic way. Through policy guidance and resource support, the government encourages social organizations and enterprises to participate in the protection and development of folklore sports and culture, such as introducing enterprises to invest in the location of folklore sports and cultural events. Through organizing folk sports and cultural festivals and carrying out village-level events, villagers' knowledge of and participation in local folk sports and culture can be enhanced. Folk sports categorization governance should focus on the consultation and common governance of multiple subjects, and promote the transformation of the main body of governance from the "government subject" to the "multiple subjects".^[8] Establish a sound social participation incentive mechanism, set up a folk sports culture inheritance fund, and reward individuals and groups with outstanding performance in the protection and innovation of folk sports culture.

Deepening cultural leadership and enhancing political support

The enhancement of cultural values can effectively increase government support for folklore sports culture. Villages in all regions should incorporate folklore and sports culture into local cultural development strategies and formulate special protection and development plans. Through local legislation and policy support, the status and role of folklore and sports culture in rural cultural revitalization should be clarified. Strengthen the international dissemination of folklore sports culture, organize rural folklore sports performance teams to participate in international cultural exchanges, and enhance international influence so as to gain more attention and support from the government. The government has increased its investment in research on folklore sports culture and supported the theoretical exploration and practical innovation of local folklore sports culture by academics.

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Author Contributions

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About the Authors

Xinyun Zhou

Tianjin Agricultural University, Tianjin, China

Yan Jiang

Tianjin Agricultural University, Tianjin, China

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Impact of Ramadan Fasting on Sports Performance

Liao OuYang^{1a}, Guangyou Du^{1b}, Chi Zhou^{2c} and Zhengkang Wu^{1*d}

¹Yangtze University, China,430100

²Jiangxi Normal University, China,330022

*Corresponding author:17687921962@163.com

Abstract

This study systematically reviews and analyzes the impact of Ramadan fasting on athletes' anaerobic performance, aerobic endurance, and strength variations. As a unique form of intermittent fasting with religious and cultural significance, Ramadan fasting requires abstaining from food and drink from sunrise to sunset for an entire month. The study explores the physiological adaptations during fasting, such as changes in energy metabolism, hydration status, and recovery processes, as well as psychological factors like motivation, focus, and perceived exertion that may influence athletic performance. The results indicate that while the effects of Ramadan fasting on anaerobic and aerobic performance are limited, certain performance metrics (e.g., endurance and strength) may improve with proper training and nutrition management. The study emphasizes the importance of maintaining consistent training, optimizing hydration and energy intake during non-fasting hours, and ensuring adequate sleep and recovery. This work provides valuable insights for athletes, coaches, and sports scientists, supporting the development of individualized training and nutrition strategies to help athletes maintain competitive performance while respecting religious and cultural practices. It also offers directions for future research into the long-term effects of Ramadan fasting on athletic performance and the development of evidence-based guidelines.

Keywords: Ramadan fasting; aerobic exercise; anaerobic exercise; endurance exercise

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Introduction

Ramadan fasting is a specific form of intermittent fasting characterized by alternating periods of fasting and eating, where individuals abstain from food and drink from sunrise to sunset for an entire month. This practice is deeply rooted in religious and cultural traditions, observed by Muslims worldwide as a time of spiritual reflection and self-discipline. Intermittent fasting, in a broader sense, encompasses various approaches, including alternate-day fasting, time-restricted eating, and periodic fasting, each with its own unique structure and guidelines. For example, alternate-day fasting involves alternating between days of normal eating and days of significant calorie restriction, while time-restricted eating limits food intake to a specific window of time each day, such as 8 hours, followed by 16 hours of fasting. Periodic fasting, on the other hand, involves extended fasting periods, such as 24-hour fasts, conducted once or twice a week. These fasting models, including Ramadan fasting, serve as short-term dietary strategies aimed at improving health by adjusting meal frequency and timing (Hoddy, 2015). They have been associated with various potential benefits, such as enhanced metabolic health, improved weight management, and better regulation of blood sugar levels. Additionally, intermittent fasting may promote cellular repair processes, such as autophagy, and reduce inflammation, contributing to overall well-being. While Ramadan fasting is primarily observed for religious purposes, it shares common physiological mechanisms with other forms of intermittent fasting, making it a valuable area of study for understanding the broader impacts of fasting on health and performance. By exploring these fasting models, researchers and practitioners can gain insights into how dietary interventions can be tailored to support both physical and mental health (Ding, 2023).

Information and methodology

systematic review

Utilized to conduct a thorough analysis of existing research on the impact of Ramadan fasting on athletic performance. The primary aims of this study are: To assess the effects of Ramadan fasting on aerobic performance, anaerobic exercise, endurance exercise, and muscular strength; To summarize and compare the findings of different studies in order to identify consistencies and discrepancies; To identify key factors influencing athletic performance, such as nutritional intake, training intensity, training schedule, and individual adaptability (Hua, 2023).

Results

Mechanisms of Energy Metabolism During Ramadan Fasting

Aerobic Energy Metabolism

The energy conversion mechanism in aerobic exercise describes how the human body efficiently converts food energy into the energy needed to support physical activity under aerobic metabolic conditions. This process involves three key stages: glycogen metabolism, fat metabolism, and protein metabolism.

Glycogen Metabolism: In aerobic exercise, the body's glycogen stores, mainly located in the liver and muscles, are mobilized and broken down into glucose. This glucose undergoes glycolysis to produce pyruvate, releasing small amounts of adenosine triphosphate (ATP), providing initial energy. The pyruvate is then transported into the tricarboxylic acid (TCA) cycle, a complex biochemical process occurring in the mitochondria, ultimately producing a large amount of ATP, which serves as the primary energy source for muscle activity (Hargreaves, 2015).

Fat Metabolism: Fat serves as another crucial energy source in aerobic exercise. During physical activity, fat is metabolized into free fatty acids and glycerol. These free fatty acids are transported

to the mitochondria, where they undergo β -oxidation, converting into acetyl-CoA. This acetyl-CoA then enters the tricarboxylic acid (TCA) cycle, leading to the production of a significant amount of ATP, thereby supporting sustained aerobic exercise demands (Spriet, 2014).

Protein Metabolism: During prolonged, low-intensity aerobic exercise, when glycogen and fat supplies are insufficient, the body may utilize protein as an energy source. In this process, proteins are broken down into amino acids, some of which can be converted into metabolic intermediates that participate in the TCA cycle, ultimately generating ATP. Although protein can provide energy, it is not the primary energy source, as relying on protein metabolism may lead to muscle tissue breakdown, potentially resulting in negative physiological effects. The synergistic function of these three stages ensures a continuous and efficient supply of energy during aerobic exercise, enabling the body to sustain high energy output while minimizing energy loss.

Anaerobic Energy Metabolism

The energy production mechanism in anaerobic exercise differs significantly from that in aerobic exercise. This is primarily because, under anaerobic metabolic conditions, muscle cells cannot obtain sufficient oxygen to support ATP synthesis.

Phosphocreatine System (ATP-PCr System): Phosphocreatine (PCr) is a high-energy phosphate compound stored in muscle cells, capable of rapidly breaking down to provide immediate energy. During this process, PCr transfers its phosphate group to ADP, quickly resynthesizing ATP. Since this process does not require oxygen, it provides the necessary energy for high-intensity, short-duration activities such as sprinting and weightlifting, making it a critical energy source for explosive movements (Fox, 1965).

Lactic Acid System: Under anaerobic conditions, muscle glycogen is broken down into glucose, which then undergoes glycolysis to produce ATP. However, due to insufficient oxygen supply, lactate accumulates as a byproduct in the muscles, leading to muscle acidification. This can impair muscle function and limit continued physical activity. The buildup of lactate is a major contributor to muscle fatigue and a crucial factor limiting the duration of anaerobic exercise (Hua, 2023).

Synergistic Action of ATP-PCr and Lactic Acid Systems: During high-intensity exercise, the phosphocreatine system and the lactic acid system often work in coordination. The ATP-PCr system provides an immediate energy supply, while the lactic acid system offers energy for a slightly longer duration. This dual mechanism enables athletes to engage in short bursts of intense physical activity. The efficient cooperation of these energy systems forms the biochemical basis for sustaining high-intensity, short-duration exercise.

Research on Ramadan Fasting

Recent research continues to provide new insights into the impact of Ramadan fasting on athletic performance, particularly in understanding how fasting influences physical fitness, exercise capacity, and metabolic adaptations. The following summarizes key findings from recent studies, highlighting the physiological and performance-related effects of fasting:

Soeters et al. recently published a comprehensive review examining the relationship between lipid and glucose metabolism during short-term fasting. The study revealed that within the first 24 hours of food deprivation, significant metabolic changes occur. Specifically, a decrease in plasma insulin concentration, an increase in sympathetic nervous system activity, and elevated growth hormone levels collectively enhance whole-body lipolysis and fat oxidation. These changes lead to a reduced reliance on carbohydrates and an increased dependence on fatty acids as the primary energy source. Plasma fatty acid concentrations were found to rise notably during the initial fasting phase, particularly within 14 hours after the last meal. This shift in substrate utilization underscores the body's ability to adapt to fasting by optimizing fat metabolism for energy production (Tinsley, 2015). In a related study,

Klein et al. conducted a detailed investigation into the whole-body lipid and glucose metabolism of young adult males with normal body weight during fasting intervals of 12, 18, 24, 30, 42, 54, and 72 hours. The results demonstrated that between 12 and 24 hours of fasting, the rate and concentration of plasma glycerol increased most significantly, accounting for 50% to 60% of the total glycerol increase observed over 72 hours. During this period, fat oxidation increased by approximately 50%, while glucose oxidation decreased by about 50%, further supporting the concept of a substrate utilization shift. Additionally, the study found that plasma insulin levels declined significantly during fasting, while glucagon levels increased. Interestingly, epinephrine and cortisol concentrations (Tinsley, 2015). Lawrence investigated Ramadan fasting as a way to study how time-restricted eating influences aerobic performance in top runners. The findings showed that even with a decrease in nutritional intake during fasting, the athletes' aerobic performance was mostly unchanged. This indicates that after a period of adjustment, athletes can sustain their aerobic capacity despite limited nutrition. However, additional research has suggested that fasting could affect endurance performance, especially during extended and high-intensity activities, where lower nutrient intake might result in greater fatigue (Spriet, 2014).

In summary, these studies highlight how short-term fasting leads to significant shifts in the body's energy utilization, especially during Ramadan fasting. By increasing fatty acid usage and reducing carbohydrate dependence, the body adjusts its primary energy sources. These metabolic changes may have profound implications for athletes engaged in prolonged and high-intensity training, although aerobic capacity may remain stable after adaptation.

Impact of Ramadan Fasting on Sports Performance

Impact of Ramadan Fasting on Sports Performance

The influence of Ramadan fasting on aerobic performance appears to be minimal, with some studies suggesting potential benefits under specific conditions. Ali and colleagues conducted a study to explore whether Ramadan fasting could enhance long-distance running performance in elite athletes. The research involved fifteen well-trained male long-distance runners who observed Ramadan. Each participant visited the human performance laboratory on two occasions—once before Ramadan and once during the final week of Ramadan. During each visit, the athletes underwent a graded exercise test on a treadmill, during which key physiological and performance metrics were measured, including VO_2 (maximal oxygen uptake), heart rate, time to exhaustion, perceived exertion (RPE), and running speed. Additionally, the study collected detailed data on anthropometric measurements, dietary intake, sleep patterns, and exercise routines to provide a comprehensive understanding of the athletes' overall condition during the fasting period. The findings of the study revealed that fasting conditions led to notable improvements in time to exhaustion and running speed compared to non-fasting conditions. These improvements suggested that Ramadan fasting might have a positive impact on endurance performance in elite long-distance runners. However, the study also found that these enhancements were not associated with significant changes in peak VO_2 , oxygen consumption, or RPE. This indicates that the observed improvements in performance were likely not due to changes in aerobic capacity or cardiovascular efficiency but rather to other factors, such as potential adaptations in substrate utilization, psychological resilience, or pacing strategies during fasting. The study's results highlight the complexity of the relationship between Ramadan fasting and athletic performance (Spriet, 2014). While the fasting period did not negatively affect aerobic performance, the improvements in time to exhaustion and running speed suggest that elite athletes may adapt effectively to the physiological and metabolic demands of fasting. The absence of significant changes in VO_2 and RPE further underscores the idea that the observed

performance enhancements may be influenced by non-physiological factors, such as mental focus, motivation, or altered energy management strategies during fasting. These findings have important implications for athletes and coaches, particularly those working with endurance athletes who observe Ramadan. The study suggests that with proper management of training, nutrition, and recovery, elite athletes can maintain or even improve their performance during Ramadan. It also emphasizes the need for individualized approaches to training and competition scheduling to account for the unique challenges and opportunities presented by fasting. Overall, the research contributes to a growing body of evidence that Ramadan fasting, when managed appropriately, does not hinder athletic performance and may, in some cases, offer performance benefits for certain athletes. Researchers Chtourou and Güvenç examined the effects of Ramadan fasting on aerobic performance in athletes of similar age and health levels as the current study participants. Their study reported that peak running speed increased at the end of Ramadan compared to pre-Ramadan levels. However, some published studies on the effects of Ramadan fasting have reported negative impacts on endurance performance when exercise tests were conducted within the first two weeks of fasting (Al-Nawaiseh, 2021).

Scholar Alpaz Güvenç A study was conducted involving sixteen amateur football league players, comprising five defenders, seven midfielders, and four forwards. These athletes had an average age of 17.4 years, a mean height of 175.4 cm, an average weight of 69.6 kg, and an average training experience of 5.1 years. The research took place in Turkey between August and October and was divided into four distinct phases: the last four days before Ramadan (Pre-RF), the first weekend of Ramadan (Beg-RF), the final four days of Ramadan (End-RF), and two weeks post-Ramadan (After-RF). Throughout Ramadan, all participants voluntarily observed a full fast from sunrise to sunset, abstaining from food and drink during daylight hours. The primary objective of the study was to evaluate the effects of Ramadan fasting (RF) on body composition, aerobic performance, lactate (LA) levels, heart rate (HR), and ratings of perceived exertion (RPE) in young football players who maintained their regular training routines. Despite limited existing data on the impact of RF on physical performance, this study was the first to focus specifically on young amateur athletes. The findings revealed that as long as a consistent training regimen, adequate sleep duration, daily energy intake, and fluid balance were maintained, Ramadan fasting did not adversely affect aerobic performance or body composition in these athletes. While submaximal RPE responses to aerobic exercise increased during Ramadan, objective measures of exercise intensity, such as LA and HR, remained unchanged or even declined by the end of the fasting period. In addition to the changes in submaximal LA and HR responses, the study observed notable improvements in peak running distance, peak running time, peak running speed, and running speed at the anaerobic threshold by the end of Ramadan. These improvements suggest that young football players can adapt effectively to the physiological demands of fasting without compromising their aerobic performance. The study's findings underscore the importance of maintaining regular training schedules, fluid balance, daily energy intake, and sleep duration during Ramadan to ensure optimal performance outcomes. Although subjective perceptions of exertion during submaximal-intensity exercise increased, objective measures of aerobic performance remained stable or showed improvement by the end of the fasting period, indicating that the athletes' physical capabilities were not negatively impacted. Throughout Ramadan, all players continued their regular training sessions after breaking their fast in the evening (Güvenç, 2011). The continuation of structured training regimens likely played a significant role in enhancing aerobic capacity and mitigating any potential negative effects of fasting. From a practical standpoint, maintaining normal training routines and scheduling training sessions post-fast may serve as an effective strategy for fasting athletes and their coaches to optimize performance while adhering to Ramadan fasting

practices (Pritchard, 1993). This approach ensures that athletes can meet the physical demands of their sport while respecting their religious obligations. The study's results provide valuable insights for coaches, athletes, and sports scientists, highlighting the importance of tailored training and recovery strategies during Ramadan. By maintaining consistent training, nutrition, and hydration practices, young football players can sustain or even improve their aerobic performance during the fasting period. These findings contribute to a growing body of evidence that Ramadan fasting, when managed appropriately, does not hinder athletic performance and may, in some cases, offer opportunities for physiological adaptation and performance enhancement (Güvenç, 2011).

These findings indicate that the impact of Ramadan fasting on aerobic performance is multifaceted and varies depending on individual and contextual factors. However, with appropriate training adjustments and sufficient nutrition and hydration, athletes can effectively adapt to the challenges of Ramadan fasting and, in some cases, even improve performance. For fasting athletes and their coaches, continuing regular training programs and adjusting training times post-Iftar may be an effective strategy.

Impact of Ramadan Fasting on Anaerobic Performance

Karli et al. conducted a detailed study to investigate the effects of Ramadan fasting on anaerobic power capacity and lactate clearance rate in elite strength athletes following high-intensity anaerobic exercise. The study involved ten male elite strength athletes, comprising two wrestlers, seven sprinters, and one thrower, aged between 20 and 24 years, with an average age of 22.30 ± 1.25 years. The research was structured into three distinct phases: three days before Ramadan (Pre-RF), the last three days of Ramadan (End-RF), and the final three days of the fourth week after Ramadan (Post-RF). To assess anaerobic power and capacity, the Wingate Anaerobic Test (WAnT) was administered at each of these stages. Additionally, capillary blood samples were collected at rest, immediately after the WAnT, and throughout the recovery period to analyze lactate levels and record heart rate (Karli, 2004).

The findings from the repeated measures analysis of variance indicated no significant changes in the participants' body weight, body mass index, lean body mass, body fat percentage, daily sleep duration, or daily caloric intake during Ramadan. Overall hydration levels remained relatively stable throughout the fasting period; however, urine density at End-RF was significantly higher compared to Post-RF. Measurements of peak heart rate (HR) and lactate (LA) levels at Pre-RF, End-RF, and Post-RF suggested that the cardiovascular and metabolic stress induced by the Wingate Anaerobic Test (WAnT) was not impacted by Ramadan fasting. Furthermore, Ramadan fasting had no adverse effects on the athletes' power capacity or lactate clearance rate following high-intensity anaerobic exercise. The study's main findings suggest that if strength athletes maintain regular strength training, food intake, fluid balance, and sleep duration during Ramadan, fasting does not negatively impact body composition, anaerobic power, or performance capacity. Additionally, high-intensity exercise and post-exercise lactate metabolism remained unaffected during Ramadan (Karli, 2004). These results highlight the importance of maintaining proper training and lifestyle habits for sustaining athletic performance.

In a related study, Chaouachi, Anis, and colleagues examined the impact of Ramadan Intermittent Fasting (RIF) on maintaining aerobic and anaerobic performance in elite judokas undergoing regular training. The study included 15 elite judo athletes who participated in physical tests at four different time points: before Ramadan (T1), at the beginning of Ramadan (T2), at the end of Ramadan (T3), and three weeks after Ramadan. These tests assessed various performance metrics, including the squat jump (SJ), countermovement jump (CMJ), 30-second repeated jumps, 30-meter sprint, multi-stage fitness tests, and fatigue levels. The results indicated that RIF did not have a negative impact on the overall aerobic and anaerobic performance of athletes engaged in

intensive physical training. Throughout Ramadan, elite judokas maintained their performance in maximal aerobic and anaerobic tests. However, a decline in the 30-second repeated jump test results and an increase in perceived fatigue were observed at the end of Ramadan. These findings suggest that while RIF may lead to short-term effects on specific performance metrics, elite judokas can sustain their athletic capabilities during Ramadan with proper training and recovery strategies (Chaouachi, 2014).

Both studies underscore the resilience of elite athletes to the physiological demands of Ramadan fasting, provided they adhere to consistent training regimens and maintain balanced nutrition and hydration. The results emphasize the importance of tailored training and recovery protocols to mitigate any potential short-term declines in performance, ensuring that athletes can continue to perform at their peak even during periods of intermittent fasting (Chaouachi, 2014).

In conclusion, both studies suggest that when appropriate training and lifestyle habits are maintained, Ramadan fasting does not necessarily have a negative impact on elite athletes' performance. Whether in strength-based or endurance sports, athletes can sustain or even improve certain aspects of their performance during Ramadan.

Effects of Ramadan Fasting on Endurance Performance

BouguerraA study was conducted to assess the effects of Ramadan fasting on runners training at different times of the day (9:00 AM, 2:00 PM, and 10:00 PM) concerning maximal aerobic velocity (MAV), time to exhaustion (tlim100), and 3000-meter run performance. The study was structured into three phases: pre-Ramadan, during Ramadan, and post-Ramadan, with participants divided into three groups based on training time—AG group (afternoon training), MG group (evening training), and EG group (morning training). The results indicated that MAV and maximal oxygen uptake (VO_2 max) in the AG and MG groups were significantly higher than in the EG group before, during, and after Ramadan. Notably, compared to the AG group, the EG and MG groups experienced a significant increase in 3000-meter run completion time ($p < 0.01$) and a significant reduction in time to exhaustion (tlim100, $p < 0.001$) before and after Ramadan. These findings suggest that training in the afternoon may be more advantageous for improving aerobic capacity while fasting during Ramadan. Additionally, runners training in the afternoon exhibited higher MAV, VO_2 max, and overall performance across all test phases. Compared to those training in the morning or evening, they also demonstrated greater improvements in tlim100 and distance limit (dlim100) (Bouguerra, 2017).

No significant differences in biochemical responses were observed in the afternoon training group across the three test periods. Although research indicates that VO_2 max does not significantly change during Ramadan fasting, heart rate decreases, and moderate-intensity aerobic exercise performance remains largely unaffected (Bouguerra, 2017). Additionally, studies have shown that young male soccer players exhibited significantly improved endurance performance within two weeks after Ramadan, likely due to their consistent training during the fasting period. Some studies also report that elite long-distance runners improved their time to exhaustion and maximal running speed during Ramadan, while their VO_2 max and body composition remained unchanged. This may be attributed to athletes adapting better to unfavorable environmental conditions and adjusting their training load to mitigate dehydration risks, thereby maintaining high-quality training levels. Another study found that at the end of Ramadan, young soccer players' maximum sprint distance and speed improved, with no negative impact on their aerobic capacity or body composition. Therefore, maintaining appropriate training volume, adequate sleep, and sufficient hydration and nutrition during Ramadan fasting can effectively prevent or mitigate its potential negative effects on aerobic exercise performance (Al-Nawaiseh, 2021).

The impact of Ramadan fasting on aerobic endurance performance is closely related to the timing of exercise. For instance, a study on 20 middle- and long-distance runners who trained at different times (9:00 AM, 2:00 PM, and 10:00 PM) during Ramadan found that afternoon training resulted in better aerobic endurance performance due to higher muscle temperature, which facilitated better utilization of free fatty acids. Conversely, another study observed that 10 adolescent soccer players performed better in aerobic and anaerobic exercises at 7:00 AM compared to 5:00 PM during Ramadan. This suggests that Ramadan fasting does not negatively impact morning exercise performance, likely because athletes are well-rested, have recovered to their optimal physiological state, and have adequate carbohydrate stores in the morning, whereas afternoon performance may decline due to fatigue, hunger, and sleep deprivation (Hua, 2023).

Overall, Ramadan fasting may have some adverse effects on aerobic endurance performance, primarily due to dehydration, reduced muscle glycogen stores, fatigue, and sleep disturbances. Additionally, decreased melatonin and cortisol secretion and increased IL-6 levels may further influence performance (Bouguerra, 2017). However, by maintaining consistent training and selecting optimal exercise timing during Ramadan, athletes can effectively mitigate these negative effects, sustain, or even enhance their endurance performance. This strategy not only helps athletes adapt to the physiological changes during Ramadan fasting but also optimizes their overall performance.

Effects of Ramadan Fasting on Strength Changes

Rebaï conducted a comprehensive study to investigate the effects of Ramadan Intermittent Fasting (RIF) on short-term maximal performance, specifically examining the outcomes of maintaining or reducing resistance training volume during this period. The research involved 20 young male football players, with an average age of 18.4 ± 0.8 years, an average weight of 72.4 ± 4.1 kg, and an average height of 183.4 ± 4.6 cm. These participants were randomly assigned to one of two groups: a normal training group (G1), which maintained their regular training regimen throughout the study, and a tapering training group (G2), which implemented a gradual reduction in training volume during the RIF period. The study was designed to assess the impact of these training strategies on muscle strength and power over four key time points: one month before the start of RIF (T0), one week before RIF began (T1), two weeks into the fasting period (T2), and at the end of RIF (T3). To evaluate the participants' performance, the study focused on two primary metrics: muscle strength, measured through maximal voluntary contraction (MVC), and muscle power, assessed using squat jump (SJ) and countermovement jump (CMJ) tests. Between T1 and T2, all participants followed a standardized full-body resistance training program, which included 8 repetitions across 4 sets, with 4-minute rest intervals between sets to ensure adequate recovery. This phase was critical for establishing a baseline of strength and power improvements. However, during the RIF period, the two groups diverged in their training approaches. G1 continued with their original training program without any modifications, while G2 adopted a tapering strategy, reducing their training volume to 3 sets per session, representing a 22% decrease in overall training load. The results of the study revealed that both groups experienced significant improvements in muscle strength and power from the baseline (T0) to each subsequent testing phase (T1, T2, and T3). However, the data highlighted a notable difference between the two groups. G2, which reduced its training volume during RIF, demonstrated significantly greater enhancements in both strength and power between T1 to T2 and T1 to T3 compared to G1, with these differences reaching statistical significance ($p < 0.05$). By the time of the second testing phase (T2), G2's performance had surpassed that of G1, with the difference being statistically significant at $p < 0.01$. Furthermore, when analyzing the overall performance changes from the baseline (T0) to T2 and T3, G2 exhibited significantly higher improvements than G1, with these differences also achieving statistical significance ($p <$

0.05). These findings suggest that a strategically implemented reduction in training volume, as seen in G2's tapering approach, can lead to superior gains in strength and power during periods of intermittent fasting, such as Ramadan. The study underscores the potential benefits of adjusting training loads to align with physiological and metabolic changes induced by fasting, highlighting the importance of periodization and individualized training strategies for optimizing athletic performance. Additionally, the results provide valuable insights for coaches and athletes who may need to adapt their training programs during religious or other fasting periods to maintain or even enhance performance outcomes (Rebaï, 2013).

From the initial testing phase (T0) to the first follow-up (T1), all participants engaged in a structured full-body resistance training program, which consisted of performing 8 repetitions across 4 sets, with a 4-minute rest interval between each set to ensure adequate recovery. This regimen was designed to optimize strength and power gains over the training period. Following T1, during the reduced intensity phase (RIF), the participants were divided into two groups: Group 1 (G1) continued with their original training program without any modifications, maintaining the same intensity and volume. In contrast, Group 2 (G2) implemented a gradual reduction in their training volume, decreasing to 3 sets per session, which represented a 22% reduction in overall training load. The results indicated that both groups experienced significant improvements in strength and power from the baseline (T0) to the first follow-up (T1), and these gains were sustained and further increased from T0 to the second follow-up (T2) and from T0 to the third follow-up (T3). However, the data revealed that G2, which had reduced their training volume during the RIF, demonstrated a significantly greater improvement in both strength and power metrics between T1 to T2 and T1 to T3 compared to G1, with statistical significance set at $p < 0.05$. By the time of the second follow-up (T2), the performance of G2 was notably superior to that of G1, with the difference being statistically significant at $p < 0.01$. Furthermore, when examining the performance changes from the baseline (T0) to T2 and T3, G2 showed statistically significantly higher improvements than G1, with the differences again reaching statistical significance at $p < 0.05$. These findings suggest that a strategically implemented reduction in training volume, as seen in G2, can lead to enhanced strength and power outcomes compared to maintaining a constant training load, highlighting the potential benefits of periodization and load management in resistance training programs.

These results suggest that gradually reducing training volume during RIF may significantly enhance muscle strength and power for young football players. The study also confirmed that during the pre-RIF training phase, both groups experienced significant improvements in muscle strength and power. However, during RIF, reducing training volume further improved muscle performance, particularly in the first two weeks of fasting. In contrast, maintaining high training volume resulted in stable or slightly reduced muscle strength and power, as seen in the counter-movement jump performance at T3 (Rebaï, 2013).

These findings highlight the importance of adjusting training volume to optimize athletic performance, especially during fasting periods such as Ramadan. For young football players, gradually reducing training volume during Ramadan may be more beneficial for enhancing overall muscle strength and performance. Additionally, even with high training volumes, muscle strength and power may remain stable or slightly decline, particularly at the end of Ramadan, emphasizing the critical role of training adjustments in optimizing performance during this period.

Discussion

Analysis of publications, authors and institutions

In conclusion, during Ramadan fasting, athletes may experience energy deficits due to prolonged fasting, particularly a reduction in muscle glycogen stores. This can negatively impact endurance

exercises that require sustained energy output, such as running and cycling. Anaerobic exercises, such as weightlifting and sprinting, rely on rapid energy release. During Ramadan, the restrictions on food and fluid intake may affect muscle explosiveness and the ability to sustain high-intensity efforts.

Regarding strength, the inability to replenish energy and nutrients immediately, especially inadequate protein intake, may influence muscle power output and explosiveness. As for endurance, muscle fatigue may accumulate more rapidly due to decreased energy utilization efficiency. The body's inability to obtain energy from food in real-time limits glycogen replenishment, which is crucial for prolonged endurance exercises such as long-distance running or cycling. The reduction in glycogen stores may lead to a decline in athletic performance.

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Author Contributions

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About the Authors

Liao OuYang

Yangtze University, China, 430100

Guangyou Du

Yangtze University, China, 430100

Chi Zhou

Jiangxi Normal University, China, 330022

Zhengkang Wu

Yangtze University, China, 430100

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The Future Development and Social Implications of the Metaverse

Mengyu Liu^{1*}

¹*Sookmyung Women's University, Korea*

**Corresponding author:daimou971231@naver.com*

Abstract

The Metaverse, as an emerging virtual world, is gradually transforming human social relationships and behavior patterns. This paper explores the Metaverse from a social science perspective, examining its technological foundations, impact on social interactions, changes in behavior patterns, governance, and ethical challenges, while also forecasting its future development trends. The study reveals that the decentralized nature, immersive experience, and virtual economy of the Metaverse are shaping new forms of social interaction and raising a series of legal and ethical issues. Finally, this paper proposes governance and policy recommendations for the future development of the Metaverse to ensure its healthy growth.

Keywords: Metaverse, Social Change, Virtual Interaction, Digital Economy, Ethics

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Introduction

The term "Metaverse" was first proposed by science fiction writer Neal Stephenson in his 1992 novel *Snow Crash*, where he described a virtual reality environment composed of digital worlds (Stephenson, 1992). In recent years, with the development of virtual reality (VR), augmented reality (AR), blockchain, artificial intelligence (AI), and Web3.0 technologies, the concept of the Metaverse has gradually evolved from science fiction into reality (Kaplan & Haenlein, 2020). Today, the Metaverse is widely defined as an immersive, decentralized, and interoperable virtual environment in which users can create digital identities, participate in social activities, and engage in economic transactions (Ball, 2022).

Currently, the Metaverse is primarily supported by the following key technologies: Virtual Reality (VR) and Augmented Reality (AR) provide immersive interactive experiences, allowing users to "enter" the virtual world and interact with the environment (Kim, 2021). Blockchain and Smart Contracts ensure decentralized governance while allowing users to own virtual assets (such as NFTs) and conduct transactions (De Filippi & Wright, 2018). Artificial Intelligence (AI) and Big Data support the automation of virtual worlds, including AI-driven NPCs (non-player characters), voice assistants, and social recommendation systems (West, 2022). Cloud Computing and 5G provide high-bandwidth, low-latency computing environments, making large-scale multiplayer interactions possible (Nakamura, 2021).

As Metaverse technologies mature, their impact on society has become a focus of academic research. Social science studies suggest that the Metaverse is not merely a virtual world but rather a new type of social ecosystem (Berger & Luckmann, 1966). It brings profound changes in social relationships, individual identity,

economic systems, legal frameworks, and ethical considerations (Smith & Jones, 2021). Under the framework of social science research, studies on the Metaverse mainly focus on the following areas: Social Constructivist Perspective explores how the Metaverse may become a "social reality" and how it shapes human perception and interaction (Blascovich & Bailenson, 2011). Human Behavior Patterns examine changes in socializing, consumption, and work habits in virtual worlds (Davis et al., 2021). Economy and Governance investigate how virtual economic models (such as NFTs and DAOs) influence real-world economic systems (De Filippi & Wright, 2018). Legal and Ethical Issues focus on how to protect user privacy, manage virtual crimes, and establish a fair digital governance framework in the Metaverse (Bryson, 2020).

With Facebook (now Meta), Microsoft, Google, Roblox, and other tech companies accelerating Metaverse development, social scientists have extensively studied its social impact, technological ethics, and governance models. These studies not only help us understand the current state of the Metaverse but also provide theoretical support for its future development. Following the COVID-19 pandemic, remote work, online education, and digital economies have rapidly developed, providing an opportunity for the rise of the Metaverse (Park & Kim, 2022). At this stage, the Metaverse has begun to influence various aspects of human social relationships: users can create virtual identities and interact with people globally through platforms such as Horizon Worlds, VRChat, and Roblox (Kim, 2021). Enterprises are adopting virtual meetings and remote collaboration platforms, such as Microsoft's Mesh for Teams and Meta's Workrooms (Johnson et al., 2023). The rise of virtual currencies and NFT trading markets has made digital assets a new form of investment (De Filippi & Wright, 2018). However, issues such as privacy breaches, virtual harassment, and algorithmic bias are becoming increasingly

prominent (Bryson, 2020). These changes have sparked widespread social discussions, prompting researchers to further explore how the Metaverse profoundly impacts human social relationships and behavioral patterns.

Based on this background, this study will explore the following core questions: (1) How does the Metaverse reshape individual identity? (2) How does the Metaverse transform social relationships? (3) How does the Metaverse influence consumption behavior, education, and work models? (4) What are the governance and ethical challenges of the Metaverse? To deeply understand these questions, this paper adopts literature analysis, case studies, and survey methods, integrating Metaverse theoretical frameworks to examine its impact on social relationships and human behavior and propose corresponding policy recommendations. The structure of this paper is as follows: Chapter 1 introduces the concept of the Metaverse, its social science background, and research questions. Chapter 2 analyzes the theoretical foundations and social impacts of the Metaverse. Chapter 3 explores how the Metaverse reshapes social relationships and human behavior. Chapter 4 discusses the governance and ethical challenges of the Metaverse. Chapter 5 summarizes the research findings and presents future policy recommendations.

Theoretical Framework and Social Implications of the Metaverse

Definition and Technological Foundations of the Metaverse

The Metaverse can be defined as a decentralized, shared virtual space driven by digital technologies, where users can engage in social interactions, economic transactions, and creative activities through immersive technologies (Kaplan & Haenlein, 2020). The realization of this concept relies on the following core technologies:

VR and AR technologies are key enablers of immersive experiences in the Metaverse. VR technology creates a fully computer-generated virtual environment that users can enter and interact with using VR devices such as Oculus Quest and HTC Vive (Blascovich & Bailenson, 2011). In contrast, AR technology overlays digital information onto the real world, as seen in games like Pokémon Go (Kim, 2021). The combination of VR and AR enhances the interactivity and realism of the Metaverse, offering new possibilities for remote socialization, education, and work (Johnson, Peters, & Wang, 2023).

Blockchain technology provides a decentralized economic model for the Metaverse, ensuring security and ownership of virtual assets (De Filippi & Wright, 2018). Through smart contracts, blockchain enables Decentralized Autonomous Organizations (DAOs), allowing users to conduct transactions without the need for centralized institutions. This mechanism grants users greater autonomy while reducing reliance on traditional financial systems (Nakamura, 2021).

Artificial intelligence (AI) plays a significant role in the Metaverse, mainly through intelligent assistants, AI-generated content (AIGC), and virtual characters (West, 2022). AI enhances personalization by leveraging natural language processing (NLP) to create smart NPCs, improving the realism of user interactions (Floridi, 2021). Furthermore, AI contributes to automated

management and recommendation systems in social interactions, enhancing the sustainability of the Metaverse (Kaplan & Haenlein, 2020).

NFTs (Non-Fungible Tokens) are a crucial component of the Metaverse's economic system, enabling users to purchase, trade, and own unique digital assets such as virtual real estate, artwork, and fashion items (Smith & Jones, 2021). By leveraging blockchain technology, NFTs address the ownership issue of digital assets, allowing users to truly "own" virtual items rather than merely obtaining usage rights (De Filippi & Wright, 2018).

The Metaverse from a Social Science Perspective

The Metaverse is not merely a product of technological innovation but also a continuously evolving social space. From the perspective of social sciences, the formation and development of the Metaverse can be explained through social constructivism and virtual interaction theory.

Social constructivism posits that social relationships, identity formation, and cultural patterns in the real world are collectively created through human interactions (Berger & Luckmann, 1966). In the Metaverse, users engage in social interactions, economic transactions, and content creation through their virtual identities, thereby constructing a new form of social reality. This theory explains why individuals can establish stable social networks and develop a sense of identity and belonging within virtual worlds (Davis et al., 2021).

The virtual interaction theory, proposed by Blascovich and Bailenson (2011), suggests that human behavior in virtual environments is influenced by perceived immersion, social cognition, and situational norms. The stronger the sense of immersion in the Metaverse, the more realistically users behave within it. For instance, interactions in VR meetings or virtual classrooms closely resemble those in the real world, demonstrating the Metaverse's potential to shape human social behavior (Johnson et al., 2023).

Changes in Virtual Identity and Social Roles

With the development of the Metaverse, virtual identity is gradually becoming an extension of real-world identity, and in some cases, it may even surpass the importance of real-world identity (Kim, 2021). In traditional society, an individual's identity is primarily based on real-world social roles, such as profession, gender, and nationality. However, in the Metaverse, users can create entirely different virtual identities, which are not just replications of their real-world selves but may also diverge significantly from them (Davis et al., 2021). For example, a real-world teacher might become a virtual artist in the Metaverse, or an ordinary user might establish a strong social network in the digital world through their virtual identity.

In the Metaverse, human interactions are no longer limited by geographical boundaries, and the formation of social networks is increasingly based on shared interests, skills, and virtual communities (Park & Kim, 2022). Research suggests that virtual communities can enhance social participation but may also lead to social isolation and virtual addiction (West, 2022).

The rise of the Metaverse is not only the result of technological advancements but also a reflection of evolving social interaction patterns. From a technological perspective, VR, AR, blockchain,

AI, and NFTs collectively create a decentralized, immersive, and interconnected virtual world. From a social science perspective, the impact of the Metaverse on human social relationships can be understood through social constructivism and virtual interaction theory. Furthermore, the integration of virtual and real-world identities is shaping new social behavior patterns, leading to unprecedented changes in self-identity and social roles. In the future, as technology advances and governance frameworks improve, the Metaverse is expected to further influence economic, cultural, and legal systems.

Transformation of Social Relationships and Human Interaction

The social interaction model in the Metaverse differs significantly from traditional social networks of the internet era, such as Facebook and Twitter. Unlike these platforms, the Metaverse leverages immersive technologies and emphasizes virtual identity, interactive experience, and virtual communities (Blascovich & Bailenson, 2011). Within the Metaverse, users can create their own avatars, communicate within three-dimensional spaces, and participate in virtual activities such as meetings, social gatherings, and gaming (Kim, 2021).

The Reconstruction of Virtual Social Interaction

From a sociological perspective, the rise of virtual social interactions can be explained through social constructivism. Berger and Luckmann (1966) argued that social reality is continuously constructed through human interactions. The Metaverse redefines the ways in which people engage with one another in virtual environments, enabling users to overcome geographical and physical limitations to establish global social relationships (Davis et al., 2021).

Within these virtual social environments, social etiquette has become increasingly important. For instance, in VRChat, users are expected to maintain appropriate social distances to avoid "invading" others' personal space. Moreover, issues such as virtual harassment and verbal abuse have garnered growing attention, prompting platforms to introduce "Metaverse social etiquette" guidelines to regulate user behavior (West, 2022).

The reconstruction of virtual social interactions has not only transformed the way people engage with one another but has also introduced new social norms and challenges. These developments necessitate continuous governance adjustments by Metaverse platforms to foster a fairer and more inclusive virtual social environment.



The Transformation of Remote Work and Education

Social interactions in the Metaverse differ significantly from those in the real world, necessitating the reconstruction of etiquette and behavioral norms. For instance, the concept of social distance in virtual environments is fundamentally different from that in physical spaces. While users are not bound by physical constraints in virtual spaces, they still need to adhere to specific social distance norms and etiquette (West, 2022). Additionally, concerns regarding virtual harassment have emerged, including unauthorized intrusion into others' virtual spaces, inappropriate language, and disruptive behaviors (Kim, 2021).

Microsoft's Mesh and Meta's Workrooms are Metaverse-based platforms designed specifically for remote work, integrating VR/AR technologies to facilitate virtual meetings, 3D interactions, and collaborative work (Johnson et al., 2023). Traditional remote work primarily relies on video conferencing tools such as Zoom and Microsoft Teams. In contrast, Mesh and Workrooms provide a more immersive collaboration experience. For example, in Mesh, users can hold meetings in a 3D virtual office, utilize virtual whiteboards, and engage in real-time gesture interactions, enhancing teamwork efficiency (Kaplan & Haenlein, 2020).

Despite the potential of immersive remote work, several challenges remain. Prolonged use of VR devices may cause physical discomfort, while the lack of face-to-face emotional exchanges could impact team cohesion (Davis et al., 2021). Although virtual workspaces are becoming an integral part of future work models, further technological optimizations and new management strategies are required to better accommodate this emerging work paradigm.



The Reshaping of Social Organizations and Economic Models

With the increasing adoption of remote work, the Metaverse has introduced new digital workplace models, enhancing the efficiency of remote collaboration (Kaplan & Haenlein, 2020). In traditional remote work settings, employees typically rely on video conferencing and instant messaging tools. However, Metaverse-based work platforms such as Microsoft Mesh and Meta Workrooms enhance collaboration and immersion through virtual meetings, interactive whiteboards, and 3D interactions (Johnson et al., 2023).

Educational platforms are also leveraging Metaverse technologies to enhance learning efficiency. Engage, a VR-based educational platform, and Roblox Education, which focuses on gamified learning, are exploring how immersive technologies can improve education (Park & Kim, 2022). Engage allows students to participate in virtual classrooms and interact with teachers and peers. For instance, medical students can conduct virtual dissections, while history students can "travel" to ancient cities for an immersive historical learning experience (Johnson et al., 2023). Similarly, Roblox Education encourages students to engage in game-based learning, where they complete mathematical challenges or scientific experiments within virtual environments (Kim, 2021).



This paper explores the transformative impact of the Metaverse on virtual social interactions, remote work and education, and economic and organizational models. The findings suggest that the Metaverse is reshaping social relationships, fundamentally altering the way people socialize, work, learn, and engage in economic activities.

However, despite its potential, the development of the Metaverse still faces several challenges, including:

- The establishment of social norms in virtual environments.
- The optimization of remote work experiences to enhance productivity and employee well-being.
- Ensuring educational equity, particularly in access to immersive learning technologies.
- Addressing issues related to decentralized governance and the regulation of digital economies.

Future research must further investigate these challenges to ensure the sustainable development of Metaverse technologies, enabling them to contribute to a more inclusive, efficient, and ethically governed digital society.

Ethical, Legal, and Governance

Challenges in the Metaverse

With the rapid development of the Metaverse, human society is undergoing a profound technological transformation. This digital ecosystem, built upon core technologies such as Virtual Reality (VR), Augmented Reality (AR), Blockchain, and Artificial

Intelligence (AI), has introduced new economic, social, and governance models (Ball, 2022). However, despite its vast potential, the Metaverse also presents numerous governance and societal challenges, including legal frameworks, social equity, and ethical concerns (West, 2022).

Digital Governance and Legal Frameworks: Privacy Protection and Virtual Property Rights

One of the core characteristics of the Metaverse is its highly immersive interactive experience, which involves the massive collection and analysis of user biometric data (such as eye-tracking, facial recognition, and gesture control) and behavioral data (West, 2022).

From a legal perspective, while existing privacy regulations offer some degree of oversight, the decentralized and distributed nature of the Metaverse makes it difficult for traditional legal frameworks to fully regulate this emerging space. Scholars propose the establishment of a dynamic digital privacy governance system that integrates technological solutions, such as Zero-Knowledge Proofs (ZKP) and Decentralized Identifiers (DID), to enhance data security (Park & Kim, 2022).

Virtual assets, including virtual real estate, NFTs, and digital currencies, are emerging as new economic entities. However, the legal status and ownership rights of these assets remain ambiguous (Smith & Jones, 2021). The primary challenges include: Many countries have yet to legally recognize NFTs or virtual real estate, making it difficult for users to protect their digital property rights through legal means (De Filippi & Wright, 2018). Smart contracts enable the execution of asset transactions on the blockchain, but their irreversible nature poses risks, such as hacking incidents or code vulnerabilities (Kim, 2021). While decentralized economic models are gaining popularity, many virtual worlds—such as Meta's Horizon Worlds—are still centralized platforms, meaning that users' assets are subject to platform-imposed restrictions (West, 2022).

To address these issues, scholars advocate for the establishment of global virtual property rights regulations to protect users' legal interests in digital economies. Additionally, smart contract auditing, legal intervention mechanisms, and regulatory oversight could help mitigate potential legal disputes in virtual transactions (Nakamura, 2021).

Social Equity and the Digital Divide

Despite the Metaverse's promise of creating an inclusive virtual environment where users can equally participate in social, economic, and professional activities, significant digital divides have emerged (Park & Kim, 2022). One of the primary barriers is high hardware costs, as advanced VR devices such as Oculus Quest 3 and HTC Vive Pro remain expensive, making it difficult for low-income individuals to access the Metaverse. This has led to concerns over "technological elitism," where only those with sufficient financial resources can fully engage in virtual experiences (Nakamura, 2021). Another challenge is unequal network infrastructure, as high-speed internet and cloud computing are essential for seamless Metaverse interactions. However, many developing regions and rural areas lack the necessary technological infrastructure, restricting their ability to access virtual environments (Smith & Jones, 2021). Additionally, digital literacy

and skill gaps pose further obstacles, as Metaverse platforms require a certain level of technological proficiency. Given the unequal distribution of digital education resources, older adults and low-income communities may struggle to adapt, effectively excluding them from digital society (Johnson et al., 2023). To address these challenges, researchers propose reducing hardware costs by promoting affordable VR devices, expanding digital education programs to improve users' Metaverse-related skills, and encouraging government-private sector collaborations to enhance network infrastructure in underserved areas (West, 2022).

Beyond technological barriers, social and economic structures within the Metaverse still suffer from systemic biases. AI-driven recommendation systems, widely used in Metaverse platforms, often reinforce pre-existing societal biases related to gender, race, and age. In particular, AI-based hiring algorithms may perpetuate historical employment discrimination, unintentionally reducing fair job opportunities in the Metaverse (Floridi, 2021). Furthermore, economic opportunities in the Metaverse remain unequally distributed, as large corporations continue to dominate virtual commerce, limiting the ability of independent creators and small businesses to compete (Kim, 2021). To mitigate these issues, scholars suggest implementing transparent AI auditing mechanisms to prevent algorithmic discrimination in areas such as recruitment and content recommendations. Additionally, promoting decentralized economic models could help prevent market monopolization and ensure fairer access to financial opportunities in the Metaverse (De Filippi & Wright, 2018).

Metaverse Social Impact Survey Study

With the rapid development of Metaverse technology, its impact on social interactions, remote work and education, economic equity, and mental health has garnered widespread attention. This study adopts a questionnaire survey to explore the public's acceptance, user experience, and the potential social transformations and challenges brought about by the Metaverse. The survey was conducted from January 1, 2025, to February 15, 2025, collecting a total of 120 valid responses. Respondents covered different age groups and occupational backgrounds: 30% were aged 18-24, 35% were 25-34, 20% were 35-44, and 15% were 45 and above. In terms of occupation, 40% were students, 30% were corporate employees, 15% were freelancers, and 15% were classified as others (including government employees, researchers, etc.). Regarding usage, 35% of respondents used the Metaverse occasionally (1-3 times per month), 30% used it frequently (at least once a week), 15% were deep users (daily usage), while 20% had never used it.

The survey results indicate that 75% of respondents believe the Metaverse enhances social interactions, particularly by providing more opportunities for communication across regions and among individuals with social barriers. However, 40% expressed concerns that the Metaverse might reduce real-world social interactions, with some believing that over-reliance on virtual socializing could weaken real-life communication skills and lead to more superficial interpersonal connections. Additionally, 45% of users preferred interacting with real-life friends in the Metaverse, while 35% found it a platform for meeting new friends, and 20% considered virtual social experiences to be unsatisfactory.

Regarding remote work and education, 65% of respondents supported Metaverse-based remote work, believing it increases work flexibility. However, 35% felt that remote work was less efficient due to communication barriers, virtual fatigue, and the blurring boundaries between work and personal life. Additionally, 70% of respondents agreed that immersive learning enhances educational effectiveness, especially in fields requiring simulated operations such as medicine, engineering, and history. However, some were concerned that the high cost of VR devices might limit educational equity and affect students from lower socioeconomic backgrounds.

In terms of economic equity, 80% of respondents believed that the high cost of VR devices and high-speed internet could exacerbate the digital divide, preventing people in economically disadvantaged areas from participating equally in the Metaverse. Moreover, 60% of respondents worried that the Metaverse economy might be monopolized by large corporations. Currently, NFT transactions, virtual real estate, and DAO organizations are largely controlled by a small number of capital holders, making it difficult for ordinary users and small creators to compete and benefit from the Metaverse economy.

Regarding mental health and ethical concerns, 55% of respondents believed the Metaverse could lead to "virtual addiction," with some users reporting excessive immersion in Metaverse games or social activities, negatively affecting their studies and work. Additionally, 85% of respondents expressed concerns about data privacy, fearing that Metaverse platforms might misuse biometric data (such as eye tracking and gesture control) and that big data analytics and personalized recommendations could influence users' autonomy. Furthermore, 55% of respondents believed AI algorithms could cause bias in areas such as recruitment, social matching, and information recommendations due to deficiencies in training data, potentially leading to gender, racial, or age discrimination.

Regarding policy and regulation, 90% of respondents supported increased government regulation of the Metaverse, with key concerns including data privacy protection, virtual property rights, market competition fairness, and content governance. They believed stricter regulations should be enacted to ensure users have autonomy over their personal data and to establish a decentralized market regulatory framework to prevent tech giants from monopolizing the Metaverse economy. Many respondents also hoped for cooperation between governments and enterprises to reduce the cost of VR devices, improve technological accessibility, enhance network infrastructure, and promote Metaverse-related technology education, ensuring that people from all socioeconomic backgrounds can access the Metaverse fairly.

Overall, this survey indicates that the public holds a cautiously optimistic attitude toward the future of the Metaverse. While the Metaverse demonstrates great potential in social interactions, work, and education, it also faces challenges such as social isolation, remote work efficiency, economic equity, virtual addiction, and data privacy concerns. Most respondents support government intervention to ensure fair technological development and hope the Metaverse will lower entry barriers, enabling more people to access this emerging ecosystem fairly. Future development should focus on technological optimization, legal regulation, reducing the digital divide, protecting mental health, and increasing algorithm

transparency to ensure that the Metaverse evolves into a more equitable, healthy, and sustainable virtual world. The findings of this study provide valuable data support for policymakers, enterprises, and academia, contributing to the rational development of the Metaverse and maximizing its social value.

Future Prospects and Conclusion

As an emerging digital ecosystem, the Metaverse is profoundly impacting multiple aspects of human society, including social interactions, economic models, work structures, and cultural exchanges. With the continuous evolution of core technologies such as Virtual Reality (VR), Augmented Reality (AR), blockchain, and Artificial Intelligence (AI), the Metaverse is progressing toward greater immersion, intelligence, and decentralization. However, this rapidly advancing field also presents numerous challenges, including privacy protection, the digital divide, ethical norms, and governance frameworks. Therefore, analyzing future trends in the Metaverse and exploring ways to balance technological innovation with sustainable social development are crucial for its healthy growth. This paper examines the development direction of the Metaverse from the perspectives of technological evolution, social adaptation, policy regulation, and societal transformation. It also proposes policy recommendations to promote fairness and strengthen regulations, ensuring the sustainable development of the Metaverse.

The future Metaverse will likely experience breakthroughs in four key areas. First, advancements in VR and AR technologies will enhance immersion and interactivity, improving users' sensory experiences in virtual environments. Second, the development of AI will drive the intelligence of the Metaverse, including intelligent NPCs, personalized recommendation systems, and automated content generation, thereby increasing the realism and interactivity of user experiences. Third, a decentralized economic model will become a defining feature of the Metaverse. Blockchain, NFTs, and smart contracts will grant users greater virtual property rights, reducing centralized platforms' control over digital assets. Lastly, improvements in cloud computing and high-speed networks will enable the Metaverse to operate with low latency and high throughput, enhancing accessibility for users.

However, as technology advances, social adaptability issues cannot be ignored. Current legal and regulatory frameworks lag behind technological progress, making it difficult to effectively regulate data privacy, property rights, and content governance within the Metaverse. Additionally, the immersive nature of the Metaverse may exacerbate mental health issues such as virtual addiction and social isolation, further affecting users' real lives. Therefore, as society adapts to the Metaverse, comprehensive measures in legal, ethical, and educational aspects are necessary to mitigate potential social risks.

Governments, enterprises, and academic institutions need to collaborate to establish a rational regulatory framework that mitigates potential risks and protects user rights. First, dedicated legislation should be enacted to ensure data privacy and security, granting users the right to information, access, and deletion of their personal data to prevent misuse. Second, legal recognition of virtual property rights should be reinforced, ensuring users' digital assets are legally protected against arbitrary disposals by platforms or third parties. Additionally, for content governance, a

decentralized regulatory system is recommended, combining AI-powered content moderation with community-based governance models to curb misinformation, cyber harassment, and other violations in virtual spaces.

At the same time, the Metaverse may exacerbate social inequality, making equitable access a key policy concern. Lowering hardware costs and promoting affordable VR devices will help reduce the digital divide caused by expensive technology. Strengthening global technical education and training will enable people of all ages and socioeconomic backgrounds to adapt to Metaverse technologies and enhance digital literacy. Furthermore, governments and enterprises should invest in network infrastructure development in developing countries and remote areas to ensure global users can fairly access the Metaverse without being excluded due to geographic or economic constraints.

From the perspective of social relationships and human behavior, the Metaverse is reshaping social interactions, economic structures, and lifestyles. In terms of social interactions, virtual identities, immersive engagement, and global connectivity are transforming traditional communication methods, expanding interpersonal relationships from offline to virtual spaces. While this transformation offers broader social opportunities, it may also lead to social isolation, identity-related issues, and over-reliance on virtual interactions.

Economically, the Metaverse's virtual economy has begun to take shape. Decentralized finance (DeFi), NFT-based economies, and Decentralized Autonomous Organizations (DAOs) are altering traditional business models. While these emerging economic forms create new commercial opportunities worldwide, market speculation, virtual asset bubbles, and platform monopolies remain concerns requiring legal and regulatory oversight.

In the domains of work and education, remote work and immersive learning are becoming trends for the future. However, balancing virtual and real-world work environments and ensuring educational equity remain challenges that require further study. Moreover, the impact of the Metaverse on mental health is an issue that cannot be overlooked. Virtual addiction, algorithmic manipulation, and data security concerns may influence users' behaviors and psychological well-being. Therefore, ethical oversight must be strengthened alongside technological innovation to safeguard user welfare.

Overall, the rapid development of the Metaverse has introduced unprecedented social transformations while also presenting significant challenges. With advances in VR, AI, and blockchain, the Metaverse is expected to achieve breakthroughs in immersive experiences, intelligent interactions, and decentralized governance. However, technological progress must be accompanied by social governance to address issues such as privacy protection, virtual property rights, social equity, and ethical standards. Policymakers should enhance regulatory measures to ensure that technological innovation aligns with social responsibility, fostering the sustainable development of the Metaverse. Future research should further explore legal frameworks, ethical standards, and social impacts to ensure that the Metaverse ultimately creates a safe, fair, and inclusive virtual world for users worldwide.

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Statements and Declarations

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About the Authors

Mengyu Liu

Sookmyung Women's University, Korea

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Risk Perception and Trust-Building in AIGC Applications: A Bayesian Structural Equation Model Analysis

Manman Wei^{1*}, Zhiming Song^{1*}

¹ School of Economics / Jiangsu Normal University Kewen College, Xuzhou, China

*Corresponding author: sarahsonhengmincamille@gmail.com

Abstract

The rapid diffusion of generative artificial intelligence (AIGC) technologies is accompanied by multiple risks, which profoundly impact public acceptance and trust in the technology. This study integrates the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) and the Social Amplification of Risk Framework (SARF) to construct a theoretical model encompassing Risk Perception, System Trust, Risk Trust, Behavioral Intention, and Risk Prevention Sensitivity. Based on 696 valid survey responses from Jiangsu Province, a Bayesian Structural Equation Model (BSEM) is employed to empirically analyze the complex interactions among these variables. The results reveal that both Risk Perception and System Trust significantly and positively influence Risk Trust, with System Trust exerting a stronger effect. Furthermore, Risk Trust positively affects Behavioral Intention, while Risk Prevention Sensitivity demonstrates a significant negative inhibitory effect. Based on these findings, the study proposes policy recommendations such as enhancing algorithmic transparency, improving multi-stakeholder governance mechanisms, and strengthening public digital risk literacy to promote responsible innovation and effective governance of AIGC technologies.

Keywords: AIGC; Public Risk Perception; Risk Trust Mechanism; Behavioral Intention; Bayesian Structural Equation Model

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Introduction

Artificial Intelligence Generated Content (AIGC) technology is undergoing rapid development and widespread diffusion. Its core capabilities—such as text generation, image and video creation, and cross-modal content generation—have profoundly transformed the logic of digital content production and cultural communication, while reshaping the value chain of the cultural industry. However, alongside these technological advantages, a range of potential risks has emerged, including algorithmic opacity, lack of content credibility, and the accelerated spread of ethical biases (Liu et al., 2023; Qin et al., 2021). The pace at which these risks spread has far outstripped the responsiveness of governance mechanisms, resulting in a clear imbalance that constitutes the "Solow Paradox" of technological governance (Aleshkovski, 2022). This imbalance has further triggered a "Collingridge dilemma"-style reflection within academia on responsible innovation and risk management—namely, how to effectively identify and prevent systemic risks in the early stages of technological evolution, in order to avoid governance path dependency and social trust crises (Wong & Jensen, 2020). Therefore, establishing a multidimensional risk assessment system for AIGC applications and clarifying the nonlinear transmission mechanisms of risks across technological, social, and institutional networks has become an urgent requirement for achieving responsible innovation and stable societal development.

Risk perception theory suggests that when confronted with uncertain threats posed by emerging and complex technologies, the public often exhibits irrational cognitive biases such as "probability neglect" and "loss sensitivity" (Zhu, 2022). In the context of AIGC applications, such irrational tendencies in Risk Perception are particularly prominent. Given the algorithmic complexity and high degree of uncertainty associated with AIGC technologies, their

potential negative impacts are difficult to predict and may be irreversible. As a result, a more complex and subtle dynamic interaction exists between public Risk Perception and technological trust (Lim et al., 2023). Extended studies based on the Technology Acceptance Model (TAM) have confirmed that System Trust—a multidimensional and higher-order construct encompassing both technological reliability and institutional assurance—directly influences the formation of Risk Trust, and ultimately determines whether the public adopts the technology (Kaur & Arora, 2020). The "dual-threshold effect" theory of Risk Prevention Sensitivity further indicates that moderate risk awareness can encourage prudent technology adoption. However, when Risk Prevention Sensitivity exceeds a critical threshold, it may trigger avoidance and resistance toward the technology, thus hindering its broader dissemination (Gu et al., 2022).

However, traditional risk management research has largely been limited to the analysis of linear relationships and simplistic variable exploration, failing to effectively capture the more complex, nonlinear interactive effects among Risk Perception, trust mechanisms, and Behavioral Intention (Lin et al., 2024). Therefore, it is urgent to adopt a complex systems perspective and leverage more advanced and robust modeling approaches to deeply analyze the transmission pathways of AIGC-related risks and the dynamic interaction mechanisms of public trust. In response, this study integrates the extended Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) with the Social Amplification of Risk Framework (SARF) to more comprehensively explain and capture the dynamic interplay between public Risk Perception and trust-building processes. This approach aims to provide a solid theoretical foundation for constructing a risk management index system tailored to AIGC technologies.

Current academic research on technological Risk Perception and trust management has made significant progress. For instance, Yuqing (2024) confirmed that trust plays a significant mediating

and moderating role between Risk Perception and behavioral intention (Yuqing, 2024). Kaur and Arora (2020) further revealed that Risk Perception can exert an indirect yet significant influence on technology adoption intention through trust mechanisms (Kaur & Arora, 2020). Gu (2022) emphasized the dynamic, nonlinear coupling relationship between the transparency of risk communication and institutional trust, noting that information opacity may trigger a sharp decline in public trust (Gu et al., 2022). However, existing research still suffers from three main limitations: First, most studies have not sufficiently considered the potential nonlinear moderating effect of Risk Prevention Sensitivity, thereby failing to fully uncover the complex interactive mechanisms between Risk Perception and trust. Second, from a methodological perspective, traditional Structural Equation Modeling (SEM) is still widely used, despite its evident limitations in handling parameter uncertainty and small sample sizes. Third, regional studies often remain confined to single-dimensional analyses, lacking systematic, comprehensive, and regionally differentiated investigations into the transmission pathways of AIGC-related risks.

As a major hub for technological innovation in China, Jiangsu Province has in recent years actively pursued development strategies in artificial intelligence and the digital economy. It has accumulated rich practical experience in the AIGC field, while also revealing typical application risks and governance challenges. Therefore, taking Jiangsu Province as a representative region for studying AIGC risk assessment and governance pathways not only provides a scientific basis for decision-making by local governments and technology enterprises, but also offers valuable paradigmatic insights for risk governance in other regions. Specifically, conducting in-depth quantitative and path analyses of key dimensions—such as public Risk Perception, System Trust, Risk Trust, and Risk Prevention Sensitivity—can help optimize strategies for the social adoption of AIGC technologies, improve risk control systems and governance mechanisms, and provide robust theoretical and practical support for relevant policy formulation.

To effectively address the limitations of existing research, this study aims to achieve breakthroughs in three key areas at both the theoretical and methodological levels. First, at the theoretical level, drawing on the multi-level trust moderation mechanism proposed by Yuqing (2024), System Trust is introduced as a critical buffering variable to more deeply uncover the nonlinear transmission mechanisms among Risk Perception, Risk Trust, and public Behavioral Intention. Second, at the methodological level, the study integrates the analytical strengths of risk-trust balancing theory and Bayesian Structural Equation Modeling (BSEM), thereby overcoming the technical constraints of traditional SEM in dealing with parameter estimation uncertainty and small sample sizes. Third, at the regional governance level, the study innovatively incorporates the risk communication governance framework proposed by Gu et al. (2022), along with the institutional factors of Jiangsu Province's digital economy governance, in order to enhance the policy applicability and practical relevance of the research findings.

In summary, this study takes Jiangsu Province's representative experience as the empirical sample and adopts Bayesian Structural Equation Modeling as the core methodological approach to deeply analyze the complex interactive relationships and dynamic evolutionary mechanisms of Risk Perception, trust management, and risk governance in AIGC technology applications. This research not only responds to the academic demand for deeper exploration into technological risk management but also provides practical decision-making support for policy formulation in technology governance—forming the core logic and fundamental framework of this paper.

Literature Review

2.1 AIGC Technology Risks and Public Perception

Existing research indicates that the formation of AIGC-related risks exhibits distinct characteristics of technological generational shifts and cross-modal features. Unlike traditional AI technologies, which primarily involve algorithmic bias, AIGC risks are manifested in multiple dimensions such as the lack of content credibility and the ethical risks associated with content dissemination. Lin et al. (2024) conducted an empirical study revealing that semantic distortion is prevalent in AIGC-generated content, and that the dissemination speed of misinformation is 3.8 times higher than that of traditional user-generated content (UGC). This significantly heightens public concern regarding content credibility (Lin et al., 2024). Di (2024), in the context of new media, further pointed out that although improved GAN models have raised the accuracy of video tampering detection to 91%, the authenticity issues of deepfake-generated content still severely undermine public trust (Di, 2024). Additionally, Zhu (2022), through a study in the marketing field, demonstrated a nonlinear dissemination effect of ethical risks in AIGC content—where a single misleading promotional message may trigger an amplified “ripple effect,” thereby intensifying public Risk Perception (Zhu, 2022).

In terms of public Risk Perception, the application of AIGC technologies has exacerbated cognitive dilemmas. Neyazi (2023) found in an experimental study that more than 50% of users were unable to accurately identify the source of AIGC-generated content, and that there is an inverted U-shaped relationship between public cognitive bias and AIGC usage frequency (Neyazi et al., 2023). Similarly, Chen et al. (2023) noted in the medical field that when diagnostic advice generated by AIGC lacks sufficient interpretability, patients' Risk Perception increases dramatically. This finding confirms that the imbalance between technological complexity and users' cognitive capacity is a key factor in amplifying risk (Chen et al., 2023).

Taken together, these studies suggest that a salient characteristic of AIGC-related risks lies in the “overload effect” of public Risk Perception, wherein the complexity and uncertainty of the technology significantly amplify perceived risk. Therefore, this study identifies Risk Perception as one of the core latent variables, operationalized through three observed dimensions: perceived severity of consequences, likelihood of occurrence, and perceived uncontrollability. Accordingly, we propose Hypothesis H1: Risk Perception positively influences Risk Trust (derived from Qin et al., 2021, regarding the role of risk awareness in driving institutional trust).

2.2 AIGC Trust Crisis and Construction Pathways

The public trust crisis surrounding AIGC technologies stems from a dual dilemma inherent in the technology itself: First, the probabilistic and uncertain nature of AIGC-generated content makes it difficult for the public to establish stable psychological expectations; second, the ambiguity of the content generators leads to unclear accountability. Stein (2022), from a legal perspective, noted that liability determination costs in AIGC-related infringement cases are 43% higher than those in traditional AI systems, significantly weakening the institutional foundation of public trust (Stein, 2022). In response, Lin et al. (2024) proposed a content traceability method integrating blockchain and smart contracts, which significantly improves content credibility and represents an effective “technical anchoring” pathway (Lin et al., 2024). Zhang et al. (2024), in the context of autonomous driving, demonstrated that a cloud-edge-terminal distributed architecture can effectively reduce decision-making uncertainty and facilitate cross-scenario trust mechanisms (Zhang et al., 2024).

Regarding the mediating mechanisms of trust, two mainstream perspectives have emerged in academic discourse: technological transparency and institutional assurance. Howard et al. (2024) emphasized the importance of transparency in user interface design, confirming that transparency significantly enhances public trust levels (Howard & Schulte, 2024). Aleshkovski (2022) argued that a robust institutional compliance framework can significantly increase public tolerance of technological risks (Aleshkovski, 2022).

It is thus evident that the construction of AIGC trust mechanisms hinges on the co-evolution of “technological transparency” and “institutional assurance.” That is, enhancing technological maturity can improve the controllability of generated content, while strengthening the institutional framework can improve the public’s societal coping capacity. Accordingly, this study defines System Trust as a multidimensional latent variable encompassing technological transparency, technological maturity, and social coping capacity. We therefore propose Hypothesis H2: System Trust positively influences Risk Trust (in line with the technology attribute–trust transmission mechanism proposed by Kaur & Arora, 2020).

2.3 Evolution and Limitations of AIGC Risk Governance Models

Current research on AIGC technology risk governance models is undergoing a transformation across three dimensions: methodology, technical pathways, and governance perspectives. At the methodological level, there is a shift from traditional discrete risk assessment toward embedded governance during the content generation process. For example, Best et al. (2024) proposed a real-time monitoring model featuring government–enterprise collaboration, which effectively reduces the risk of content violations (Best et al., 2024). In terms of technical pathways, governance strategies have evolved from single-algorithm optimization to the coordinated governance of heterogeneous systems. Chen et al. (2023), for instance, used digital twin technology to maintain AI error rates at extremely low levels (Chen et al., 2023). From the governance perspective, research has gradually expanded from a focus on single-content regulation to the holistic governance of the AIGC ecosystem. Zhou et al. (2024) introduced a resource allocation algorithm to enable rapid risk response (Zhou et al., 2023).

However, these studies still exhibit several notable limitations. First, traditional analytical approaches struggle to capture relational risks across multimodal data. Second, static risk assessment frameworks fail to reflect the dynamic evolution of technological risks. Third, linear regression methods often overlook the nonlinear characteristics and moderating effects of the public’s Risk Prevention Sensitivity (Neyazi et al., 2023; Schaeffer et al., 2024). To address these challenges, this study introduces Bayesian Structural Equation Modeling (BSEM) to tackle issues related to parameter uncertainty and small-sample estimation. Simultaneously, it incorporates Risk Prevention Sensitivity as a latent variable, operationalized through three observed dimensions: risk assessment capability, self-protection ability, and alertness to new technologies. Accordingly, we propose the following hypotheses: H3: Risk Trust positively influences Behavioral Intention (extending the trust–behavior linear model proposed by Liu et al., 2023); H4: Risk Prevention Sensitivity negatively moderates Behavioral Intention (in line with the empirical conclusions on risk avoidance tendencies from Gu et al., 2022).

In conclusion, while existing academic research has systematically revealed the cross-modal nature of AIGC-related risks, as well as the internal mechanisms of public Risk Perception, trust crises, and governance pathways, limitations remain in understanding the nonlinear interactive effects between Risk Perception and trust, the moderating role of Risk Prevention Sensitivity, and regionally differentiated governance strategies. This study integrates prior findings by incorporating key latent

variables—Risk Perception, System Trust, Risk Trust, Risk Prevention Sensitivity, and Behavioral Intention—and employs Bayesian Structural Equation Modeling (BSEM) to explore the internal logic and governance pathways of AIGC risk transmission. In doing so, it aims to offer new research perspectives for both theoretical innovation and policy practice.

Methodology

3.1 Sampling Design and Data Collection

Data collection was conducted using a three-stage unequal probability sampling method. Compared to traditional equal probability sampling, unequal probability sampling better accounts for urban–rural differences, levels of economic development, and population structure characteristics, thereby enhancing the representativeness and heterogeneity of the sample. This approach ensures that the survey results more accurately reflect the socioeconomic diversity within Jiangsu Province. The survey was carried out simultaneously from July to August 2024 across northern, central, and southern regions of Jiangsu Province, targeting 12 selected neighborhoods in 6 prefecture-level cities. Respondents were local permanent residents.

The sample size was determined based on the finite population correction principle and calculated scientifically under a 95% confidence level ($Z = 1.96$). Taking into account the number of surveyed neighborhoods (12) and the population proportions of each city, the final effective sample size was set at 575 respondents. This sampling design not only meets the representativeness and data accuracy requirements of Bayesian Structural Equation Modeling (BSEM) but also provides a robust data foundation for addressing parameter uncertainty and conducting small-sample analysis in subsequent model estimation.

3.2 Construction of the Indicator System

Although the traditional Technology Acceptance Model (TAM) has been widely applied in early research on technology adoption, it has gradually revealed significant limitations in describing and explaining the interaction among risk perception, trust mechanisms, and behavioral intention in complex systems. To address this shortcoming, this study introduces the extended Unified Theory of Acceptance and Use of Technology (UTAUT2) and the Social Amplification of Risk Framework (SARF), and integrates the risk stratification theory, trust transmission model, and the risk–behavior interaction framework to construct a theoretical analytical path more suitable for the risk communication context of AIGC technologies (Stein, 2022; Seth, 2024; Wei et al., 2023).

UTAUT2 approaches technology adoption from the perspective of individual users, emphasizing how factors such as performance expectancy, social influence, and facilitating conditions affect usage intention and behavioral tendencies, with particular attention to the moderating role of situational and social contextual variables. In contrast, SARF adopts a macro-level societal perspective, revealing how risk information is amplified or attenuated through interactions among media, organizations, and the public, thereby influencing individual risk perception and group trust structures. The synergy between the two lies in UTAUT2 offering a micro-level cognitive–behavioral logic, while SARF elucidates the mechanisms through which risk information and trust are transmitted within broader societal contexts. Through this theoretical complementarity, the study captures both the cognitive response mechanisms of individual users facing AIGC technologies and how societal risk information is constructed and disseminated via media and trust networks to influence behavioral intention. Based on this integrative perspective, a risk management index system comprising five core latent variables and fifteen observed indicators is established (see Table 1), enabling a more systematic exploration of the dynamic relationships among public perception, trust, and behavioral intention.

Table 1. Measurement Framework for Risk Perception and Trust-Building in AIGC Applications

Latent Variable	Indicator Code	Observed Indicator
Risk Perception (A)	A1	Severity of risk consequences
	A2	Likelihood of risk occurrence
	A3	Perceived uncontrollability of risks
System Trust (B)	B1	Technological transparency
	B2	Technological maturity
	B3	Social coping capacity
Risk Trust (C)	C1	Trust in government regulation
	C2	Trust in technology enterprises
	C3	Trust in public participation mechanisms
Behavioral Intention (D)	D1	Willingness to try the technology
	D2	Willingness to support technology promotion
	D3	Willingness to engage in risk prevention
Risk Prevention Sensitivity (E)	E1	Risk assessment capability
	E2	Self-protection ability
	E3	Alertness to new technologies

Specifically, Risk Perception (A) draws on the Social Amplification of Risk Framework (SARF), which emphasizes how risks are amplified through societal processes. It begins with the public's subjective evaluation of technological threats and incorporates three dimensions—severity of consequences, likelihood of occurrence, and perceived uncontrollability—to comprehensively capture the amplification effects and subjective characteristics of risks in public cognition.

System Trust (B), informed by the UTAUT2 framework's focus on contextual factors and social expectancy effects, integrates three indicators—technological transparency, technological maturity, and social coping capacity—to reflect the public's overall trust in the AIGC application environment.

From the perspective of social governance, Risk Trust (C) is assessed through three dimensions: trust in government regulation, trust in technology enterprises, and trust in public participation mechanisms. These indicators evaluate the credibility of risk governance actors within social interaction and communication processes, embodying SARF's emphasis on the moderating role of institutional factors in shaping Risk Perception.

Behavioral Intention (D) is grounded in UTAUT2's assertion of the relationship between individual technology adoption and social influence. It is further specified into three dimensions: willingness to adopt the technology, willingness to support its promotion, and willingness to participate in collaborative risk governance—thus reflecting the public's practical inclination to engage in risk governance activities.

Finally, Risk Prevention Sensitivity (E) is conceptualized based on SARF's recognition of individual differences in risk response behavior. It captures the public's sensitivity to risk and its moderating effect on Behavioral Intention through three components: risk assessment capability, self-protection ability, and alertness to new technologies.

3.3 Construction of the Bayesian Structural Equation Model

Given the limitations of traditional Structural Equation Modeling (SEM) regarding assumptions of data distribution and sample size requirements, this study adopts Bayesian Structural Equation Modeling (BSEM) as a methodological alternative. Classical SEM typically relies on maximum likelihood estimation (MLE), which assumes that the data follow a multivariate normal distribution and requires a relatively large sample size to ensure stable parameter estimation. However, in practical survey research, these assumptions are often difficult to meet—especially when the

sample size is limited or the data deviate from normality—leading to biased parameter estimates and underestimated standard errors (Song & Lee, 2012). In addition, traditional SEM does not effectively incorporate researchers' prior knowledge or theoretical expectations into the model, which constrains its flexibility and explanatory power.

In contrast, BSEM treats parameters as random variables and incorporates prior distributions, enabling more robust estimation by integrating both observed data and theoretical information, while imposing less stringent assumptions on data distribution (Zhou et al., 2023). This approach not only enhances the model's adaptability in small-sample contexts but also quantifies estimation uncertainty through posterior distributions, thereby reducing the risk of overfitting. As such, BSEM is better aligned with the practical needs of this study, which involves path analysis under conditions of non-normality and limited sample size (Chen et al., 2024).

Specifically, the BSEM method employed in this study involves two core steps: First, the standardized path coefficients from classical SEM are converted into weakly informative prior distributions, thereby reasonably constraining the parameter estimation range. Second, Markov Chain Monte Carlo (MCMC) sampling is used to obtain the posterior distributions of parameters. The fit between the theoretical model and the empirical data is assessed through posterior predictive checks, forming an iterative optimization framework that combines prior specification, parameter estimation, and model validation, thus improving the accuracy and robustness of hypothesis testing.

3.3.1 Measurement Model and Structural Model Construction

The measurement and structural models provide the foundation for SEM by defining the relationships among latent variables. In this study, five latent variables are each associated with three observed variables. Let the vector of observed variables be defined as $y = [y_1, y_2, \dots, y_{15}]^T$, and the vector of latent variables be denoted as ω , which includes exogenous latent variables $\xi = [\xi_A, \xi_B, \xi_E]^T$ and endogenous latent variables $\eta = [\eta_C, \eta_D]^T$. The measurement model is expressed as:

$$y = \Lambda\omega + \epsilon, \quad (1)$$

where Λ is a 15×5 factor loading matrix and ϵ is a 15×1 measurement error vector, assumed to follow a normal distribution with mean 0 and variance Ψ_ϵ .

The structural model describes the causal relationships among latent variables. The relationships between the endogenous and exogenous latent variables are expressed as:

$$\eta = \Pi\eta + \Gamma\xi + \delta, \quad (2)$$

where Π and Γ are parameter matrices to be estimated, and δ is a normally distributed error vector with mean 0 and variance Ψ_δ . The error terms ϵ and δ are assumed to be independent. The exogenous latent variables ξ follow a normal distribution with mean 0 and variance Φ (Jie-Ling & Yuan-Chang, 2021). The specific structural relationships among the latent variables in this study are represented as:

$$\begin{cases} \eta_C = \gamma_1\xi_A + \gamma_2\xi_B + \delta_1 \\ \eta_D = \beta\eta_C + \gamma_5\xi_D + \delta_2 \end{cases} \quad (3)$$

where ξ_A, ξ_B , and ξ_E follow normal distributions $N[0, \Phi]$, and the error terms δ follow $N[0, \Psi_\delta]$ accordingly.

3.3.2 Bayesian Inference Foundations and Specification

BSEM estimates SEM models using the Bayesian approach. Let the observed data be denoted as $Y = (y_1, \dots, y_n)$, where each observation vector $y_i \in R^{15}$ corresponds to a latent variable vector $\omega_i \in R^5$. The model parameters are represented as $\theta = (\Lambda, \Phi, \Psi_\epsilon)$, which include:

- (1) The factor loading matrix Λ (from the measurement model);
- (2) The covariance matrix of exogenous latent variables Φ (from the structural model);

(3) The measurement error covariance matrix Ψ_ϵ , typically assumed to be diagonal.

The joint posterior distribution is derived from Bayes' Theorem and decomposed as follows:

$$p(\theta, \Omega | Y) \propto \underbrace{p(Y | \Omega, \theta)}_{\text{Likelihood}} \cdot \underbrace{p(\Omega | \theta)}_{\text{Prior}} \cdot p(\theta), \quad (4)$$

Where $\Omega = (\omega_1, \dots, \omega_n)$ is the matrix of latent variables, and θ is the vector of structural parameters. In BSEM, the latent variable matrix is treated as missing data via data augmentation, and is estimated jointly with the model parameters. This approach increases the flexibility of the model and enhances estimation efficiency (Bollen, 1989).

3.3.3 Theory-Driven Hierarchical Prior Structure

The model construction follows the principles of Bayesian hierarchical modeling (Cohen, 1992), using multi-level prior constraints to ensure both model identifiability and parameter stability. Traditional SEM standardized path coefficients are employed to guide the specification of Bayesian priors, enabling an organic integration of prior knowledge with observed data. This approach offers several advantages: it accelerates convergence, reduces uncertainty in the parameter space, constrains parameter ranges to prevent overfitting, incorporates findings from existing studies to improve model reliability, and limits the occurrence of extreme or implausible values, thus enhancing model stability and validity under small-sample conditions.

1. Latent Variable Centering Priors:

Exogenous latent variables $\xi \in \{\xi_A, \xi_B, \xi_E\}$ are assigned a normal prior $\xi \sim N(0, 0.5^2)$. Endogenous latent variables $\eta \in \{\eta_C, \eta_D\}$ are similarly assumed to follow $\eta \sim N(0, 0.5^2)$. These priors reflect the standardization assumption for latent variables (Stein, 2022), and the variance parameter is determined through preliminary simulation experiments to balance prior informativeness with estimation flexibility.

2. Regularized Priors for Factor Loadings:

In the measurement model $y_{ij} = \lambda_j \xi_i + \epsilon_{ij}$, each latent variable is measured by three observed variables. The prior distribution for each factor loading λ_j is defined as:

$$\lambda_j \sim N([1, 1, 1], 0.1^2 \mathbf{I}_3), \quad j = 1, 2, 3, 4, 5 \quad (5)$$

where \mathbf{I}_3 is the 3×3 identity matrix. Setting the mean of the factor loadings to 1 reflects a "unit variance identification" strategy, while allowing a standard deviation of ± 0.2 accommodates imperfections in the measurement instruments.

3. Random Effects in the Structural Equations:

A Gaussian process is introduced to model uncertainty in the structural layer of latent variable relationships:

$$\eta_C \sim N(\mu = \gamma_1 \xi_A + \gamma_2 \xi_B, \sigma = 0.2), \quad (6)$$

$$\eta_D \sim N(\mu = \beta \eta_C + \gamma_5 \xi_D, \sigma = 0.2). \quad (7)$$

The additive structure implies path coefficients $\gamma_{A \rightarrow C} = \gamma_{B \rightarrow C} = 1$, and the standard deviation parameter σ characterizes the uncertainty in the structural equations. The choice of $\sigma = 0.2$ is informed by typical effect sizes in psychological research (Zhou et al., 2023).

4. Hierarchical Error Structure for Enhanced Measurement Precision: A layered error specification is adopted: the measurement error follows $\epsilon_{\text{measure}} \sim N(0, 0.5^2)$, representing standardized residuals of observed variables; the structural equation error follows $\epsilon_{\text{struct}} \sim N(0, 0.2^2)$, capturing unexplained variance among latent variables.

3.3.4 Posterior Inference and Model Diagnostics Framework

In the BSEM framework, the joint posterior distribution of model parameters and latent variables, $p(\theta, \Omega | Y)$, generally has no closed-form solution. Markov Chain Monte Carlo (MCMC) is a numerical method designed to draw samples from complex high-dimensional distributions by constructing a Markov chain whose

stationary distribution equals the target posterior. The core idea is to construct a Markov chain by designing a transition kernel $K(\theta^{(t+1)} | \theta^{(t)})$, such that the chain's stationary distribution $\pi(\theta)$ equals the posterior distribution $p(\theta | Y)$.

This study adopts a Bayesian inference framework, using the No-U-Turn Sampler (NUTS) algorithm to implement MCMC sampling. The model initiates four independent Markov chains, each running for 4,000 iterations (including the first 1,000 as an adaptive tuning phase), yielding a total of 12,000 posterior samples. Sampling efficiency is ensured through a dual mechanism:

1. During the tuning phase, the step size is dynamically optimized to maintain an average acceptance rate within the recommended range of 65%–80%;

2. The number of iterations is extended to reduce autocorrelation between samples and ensure that the effective sample size (ESS) of key parameters exceeds 400, thus satisfying the Monte Carlo standard error (MCSE) precision threshold of less than 5% of the standard deviation.

Model convergence is verified through a three-stage diagnostic procedure:

1. Joint Distribution Testing of Variable Relationships: This test is based on the logic of Bayesian posterior distributions. Through kernel density estimation and scatterplot matrix analysis, the statistical associations and co-variation trends between latent and observed variables are evaluated. Under multivariate model structures, this method helps identify potential nonlinear relationships and multicollinearity issues, validating the construct validity of the measurement model. By examining the shape and structure of joint distributions, the rationality of model specification can be assessed, providing theoretical support for subsequent path coefficient estimation.

2. Bayesian Model Diagnostics: To ensure the effectiveness of the MCMC sampling process and the reliability of model convergence, diagnostics such as trace plots, autocorrelation coefficients, and the Gelman–Rubin convergence statistic are employed. These tools help determine whether the sampling chains have reached a stationary state and whether parameter estimates are sufficiently precise. This prevents estimation bias due to non-convergent chains or inefficient sampling and enhances the credibility of the model's inferential results.

3. Posterior Distribution and Highest Density Interval (HDI) Testing: Posterior uncertainty is quantified using the shape of the posterior distribution and Highest Density Interval (HDI) analysis. Unlike traditional point estimates, HDIs provide probabilistic interval estimates that more comprehensively reflect the central tendency and variability of parameters. This approach addresses the limitations of frequentist point estimates and improves the interpretability of results under uncertainty.

Together, these three diagnostics ensure the scientific rigor and explanatory power of the model estimation process.

Results

4.1 Data Cleaning and Preliminary Testing

A total of 759 questionnaires were collected during the formal survey. After screening for logical consistency and removing responses with completion times below 60 seconds or above 300 seconds, a final valid sample of 696 responses was obtained, yielding an effective response rate of 91.70%. The sample showed a slightly higher proportion of female participants and was predominantly composed of younger respondents (see Table 2). After excluding demographic variables such as age, education, and gender, reliability and validity tests were conducted on the remaining 19 scale items. The Cronbach's alpha coefficient was calculated to be 0.912, and the Kaiser-Meyer-Olkin (KMO) value was 0.946, indicating high reliability and suitability for factor analysis.

Table 2. Demographic Characteristics of the Sample

Item	Category	Sample Size	Proportion
Gender	Male	318	45.7%
	Female	378	54.3%
Age	Under 18	43	6.2%
	18–30	407	58.5%
	31–40	154	22.1%
	41–50	63	9.1%
	Over 50	29	4.2%
Education	Junior high or below	25	3.6%
	High school/vocational	92	13.2%
	Associate degree	74	10.6%
	Bachelor's degree	471	67.7%
	Master's and above	34	4.9%

A two-stage Confirmatory Factor Analysis (CFA) was conducted to assess the reliability and validity of the measurement model. First, results from the convergent validity analysis (see Table 3) showed that all standardized factor loadings for observed variables ranged from 0.775 to 0.865 ($CR > 2.58$, $p < 0.001$), meeting standard thresholds of significance. The Composite Reliability (CR) of each latent construct ranged from 0.831 to 0.871, and the Average Variance Extracted (AVE) ranged from 0.606 to 0.692 (see Table 4), all exceeding the benchmarks recommended by the Fornell–Larcker criterion, indicating excellent internal consistency and discriminant validity of the measurement scales.

Table 3. Convergent Validity Results

Latent Construct	Indicator	Std. Estimate	z (CR)	p-value
Risk Perception (A)	A1	0.833	-	-
	A2	0.806	24.460	0.000
	A3	0.848	26.233	0.000
System Trust (B)	B1	0.781	-	-
	B2	0.780	20.959	0.000
	B3	0.775	20.813	0.000
Risk Trust (C)	C1	0.767	-	-
	C2	0.785	21.936	0.000
	C3	0.811	22.807	0.000
Behavioral Intention (D)	D1	0.807	-	-
	D2	0.811	20.825	0.000
	D3	0.764	19.906	0.000
Risk Prevention Sensitivity (E)	E1	0.836	-	-
	E2	0.794	24.519	0.000
	E3	0.865	27.860	0.000

Table 4. Confirmatory Factor Analysis Results

Dimension	AVE	CR	Reliability Evaluation
Risk Perception	0.688	0.869	Very High
System Trust	0.606	0.822	Very High
Risk Trust	0.621	0.831	Very High
Behavioral Intention	0.631	0.837	Very High
Risk Prevention Sensitivity	0.692	0.871	Very High

4.2 Traditional SEM Path Coefficient Estimation

To enhance the stability and convergence of path coefficient estimation in the Bayesian Structural Equation Model (BSEM), the standardized path coefficients derived from the traditional Structural Equation Model (SEM) were used as informative priors for the Bayesian framework. Initially, a conventional SEM was used to estimate path coefficients and evaluate model fit. As shown in Table 5, the model's chi-square to degrees-of-freedom ratio is 2.932, meeting the recommended threshold of <3 . Other goodness-of-fit indices (NFI, IFI, CFI, GFI) all exceed the critical value of 0.9, indicating a good model fit.

As presented in Table 6, the estimated standardized path coefficient from risk perception to risk trust is 0.429 ($p < 0.001$), and from system trust to risk trust is 0.598 ($p < 0.001$). The influence of risk trust on behavioral intention is 0.966 ($p < 0.001$), while risk prevention sensitivity shows a significant negative effect on behavioral intention, with a coefficient of -0.386 ($p < 0.001$). All path coefficients are statistically significant and align with theoretical expectations.

Table 5. Model Fit Indices

Fit Index	Acceptable Range		Observed Value	Fit Evaluation
	Acceptable	Good		
χ^2/df	2-3	<2	2.932	Acceptable
NFI	0.7-0.9	≥ 0.9	0.961	Good
IFI	0.7-0.9	≥ 0.9	0.973	Good
CFI	0.7-0.9	≥ 0.9	0.973	Good
GFI	0.7-0.9	≥ 0.9	0.950	Good

Table 6. Path Coefficients and Significance Testing

Predictor	Outcome	Std. Coefficient	SE	z (CR)	p-value
Risk Perception	Risk Trust	0.429	0.043	8.751	***
System Trust	Risk Trust	0.598	0.054	11.178	***
Risk Trust	Behavioral Intention	0.966	0.149	6.617	***
Risk Prevention Sensitivity	Behavioral Intention	-0.386	0.137	-2.731	***

4.3 Bayesian Structural Equation Model (BSEM): Posterior Distribution Diagnostics

This study employed the PyMC library to construct a Bayesian Structural Equation Model (BSEM) and estimate posterior distributions using the Markov Chain Monte Carlo (MCMC) algorithm. The model was built in three key stages:

1. Model specification: Based on the theoretical framework, structural paths between latent and observed variables were defined.

2. Prior setting: Standardized path coefficients obtained from traditional SEM were incorporated as weakly informative priors to accelerate convergence.

3. Posterior estimation: MCMC sampling was conducted to estimate the posterior distributions of model parameters.

After model construction, a three-stage diagnostic framework was employed to assess robustness, reliability, and validity of parameter estimates.

4.3.1 Joint Distribution Diagnostics of Variable Relationships

The first diagnostic step involved assessing the joint distribution between latent variables and observed indicators using kernel density estimation and scatterplot matrix analysis (see Figure 1). The results indicate that the marginal distributions (diagonal) and joint distributions (off-diagonal) of all latent constructs and factor loading parameters form elliptical or approximately circular high-

density regions. No evidence of multimodality, severe skewness, extreme collinearity, or outliers was detected. These findings suggest that the posterior distributions are well-behaved, with strong convergence and stability.

In sum, the posterior and joint distributions demonstrate no abnormalities, indicating that the model produces robust estimates of latent variables and their loadings.

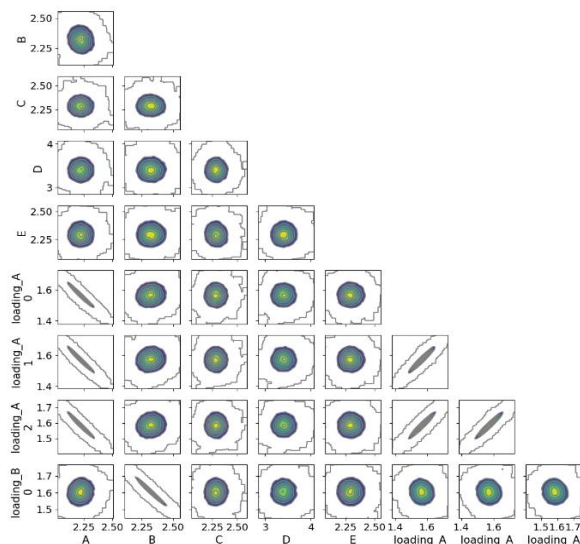


Figure 1. Joint Distribution Plot of Variable Relationships

4.3.2 Bayesian Model Diagnostics

The second stage focused on assessing the stability of parameter estimation through MCMC convergence diagnostics. Specifically, the Gelman-Rubin diagnostic criterion (i.e., Potential Scale Reduction Factor, PSRF) was employed to evaluate the mixing behavior and within-chain autocorrelation across four independent MCMC sampling chains.

The diagnostic plots comprise the marginal posterior distributions (left panel) and MCMC sampling traces (right panel) for each parameter. The marginal distribution plots display smooth, symmetric posterior curves without visible anomalies. In the trace plots, most sampling chains stabilize after a short burn-in period, with high overlap and interweaving among chains—indicating minimal differences between chains. All PSRF values were below the conventional threshold of 1.05, confirming that the model had reached a satisfactory level of convergence.

Although minor fluctuations appeared in the trace plots of a few path loadings, the amplitude of these variations remained within acceptable bounds and did not compromise overall convergence. These results validate the reliability and robustness of parameter estimation, ensuring the effectiveness of the subsequent Bayesian structural model analysis.

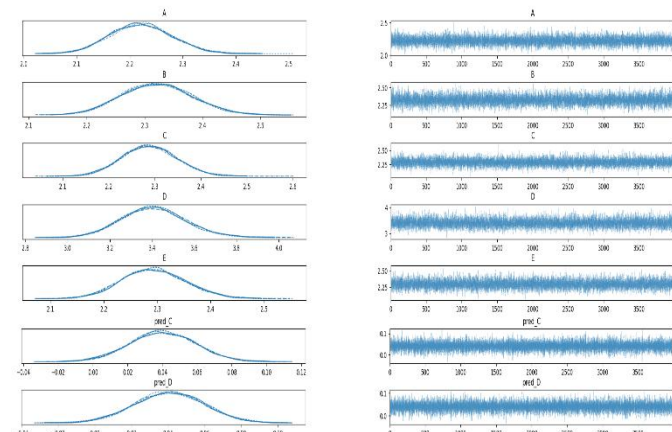


Figure 2. Bayesian Model Diagnostic Plot

4.3.3 Posterior Distribution and Highest Density Interval (HDI) Analysis

The third stage involved a detailed examination of the posterior distributions and the Highest Density Intervals (HDIs) of the model parameters, aimed at evaluating estimation accuracy and parameter uncertainty.

The posterior plots revealed that all model parameters exhibited unimodal and symmetric posterior distributions with well-defined peaks and density concentrated around the parameter means. This pattern indicates that the parameter estimates derived from Bayesian inference are highly credible and stable.

Moreover, analysis of the 94% HDI intervals—which represent the range containing the most credible 94% of the posterior probability mass—demonstrated that all HDIs were narrow and did not include zero, further supporting the low uncertainty in parameter estimates and the model's strong explanatory power for the observed data.

Taken together, the diagnostic results from this stage provide compelling evidence that the BSEM constructed in this study offers precise and robust parameter estimates, lending strong theoretical reliability and practical value to the conclusions drawn from the model.

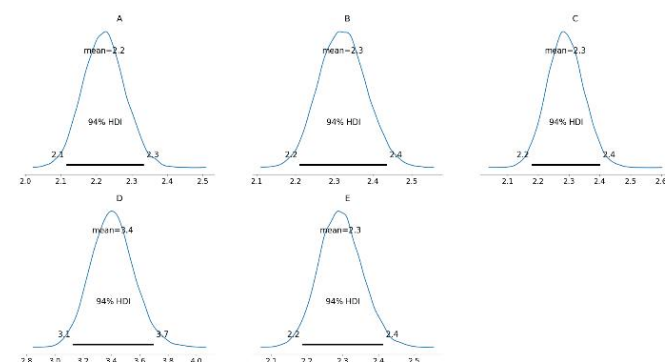


Figure 3. Posterior Distribution and Highest Density Interval Plot

4.4 Bayesian Structural Equation Path Analysis

The results confirm that the BSEM demonstrates good model fit and stability, and that its parameter estimates are reliable, providing a robust statistical foundation for inferring and interpreting path coefficients. On this basis, the path coefficients derived through Bayesian inference further uncover the causal relationships and influence pathways among latent variables, offering in-depth empirical insights into the model's theoretical significance and practical implications.

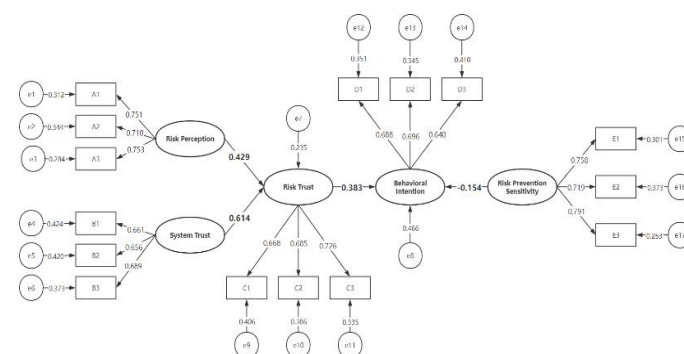


Figure 4. Path Diagram of Standardized Parameter Estimates in Bayesian SEM

The path analysis results based on the BSEM (see Figure 4) reveal the underlying causal relationships and mechanisms of influence among key constructs. First, the path coefficient from Risk Perception (A) to Risk Trust (C) is 0.429, indicating a significant positive effect and supporting Hypothesis H1. This

suggests that as individuals' risk perception increases, their level of risk trust also tends to rise. Second, the path coefficient from System Trust (B) to Risk Trust (C) is 0.614, thereby supporting Hypothesis H2. This indicates that system trust is a stronger determinant of risk trust—higher system trust levels can substantially enhance individuals' willingness to trust in risky situations. In addition, the path coefficient from Risk Trust (C) to Behavioral Intention (D) is 0.383, validating Hypothesis H3, which implies that higher levels of risk trust are associated with more proactive behavioral intentions. Notably, the path coefficient from Risk Prevention Sensitivity (E) to Behavioral Intention (D) is -0.154, indicating a negative relationship. This suggests that heightened sensitivity to risk prevention may suppress behavioral intention, possibly due to excessive risk vigilance, thus confirming Hypothesis H4.

These path coefficients provide empirical support for the proposed research hypotheses, reflecting the core relational structure of the model and the interaction mechanisms among variables. The findings offer valuable theoretical guidance for optimizing risk management strategies and building effective trust mechanisms.

Conclusion

5.1 Core Pathway Analysis

1. Risk Perception (A) → Risk Trust (C) ($\beta = 0.429$)

The results of the Bayesian Structural Equation Modeling (BSEM) indicate that risk perception exerts a significant positive effect on the public's risk trust. At first glance, this finding appears to contradict conventional assumptions, but it can be reasonably interpreted from the perspectives of technological black-box characteristics and risk communication.

In the context of Artificial Intelligence Generated Content (AIGC) technologies, the opaque and algorithmically complex nature of such systems makes it difficult for the public to directly assess risk levels. As a result, individuals are compelled to construct trust through systematic cognitive processing. According to dual-process theory, people typically rely on both rational cognition and emotional intuition when processing risk-related information (Selvarajan et al., 2024). A high level of risk perception regarding AIGC technology often indicates that individuals have cognitively evaluated the potential risks and corresponding mitigation mechanisms, thereby forming a kind of "calibrated" rational trust.

This finding aligns with risk society theory, which emphasizes the paradoxical relationship between the public and expert systems in modern society: due to limitations in lay knowledge, individuals often seek institutional support and informational transparency—paradoxically reinforcing their trust in risk governance mechanisms. Moreover, the Social Amplification of Risk Framework (SARF) suggests that when risk information is sufficiently transparent, even heightened risk perception may coexist with strong risk trust, as individuals perceive existing governance measures to be effective (Li et al., 2024).

Existing research in the AIGC domain also supports this view, showing that functional risk perception tends to positively influence technology trust, whereas emotional risk perception often diminishes it. This indicates that a clear and comprehensive understanding of technological risks can facilitate the formation of rational trust among the public (Niculae, 2023). Therefore, enhancing the transparency and explanatory power of risk communication is crucial for promoting rational public engagement with risk and achieving effective AIGC governance.

2. System Trust (B) → Risk Trust (C) ($\beta = 0.614$)

The findings further show that system trust has a particularly significant impact on risk trust, with a path coefficient of 0.614. This suggests that public trust in the broader technological

environment—including technology providers, regulatory institutions, and institutional frameworks—serves as a key antecedent of risk trust.

This conclusion echoes the UTAUT2 model's emphasis on contextual and environmental factors in technology acceptance: when evaluating technological risks, individuals often rely on their trust in external institutions as a cognitive shortcut. This heuristic processing is consistent with risk communication theory, which posits that public trust in authoritative entities such as governments and scientific organizations helps mitigate uncertainty associated with emerging technologies (Peng et al., 2024).

Moreover, the finding aligns with the "abstract system trust" perspective in risk society theory, which contends that modern societies heavily depend on institutionalized expertise and systemic trust to alleviate anxiety arising from technological complexity. In the case of AIGC, the high degree of algorithmic complexity often renders the technology incomprehensible to lay users, who end up placing blind trust in its outputs. Consequently, institutional trust guarantees become critically important for shaping public perceptions and behaviors (Sands et al., 2022).

In sum, enhancing institutional credibility and promoting multi-stakeholder collaborative governance are essential strategies for effectively increasing public risk trust in the context of AIGC technologies.

3. Risk Trust (C) → Behavioral Intention (D) ($\beta = 0.383$)

The positive effect of risk trust on behavioral intention indicates that when the public has sufficient trust in the risk management capabilities of AIGC technologies, they are more likely to exhibit a favorable intention to adopt such technologies. This finding is highly consistent with both UTAUT2 and the extended Technology Acceptance Model (TAM), which emphasize trust as a critical mediating factor in technology adoption decisions.

Although AIGC technologies may offer substantial performance benefits and convenience, a lack of trust can significantly reduce users' willingness to adopt them (Wong & Jensen, 2020). Empirical studies in the field of artificial intelligence have reached similar conclusions, showing that trust effectively reduces risk perception and enhances positive evaluations of the technology, thereby promoting its adoption (Aleshkovski, 2022).

In the present context, when individuals believe that AIGC systems can effectively mitigate their inherent risks, they are more inclined to focus on the tangible benefits these technologies can bring, which in turn enhances their intention to use. Therefore, strengthening public trust in AIGC risk governance emerges as a key pathway to facilitating technology adoption, and this study provides empirical support for such a mechanism.

4. Risk Prevention Sensitivity (E) → Behavioral Intention (D) ($\beta = -0.154$)

The study also finds that risk prevention sensitivity has a significant negative impact on behavioral intention, suggesting that individuals who are overly sensitive to risk prevention tend to exhibit lower levels of willingness to adopt new technologies. This phenomenon reflects the inhibitory effect of risk aversion tendencies on the acceptance of emerging technologies, which aligns with the diffusion of innovation theory, where higher perceived risk is associated with lower technology adoption (Salles & Farisco, 2020).

According to the Social Amplification of Risk Framework (SARF), individuals with high risk prevention sensitivity are more susceptible to negative risk information disseminated through media and social channels, and thus are more likely to avoid potential uncertainties associated with technology use. Dual-process theory further explains this behavior by indicating that highly risk-sensitive individuals are prone to rely on emotion-driven heuristic processing, rather than engaging in deep cognitive analysis of the actual risks and benefits of a given technology (Li et

al., 2024). This cognitive pattern increases the likelihood of technology avoidance.

Additionally, risk society theory posits that under high uncertainty, some individuals adopt a "better safe than sorry" attitude, leading to conservative or even resistant stances toward new technologies. However, the relatively small effect size of this path ($\beta = -0.154$) in the current study suggests that most members of the public are not dominated by excessive fear or avoidance.

Therefore, targeted risk education and strategic communication can play a crucial role in alleviating public over-sensitivity to risk, thereby promoting more rational and balanced technology adoption.

5.2 Policy Recommendations

Based on the findings from the path analysis, this study proposes three key policy recommendations:

First, enhance technological transparency and explainability. Enterprises should be encouraged to develop explainable artificial intelligence (XAI) systems, disclosing the basic principles, decision-making logic, and risk control mechanisms of algorithms without compromising commercial confidentiality. A government-led framework for algorithmic transparency standards should be established, incorporating third-party certification mechanisms to reduce uncertainty stemming from the "black-box" nature of AIGC technologies.

Second, strengthen institutional trust through multi-stakeholder collaborative governance. Governments should clarify the legal accountability boundaries of AIGC technologies, implement stringent safety and management standards, and foster governance platforms that involve enterprises, research institutions, industry associations, and public representatives. Such inclusive and authoritative institutional frameworks are essential to consolidating public trust.

Third, advance public education and cognitive-ecological interventions. Proactive monitoring of risk-related information and timely disinformation correction should be prioritized to prevent the amplification of negative perceptions. Additionally, platform algorithms should be optimized to reduce cognitive biases and mitigate the "information cocoon" effect. Nationwide public engagement initiatives such as AI literacy campaigns and interactive technology exhibitions should be implemented to guide the public toward a more rational understanding of technological risks. This would help cultivate a moderate level of risk sensitivity and a resilient trust attitude, ultimately promoting the responsible and rational adoption of AIGC technologies.

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Institutional Review Board Statement

This study received an exemption for ethical review from the Ethics Review Committee of the School of Economics, Jiangsu Normal University Kewen College (Approval Code: KW-E-2408A, dated November 25, 2023). The study strictly adhered to the principles of the Declaration of Helsinki, and the authors ensured the following: • Informed consent was obtained from all participants. • The purpose of the study was explained to

participants. • Participants were fully informed about the study's goals. • All participant data were anonymized to ensure privacy and non-traceability. • Participants understood how their data would be used and voluntarily agreed to participate.

Informed Consent Statement

This study obtained written informed consent from all participants. The investigators explained the purpose and scope of the data collection. Data for this empirical study were generated through a questionnaire survey, which all respondents were required to complete. Participation was entirely voluntary. The research background, objectives, planned activities, potential benefits and outcomes of the study, as well as any foreseeable risks, discomfort, or inconveniences, and the confidentiality of recorded information, were clearly explained to the participants.

Participants were informed that they could withdraw from the survey at any time. Before participating, all individuals were fully briefed on the purpose of the study and assured that their data would remain anonymous. Participation was voluntary, and no compensation was provided to participants for their involvement in the study.

Data Availability Statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Statements and Declarations

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Author Contributions

Both authors have contributed equally to the development of this manuscript.

About the Authors

Manman Wei

School of Economics / Jiangsu Normal University Kewen College, Xuzhou, China

Zhiming Song

School of Economics / Jiangsu Normal University Kewen College, Xuzhou, China

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