Humanities & Social Sciences Communications

ARTICLE

https://doi.org/10.1057/s41599-024-02718-x OPEN

Digital art exhibitions and psychological well-being in Chinese Generation Z: An analysis based on the S-O-R framework

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In the post-pandemic era, there has been a heightened global focus on the mental health challenges facing individuals, with a particular emphasis on innovative and effective therapeutic approaches. Despite the extensive body of research within the realm of art therapy addressing individual psychological healing, the potential of digital mediums in this field has been largely overlooked. This gap is especially pronounced in studies targeting the unique demographic of Generation Z, known as 'digital natives.' This study aims to investigate the role of engagement in online digital exhibitions as a potential restorative intervention for enhancing the mental well-being of Generation Z users. Grounded in the Stimulus-Organism-Response (S-O-R) framework and the theory of restorative environments, this research examines the psychological responses of Generation Z participants to online digital art exhibitions, particularly from the perspective of website aesthetics. The impact of these responses on users' place attachment and loyalty behaviors is also explored. Utilizing a structural equation modeling approach, an online digital art exhibition was deployed on the ZEPETO app, a platform popular among Chinese Generation Z users. Participants were subsequently invited to partake in an online survey post-exhibition, yielding a dataset of 332 valid responses. The findings reveal that: (1) the four design elements of website aesthetics (coherence, novelty, interactivity, immersion) significantly influence the perceived restoration among Generation Z users, with immersion being the most influential factor; (2) perceived restoration and place attachment are crucial predictors of loyalty behavior; (3) perceived restoration has a positive impact on the place attachment of Generation Z users towards online digital art exhibitions. This study demonstrates that online digital art exhibitions can facilitate an emotional healing journey for Generation Z, contributing to the alleviation of psychological stress and the promotion of psychological well-being. Moreover, digital technology exhibitions have the potential to transcend human creativity and imagination, offering a unique and promising pathway for future research and practices in design related to emotional healing.

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Introduction

In the wake of the COVID-19 pandemic, global attention has significantly shifted towards the mental health of individuals, as underscored in existing literature (Tan et al. 2020). This unprecedented health crisis, characterized not only by its physical health threats but also by its profound psychological impacts, has catalyzed scholarly interest in the manifold mental health challenges ensuing from social isolation, economic uncertainty, and health-related anxiety. Numerous cross-sectional studies have documented the varied psychological burdens borne by populations during the COVID-19 era, suggesting a potential increase in the prevalence of mental health issues (Hossain et al. 2020; Liu et al. 2021). This shift has underscored the imperative for innovative psychological interventions, especially in the domain of therapeutic methodologies.

Amidst this scenario, art therapy has emerged as a non-traditional yet effective modality for psychological healing, as evidenced by prior research (Stuckey and Nobel, 2010; Peacock, 2012; Rankin and Taucher, 2003). The solace provided by art exhibitions, long recognized by researchers (Solway et al. 2015; Roberts et al. 2011), has gained renewed emphasis in the context of the pandemic's psychological toll (Gupta, 2020). During the pandemic, art expression entered the public health discourse as an alternative response to crisis, showcasing the creative and diverse initiatives undertaken by museums and galleries worldwide. These institutions, adapting to the constraints of the pandemic, developed online exhibitions, thereby leveraging digital initiatives to showcase their collections and extending the soothing power of art to a broader audience (Feen-Calligan et al. 2023). This phenomenon has sparked interest in online art activities as a novel avenue for psychological healing, particularly for Generation Z. As digital natives (Bassiouni and Hackley, 2014), this cohort's affinity for online interaction and digital content positions online art experiences as potentially ideal platforms for addressing their mental health needs. Consequently, the therapeutic potential of online digital art exhibitions, hitherto underexplored, demands attention. Prior studies have predominantly focused on the psychological healing benefits of online museums and galleries for specific demographics like hospital patients, adolescents, and the elderly (Overgaard and Sørensen, 2015; McCaffrey, 2007; Witmer et al. 2000; Goessling, 2019; Johnson, 2016). However, the impact of digital media art on the mental health of younger demographics, particularly the pivotal Generation Z, remains relatively unexamined.

In the quest for effective psychological healing modalities, online digital art exhibitions have emerged as a promising medium, especially pertinent in the post-pandemic era. With mobility restrictions during the pandemic, virtual exhibition viewing has evolved into a preferred lifestyle pursuit (Holmes et al. 2020), signifying a shift in social and cultural experience paradigms. Digital art exhibitions not only bridge the gap between art and audiences but also provide a platform for shared experiences and discussions about art (Giannini and Bowen, 2022), a critical factor in re-establishing social connections and a sense of emotional security post-pandemic. This emerging form of therapy aligns with the digital lifestyle preferences of Generation Z and offers an accessible means to alleviate psychological stress.

Despite the significant potential benefits of online art exhibitions in the realm of psychological healing, current research exploring their application and efficacy within this domain remains limited. Accordingly, this study seeks to delve into the impacts of online digital art exhibitions on the mental health of Generation Z, as well as their effectiveness as a tool for psychological therapy. Employing quantitative research methodologies, this study aims to analyze how online art exhibitions influence the psychological state of Generation Z users and investigate their potential in enhancing mental health. This research contributes new insights to the field of mental health, offering additional support and assistance strategies for Generation Z.

To address this issue, the study adopts the Stimulus-Organism-Response (S-O-R) framework, grounded in environmental psychology theory as postulated by Mehrabian and Russell (1974). It explores how online digital art exhibitions impact the perceived healing of Generation Z users from the perspective of website aesthetics, and whether this perceived healing influences place attachment and loyalty towards the online art exhibition venues. Overall, this research examines whether participation in online digital exhibitions can serve as a restorative intervention strategy to improve the mental health of Generation Z users.

The remainder of this paper is organized as follows: after reviewing the theoretical background related to Generation Z in China, online digital exhibitions, and the research model, the research methodology is explained. This is followed by an examination of the structural results and reliability tests. Finally, the paper discusses the implications of the findings and directions for future research.2 Research theory and research hypothesis.

Research Theory and Hypothesis

The Chinese generation Z and digital technology. Generation Z, a term originated in the United States and Europe, refers to the cohort born between 1995 and 2010 (Seemiller and Grace, 2018). This generation is often characterized as 'digital natives,' a demographic that has grown up with ubiquitous access to the internet, smartphones, and a variety of digital applications, thereby integrating digital technology seamlessly into their daily lives and social interactions. In China, the Generation Z population is estimated at approximately 264 million, representing less than 20% of the total population, yet accounting for an impressive 40% of consumer spending (Yu et al. 2023). This group is distinguished by its strong sense of economic independence, distinctive personal identity, high self-esteem, a preference for experiential consumption, and unique consumption patterns (Stylos et al. 2021). Furthermore, Generation Z heavily relies on digital platforms for information acquisition, social interaction, and self-expression (Shin Seung et al. 2021).

However, the COVID-19 pandemic has subjected this cohort to unprecedented stress and challenges. Reports by the American Psychological Association (APA) indicate that approximately 81% of Generation Z respondents have experienced an increase in mental health issues during the pandemic, a figure significantly higher than reported among older age groups (Becker, 2021; Liu et al. 2021). This disparity highlights the unique psychological struggles faced by this generation. Pandemic-induced social isolation further exacerbated their reliance on digital platforms as the primary means of maintaining contact and emotional support. Recent studies show that nearly 70% of Generation Z internet users in China spend over 10 h online daily (Clements, 2020), turning to digital technology as a refuge. They utilize social media for staying connected, online learning platforms for education, and digital entertainment as an escape from the pressures of reality.

Given this backdrop, the potential of aesthetically pleasing online digital art exhibitions to alleviate mental health issues among Generation Z users emerges as a key research question. Online art exhibitions, typically rich in interactivity and visual appeal, align with the interests and consumption habits of Generation Z. Their accessibility and low entry barriers make them particularly attractive to young individuals less likely to visit traditional art institutions. In digital environments, website aesthetics initially create a visually pleasing impression for

viewers (Tuch et al. 2012). Empirical studies in human-computer interaction have underscored the significance of website aesthetics (Jiang et al. 2016). Therefore, in this study, we aim to investigate the environmental setup of online digital art exhibitions and the viewing responses of Generation Z users through the lens of website aesthetics.

Online digital art exhibition. New media art, inspired by and employing practices from non-artistic disciplines, represents an interdisciplinary paradigm in the art world (Ahmedien, 2022). This genre encompasses art created using computer-generated imagery, virtual reality (VR), augmented reality (AR), and 3D printing technologies. Online digital art exhibitions, serving as platforms for showcasing digital media art, refer to art works and exhibits displayed over the internet. These exhibitions can include virtual galleries, interactive art installations, and digitized traditional artworks. A defining characteristic of online digital exhibitions is their accessibility and global reach, allowing audiences to experience artworks from around the world without physical presence (Paul, 2015).

The mode of exhibition in online digital art showcases a significant departure from traditional online art exhibitions, which primarily rely on static images or videos. By utilizing advanced technologies like VR, AR, and 3D modeling, online digital art exhibitions offer a more dynamic and interactive art experience. The application of these technologies not only enhances the expressiveness of the artworks but also provides an immersive sensory experience for the audience, transcending the limitations of physical space (Dixon, 2015). This enables a deeper understanding and appreciation of the art's essence and emotions, conveying the soothing power of art.

The emergence of online digital art exhibitions marks a significant transformation in artistic representation. As a revolutionary form of expression, new media art has redefined the role of art in facilitating psychological healing (Simanowski, 2011). This form of art, integrating advanced technology with traditional artistic creation, produces works that directly engage the audience's emotions and psyche. Presented herein are illustrative cases (Table 1) demonstrating the efficacy of online digital art exhibitions in facilitating psychological healing.

Online digital art exhibitions, through their boundaryless characteristics, interactivity, diversity, and technological integration, have introduced novel prospects for psychological healing. These exhibitions not only contribute to the democratization and accessibility of art but also furnish individuals with a platform for self-exploration, expression, and therapeutic engagement.

S-O-R framework theory. The Stimulus-Organism-Response (S-O-R) theoretical framework, originally introduced by Mehrabian and Russell (1974), emerged as an approach within environmental psychology. It posits that environmental cues influence individuals' cognitive or emotional responses, subsequently impacting their consumption behavior. Evangelista and Al (1984) further elaborate on the S-O-R system in the context of consumer behavior, where the stimulus (S) encompasses 'external entities,' comprising marketing mix variables and other environmental inputs. Organism (O) variables encompass 'internal processes and structures within individuals bridging between stimuli and ultimate behavioral responses,' comprising perceptual, psychological, and cognitive activities, specifically referring to human emotions and cognitions. Response (R) refers to the resultant outcomes or consumer reactions, including psychological responses such as attitudes or behavioral responses.

Previous research has applied the S-O-R theory across diverse domains to elucidate user behavioral responses following external stimuli. In the realm of online shopping, Wang et al. (2011) explored the perceived service quality, satisfaction, and how these psychological changes, from the perspective of web aesthetics, subsequently influence online consumer behavioral intentions. In the context of tourism, Zhu et al. (2020) investigated the impact of online travel video blogs on prospective travelers. In the service sector, Ryu and Jang (2007) delved into the influence of themed restaurant spatial environments on customer emotions and repeat visit intentions, among others, effectively elucidating user responses following external stimuli.

Our research framework aims to investigate consumer responses to web aesthetics at different levels. We endeavor to explore how two dimensions of web aesthetics affect emotional changes (dominance, arousal, and pleasure) among online consumers and how these psychological changes, in turn, influence consumers' online behaviors such as searching and purchasing on other websites. Consequently, we adopt the S-O-R framework to comprehend the relationships among web aesthetics, emotional models, other website search behavior, and purchasing behavior among consumers. We examine consumer responses to web aesthetics at different levels, seeking to understand how two dimensions of web aesthetics influence emotional changes among online consumers.

In essence, online digital exhibitions are fundamentally rooted in the S-O-R theoretical mechanism. However, there is a dearth of research specifically focused on online digital exhibitions, and their applications remain underexplored. We employ a research framework to investigate the psychological and emotional responses of Generation Z users to online digital exhibition aesthetics, and whether these responses facilitate the alleviation of psychological issues within this demographic. We utilize the S-O-R framework to comprehend the relationships among website aesthetics, perceived therapeutic benefits, place attachment, and loyalty.

Web aesthetics. The term 'aesthetics' originates from the Greek word 'AIRHHTIKH,' denoting the sensory experiences individuals derive from their senses (Greek: 'AIRHHREIR') (Lorenzo-Romero et al. 2013). Schenkman and Jönsson (2000) commonly assert that aesthetic experiences can evoke emotional responses. Website aesthetics, on the other hand, emphasize the visual appeal of website design, primarily encompassing two dimensions: aesthetic form and aesthetic attractiveness.

In this study, the focus lies on users' overall aesthetic experience perception of online digital exhibitions within the realm of web aesthetics. Current digital art exhibitions employ human-computer interaction media technology, and the audience's perceptual experience constitutes a significant characteristic, generating multidimensional and dynamic aesthetic experiences. With the development of digital technology, from touch-based interaction forms to interface-based interaction experiences, and further to multimodal immersive interaction devices, individuals' aesthetic standards and expectations continue to rise. Starting from interface interactions, the audience's contributions to digital technology will further establish their position in the integrity of artworks. Interface aesthetics design also provides possibilities for an immersive experience for the audience (Udsen and Jørgensen, 2005) and has gained increasing attention in the field of human-computer interaction. The amount of time users spend on a website is significantly influenced by the aesthetic design of the website (Ramezani Nia and Shokouhyar, 2020). Currently, web aesthetics are employed in online shopping environments to create aesthetically pleasing effects, which positively influence customers' purchasing behavior (Wang et al. 2011). Web aesthetics can evoke emotional changes

Table 1 Online Art Exhibitions in Psychological Healing: Case Studies.

case link	Case Study Introduction
https://digitaldozen.io/projects/healing-spaces/	"Healing Spaces" developed in April 2018 by Gabriela Gomes, uses AR technology to create sensory experiences for Alzheimer's patients and caregivers. Users select forest or seaside settings on a smart platform and adjust lighting, colors, and sounds to foster a restorative environment.
https://www.window-swap.com/	"WindowSwap" is a virtual window art project created by the husband-and-wife team Sonali Ranjit and Vaishnav Balasubramaniam in 2020. It allows users to see the world through the perspective of others, offering a unique virtual travel experience. The project emerged as a response to the COVID-19 pandemic, providing a way for people to alleviate feelings of boredom and loneliness during widespread home confinement.
https://soundself.com/	"SoundSelf" conceived by Robin Arnott in 2012, is a technologically-guided, immersive experience. Users activate visual effects through vocalizations, facilitating meditation and relaxation within a virtual environment. This modality serves as a therapeutic tool, aimed at stress reduction and enhancing psychological well-being, appealing to those exploring innovative relaxation and self-exploration methods.
https://www.seeeklab.com/rainproject/	"Rain, Sound, and Luminescence": In 2015, China's Seeeklab team crafted a new media interactive art exhibition for children with autism. Inspired by a group of autistic children known as 'Star Children' or 'Rain People,' the aim was to create a 'dream world' to encourage these children to break free from their enclosed world.

in customers, generating a sense of attachment to the website (Chang et al. 2014). Therefore, web aesthetics are considered an essential factor in assessing online service quality (Sathiyavany and Shivany, 2018). Given that online digital art exhibitions also focus on users' perceived experience, the effectiveness of web aesthetics becomes particularly crucial.

While aesthetics is commonly recognized as an important aspect of website design, the emphasis on user experience has primarily been concentrated within the research domain of information systems, focusing on website functionality and marginalizing other factors of web aesthetics, often tending toward functional design. This may be attributed to the evaluation of website design problems traditionally being conducted within the paradigm of information technology (Masoudi et al. 2015). Furthermore, the measurement of web aesthetics design has received limited research attention to date. Although Schenkman and Jönsson (2000) identified two dimensions of web aesthetics—formal aesthetics and hedonic aesthetics—and Lavie and Tractinsky (2004) suggested dimensions to assess visual aesthetics, namely classical aesthetics and expressive aesthetics, the conceptual definitions and components of these dimensions remain somewhat elusive. Therefore, the determinants of aesthetics remain an ambiguous and unresolved issue. In fact, (Packard and Berlyne, 1975) made a significant contribution to aesthetics research by proposing a set of aesthetic principles governing people's preferences. The level of aesthetic preference depends on the arousal potential of the stimulus, which, in turn, is determined by characteristics such as novelty, complexity, and incongruity (Martindale et al. 1990). Deng and Poole (2010), drawing on literature from environmental aesthetics, human-computer interaction, and psychology, identified visual complexity and order as two salient features influencing users' aesthetic preferences for web pages. Beardsley (1998) proposed that aesthetic design is influenced by unity, complexity, and intensity. Jiang et al. (2016) added that novelty and interactivity may also be essential design elements of web aesthetics. Additionally, Jiang et al. (2016) argued that users' perceived quality of five design elements-unity, complexity, intensity, novelty, and interactivity—acts as determinants of web aesthetics.

Hence, considering the comprehensive discourse above, the evaluation of web aesthetics can be approached by considering design elements. In this study, focusing on the web aesthetics of online digital art exhibitions, the primary emphasis is on users' perception of the overall aesthetic experience of such exhibitions (Paul, 2015). Paul (2015) asserted that digital art exhibitions exhibit characteristics of "interactivity," "mixed senses," and "cross-media." Given the characteristics of the Z generation, their iterative aesthetic levels, and their emotional experiential needs, this study identifies four main design elements of web aesthetics in online digital art exhibitions: perceptual unity, perceptual novelty, perceptual interactivity, and perceptual immersion.

Perceptual unity refers to users' perception of visual balance, layout of text and images, and color schemes in online digital exhibitions, which create a sense of consistency and comfort. Past research has indicated that unified design significantly influences individuals' aesthetic perception. When website design presents a cohesive visual effect, users consider it the most pleasing aesthetic display (Sonderegger and Sauer, 2010). Therefore, it can be argued that design unity is a crucial determinant of web aesthetics.

Perceptual novelty pertains to users' perception of the displayed content in online digital exhibitions as innovative and stimulating. Previous research has demonstrated that novelty plays a significant role in users' first impressions of website design (Kim, 2019) and is one of the determinants of aesthetics in the initial interaction between users and websites (Jiang et al. 2016). Consequently, this study also regards novelty as an important determinant of web aesthetics.

Perceptual interactivity refers to users' interaction with the website interface, primarily through physical actions such as clicks, touches, motion capture, and wearable controllers, which generate immediate feedback through direct contact. This immersive interactive mode allows users to experience the aesthetic appeal of artworks by clicking on the screen and assuming the role of a "player." In fact, some pioneering empirical studies have validated the relationship between interactivity and aesthetics (Hassenzahl, 2004). Parsons (2006) acknowledges the existence of the behavioral aspect of aesthetics, emphasizing that people perceive aesthetics through their operations and actions. Hence, interactivity is an important factor that should not be overlooked in web aesthetics.

Perceptual immersion refers to users' state of complete involvement, loss of self-awareness, and high level of concentration, leading to a state of flow—an optimal cognitive experience (Agrawal et al. 2020). Some researchers consider immersion as the core of human-computer interaction, explaining users' satisfaction with computer systems (Ghani and Deshpande, 1994). Novak et al. (2020) found that 47% of users had experienced immersive online environments on the Internet (Novak et al. 2020). Consequently, it is believed that users who

are fully engaged in a visually appealing, entertaining, informative, or perceived useful website are more likely to experience a state of flow. Therefore, immersion is an essential factor that should not be overlooked in web aesthetics.

Restorative environment. Therefore, considering the aforementioned discourse, the evaluation of a restoration environment can be understood in terms of its design elements. In the context of online digital art exhibitions, the focus is primarily on users' perception of the overall aesthetic experience (Paul, 2015). A restoration environment refers to an environment that helps individuals alleviate stress, negative emotions, psychological fatigue, and promotes psychological and physiological well-being (Ulrich, 1979; Ulrich, 1984). "Restoration" refers to the process of regaining depleted physiological, psychological, and social capacities while adapting to the external environment. In a restoration environment, individuals effectively regain their depleted capacities, experience deep restoration of their mind and body, restore direct attentional resources, and enhance reflection on significant mistakes (Kaplan, 1995). Kaplan and Kaplan (1995) propose four essential characteristics of a restoration environment: being away, fascination, extent, and compatibility. Furthermore, Hartig et al. (1997) have developed the Perceived Restorativeness Scale to assess the perceived restoration in environments. Previous research has applied the concept of a restoration environment to various domains such as nature (Zhao et al. 2020), healthcare (Abdelaal and Soebarto, 2019), and education (Kelz et al. 2013). However, its application in online virtual environments has been relatively limited. The restoration environment aligns well with the internet entertainment motivations of the Z generation, as the appreciation of exhibitions is considered an important way to alleviate psychological fatigue (Jeong and Lee, 2006). When individuals engage in artistic activities, they often seek restoration from the fatigue of daily life. The interactive, immersive, and aesthetically appealing environment of online exhibitions can provide a relaxed setting for young people of the Z generation, creating a significant contrast to their daily life circumstances and environment. Thus, online digital art exhibitions create an excellent restoration environment, and it is worth further investigation to determine if they have a positive impact on the psychological well-being of the Z generation.

In this study, the restoration environment explains the psychological healing effect of the online digital art environment on Z generation users. The present research defines this restoration environment-induced state of psychological well-being as perceived restoration. The four characteristics of a restoration environment proposed by Kaplan and Kaplan (1995) serve as the measurement dimensions of perceived restoration in this study.

"Being away" refers to the stimulation of a sense of distance among Z users within the digital art exhibition environment. It is a psychological distance that triggers the use of non-directed attention.

"Extent" pertains to Z users perceiving a sufficiently rich and complex content within the digital art exhibition environment. This richness allows Z users to perceive the place as an "other world," enabling them to relax and escape from the stress and agitation of daily life and implies the restoration of directed attentional capabilities.

"Fascination" denotes the effortless ability of the digital art exhibition environment to capture and hold Z users' attention. This fascination does not have negative effects, as Z users can freely contemplate and relax, allowing the remaining parts of the attentional system to restore. A highly fascinating environment is one that can attract individual attention for restoration.

"Compatibility" refers to the degree of alignment between the digital art exhibition environment and the personal needs, preferences, and goals of Z users. Even if an environment is highly fascinating, if it does not fulfill the needs and preferences of Z users, it is unlikely to have restoration benefits for them.

The relationship of web aesthetics and perceived restoration. Previous research has contributed to our understanding of the four attributes of perceived restoration, which aim to capture various negative emotions, reduce psychological fatigue, and promote psychological and physiological well-being. The four elements of website aesthetics (perceived unity, novelty, interactivity, and immersion) play a crucial role in the presentation of online digital exhibitions.

Existing studies have highlighted the significance of individuals' aesthetic preferences as important determinants of perceived restoration potential (Wang et al. 2019). In the domain of tourism, the relationship between aesthetic appeal of tourist destinations and tourists' perceived restoration has been explored (Kirillova and Lehto, 2016). Similarly, in healthcare environments, spatial aesthetics design is enhanced to alleviate stress and anxiety, improve patient satisfaction, and facilitate health and recovery (Schweitzer et al. 2004). Building upon these findings, it is hypothesized that superior aesthetic design in online digital art exhibitions can enhance the perceived restoration of attention among the Z generation, thereby leading to psychological healing effects. Therefore, the following hypotheses are proposed:

H1: There is a positive correlation between the perceived unity of online digital art exhibitions and perceived restoration among the Z generation.

H2: There is a positive correlation between the perceived novelty of online digital art exhibitions and perceived restoration among the Z generation.

H3: There is a positive correlation between the perceived interactivity of online digital art exhibitions and perceived restoration among the Z generation.

H4: There is a positive correlation between the perceived immersion of online digital art exhibitions and perceived restoration among the Z generation.

Place attachment. Place attachment, also known as "sense of place," originates from attachment theory that describes the relationship between mother and infant (Bowlby, 1982). It refers to the emotional connection established between individuals and specific places (Altman and Low, 1992). The understanding of place attachment is abstracted through two dimensions: place dependence and place identity, which express the value of place attachment (Williams et al. 1992). Place dependence represents the special connection between individuals and a place, where the place meets the specific needs of the participants, indicating a functional attachment (Pretty et al. 2003). Place identity refers to the psychological and spiritual sense of identification and belongingness to a place, representing the emotional attachment between individuals and the physical environment of the place (Wang et al. 2022). In this study, place attachment refers to the attachment of the Z generation young people to online digital art exhibitions, focusing on the discussion of the place dependence established between the Z generation and online digital art exhibitions, as place dependence better reflects the emotional connection of online users.

Previous research has demonstrated the positive relationship between place attachment and therapeutic environments, with place attachment being the strongest predictor of perceived restoration (Ratcliffe and Korpela, 2016; Shen et al. 2022). It has been confirmed that tourists' perception of restoration

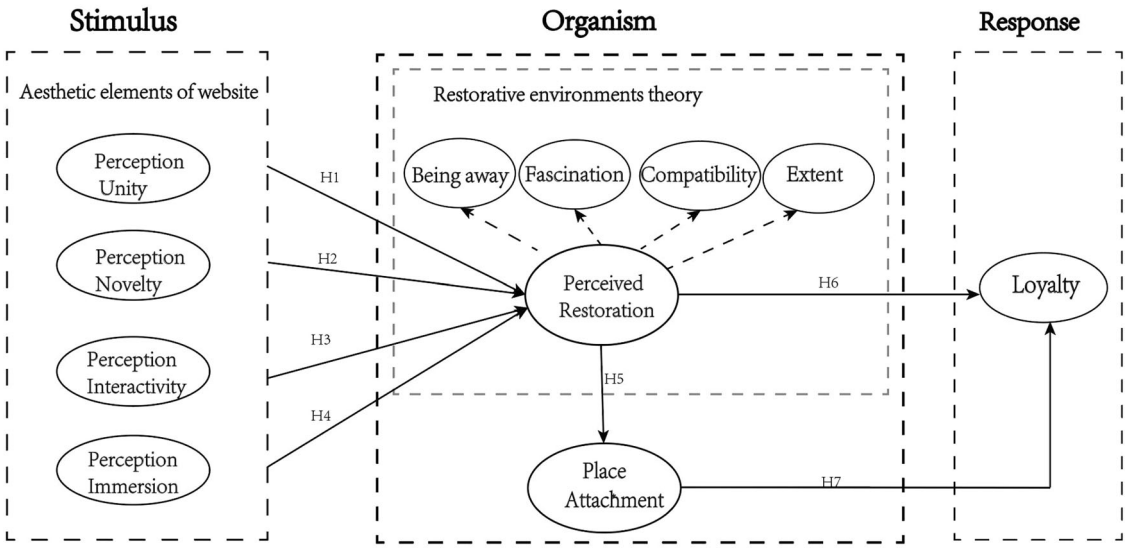

Fig. 1 Conceptual model.

significantly influences their place attachment to agritourism destinations (Dargie, 2020). If individuals have positive emotional attachment to a place, including preferences and familiarity, the place of attachment also holds healing potential. Based on this, we hypothesize:

H5: Perceived restoration has a positive impact on place attachment to online digital art exhibitions among the Z generation.

Loyalty. Oliver (1999) defined loyalty as "a deeply held commitment to rebuy or repatronize a preferred product or service consistently in the future, thereby causing repetitive same-brand or same-brand-set purchasing, despite situational influences and marketing efforts having the potential to cause switching behavior." This definition divides loyalty into two distinct levels: behavioral loyalty and attitudinal loyalty. Behavioral loyalty refers to customers' repurchase intention and positive word-of-mouth and referral intention. Attitudinal loyalty, similar to the emotional or attitudinal loyalty proposed by Oliver (1999), represents customers' higher-order or long-term commitment to an organization, which cannot be inferred solely through observing repeat purchase behavior. In this study, loyalty refers to the intention of the Z generation young people to continue visiting similar online digital art exhibitions. The study primarily examines the behavioral loyalty of Z-generation users. Bennett and Rundle-Thiele (2002) suggested that behavioral loyalty is an observable outcome of attitudinal loyalty. Repeat purchase or viewing is one of the observable indicators of loyalty, whereas attitudinal loyalty is difficult to observe (Bennett and Rundle-Thiele, 2002).

Previous research has shown that perceived healing environments have a significant impact on health, which, in turn, influences loyalty (Kim et al. 2014; Chebat and Slusarczyk, 2005; Hernández-Mogollón et al. 2020). Perceived restoration is an important aspect of the health experience, contributing to positive emotions, life satisfaction, and determining individuals' loyalty and intention to revisit (Collado and Staats 2016). Natural soundscapes in the context of the global COVID-19 pandemic have reduced visitors' mental fatigue and enhanced their loyalty (Qiu and Zhang, 2021). Moreover, researchers have also focused on the role of third places (e.g., cafes, museums) in reducing mental fatigue and increasing visitor loyalty to those locations, in addition to natural restoration (Rosenbaum, 2009). Therefore, we propose the following hypothesis:

H6: Perceived restoration has a positive impact on loyalty to online digital art exhibitions among the Z generation.

Additionally, previous studies have confirmed the relationship between place attachment and user loyalty (Su et al. 2011). Zhang et al. (2021) demonstrated that place attachment has the strongest impact on visitor loyalty. Lee et al. (2012) discovered that visitors develop a moderate level of emotional attachment to the host destination during festivals, ultimately leading to loyalty to that destination. Based on these findings, we can hypothesize:

H7: Place attachment has a positive effect on loyalty to online digital art exhibitions among the Z generation.

Research model. Building upon the theoretical literature mentioned above, this study posits causal relationships among the dimensions of web aesthetic design elements, place attachment, perceived restoration, and user loyalty to online digital art exhibitions. Thus, the aim of this study is to explore their interrelationships and develop a new S-O-R model, as illustrated in the Fig. 1. In this model, Stimulus (S) comprises the web aesthetic design elements of online digital art exhibitions, Organism (O) refers to the perceived restoration psychological state and place attachment of the Z generation. Response (R) encompasses the loyalty responses of the Z generation towards online digital art exhibitions, including psychological reactions such as attitudes or behavioral responses.

Research Methodology

Stimulus websites. In this study, we selected the ZEPETO app, currently popular among the Z generation in China, to host an online digital art exhibition titled "Newborn Party REBIRTH: Welcome the new body." ZEPETO is a 3D virtual character creation application launched in August 2018, serving as a virtual fashion social platform where users can freely customize their digital avatars using millions of fashion items. It allows users to connect with others through QR codes, fostering their virtual social space. who created two online exhibition halls: Exhibition Hall 1: Newborn Party and Exhibition Hall 2: Newborn Paradise. By combining art and technology, they aimed to provide a unique and immersive experience. We invited five artists from the virtual community of ZEPETO app to freely construct new spaces in the

Table 2 Measurement of the variables.

Constructs		Items	Explanations	Source(s)
Web aesthetics	Perception Unity	PU1	The displayed exhibits are in line with the theme of the digital art exhibition.	Jiang et al. 2016
		PU2	The text and colors on this digital exhibition website page are very cohesive.	
		PU3	The overall atmosphere of this digital exhibition is cohesive.	
	Perception Novelty	PN1	I have never seen such a digital exhibition before.	
		PN2	The combination of this new technology and art exhibition is very innovative.	
		PN3	In conclusion, for me, this digital art exhibition is very novel.	
	Perception Interactivity	PL1	My actions determine the type of experience I obtain.	Vashisht and Chauhan, 2017
		PL2	I engage in interactive experiences in online digital art exhibitions.	
		PL3	I can freely choose what I want to see.	
	Perception Immersion	PM1	I am completely focused on this digital art exhibition.	Tcha-Tokey et al. 2016
		PM2	I am so focused on the online digital exhibition that I forgot about time.	
		PM3	Watching this online art exhibition gives me a sense of immersion.	
Perceived Restoration	Being Away	BA1	This is a place far away from all aspects of daily life	Pasini et al. 2014
		BA2	Watching the digital art exhibition helps me relax physically.	
		BA3	Watching the digital art exhibition makes me forget about the daily troubles.	
Perceptual Enjoyment	Fascination	FN1	I am attracted to many interesting things here.	
		FN2	I am willing to spend a long time here.	
		FN3	The atmosphere of this art exhibition is very charming.	
	Compatibility	CP1	Watching this online exhibition always gives me a sense of belonging.	
		CP2	I can find ways to have fun in this online exhibition.	
		CP3	This online digital art exhibition aligns with my preferences.	
Satisfaction	Extent	ET1	I can see different stories through different artworks.	
		ET2	Online digital art exhibitions hardly restrict my thoughts and can take me to faraway places.	
		ET3	Online digital art exhibitions offer abundant artworks that allow me to explore a wide range of creations.	
Place attachment		PA1	This online digital art exhibition is very special to me.	Boley et al. 2021; Raymond et al. 2010
		PA2	This online digital art exhibition is very meaningful to me.	
		PA3	I have a strong sense of identification with this online digital art exhibition.	
Loyalty		LA1	I will come to see this type of online digital art exhibition frequently.	Rosenbaum, 2009
		LA2	I feel that I will stay connected with online digital art exhibitions.	
		LA3	Even if it requires a certain fee to appreciate the art exhibition, I will continue to watch.	

two exhibition halls as their themed artistic creations. The objective of the exhibition was to explore the connection between online gaming identities and personal image in the digital era. Through the artists' works, the exhibition aimed to encourage users to actively engage with their virtual avatars and explore the social value of virtual identity.

Research design. In this study, all variables and their corresponding measurement items were adapted from previous literature to ensure content validity (Joo and Yeon Lee, 2011; Straub and Gefen, 2004). A 7-point Likert scale (ranging from strongly disagree to strongly agree) was used to measure all items. The variables and specific items are presented in (Table 2). A questionnaire survey approach was employed, consisting of two parts. The first part aimed to collect demographic information from the respondents, including education level, gender, and age. The second part comprised the theoretical constructs discussed above, focusing on the relationships among web aesthetics, perceived restoration, place attachment, and loyalty. The questionnaire was developed in English and reviewed for content validity by several English-speaking scholars. Since the survey was conducted in China, the questionnaire was translated into Chinese by the first researcher. Subsequently, a second researcher translated it back into English to ensure consistency. Prior to the formal survey, the research team conducted a pilot study with a sample of 113 participants to analyze the initial questionnaire data. Based on the results, improvements were made to item descriptions, sequence arrangements, and overall questionnaire clarity and comprehensibility.

Data Collection. For this study, the research team selected Generation Z users who had been using the ZEPETO app for at least six months and were between the ages of 18 and 30 as the participants. The survey was conducted in China from April 7th to 30th, 2023, with a duration of one month. A total of 387 Generation Z users were recruited for the study. During the exhibition period, artists had the flexibility to enter the rooms and express their "identity" through the behaviors of their "virtual avatars" within the app. Users logged into the app and chose a new identity for themselves to explore the artworks in the virtual map or interact with the artists in designated rooms. Upon completion of the exhibition, participants were asked to fill out a questionnaire. Those who completed the questionnaire received a reward of 10 virtual coins in the ZEPETO app. Additionally, to ensure the authenticity and reliability of the questionnaire responses, the first question was set as "Have you had a complete experience of visiting the virtual digital art exhibition?" If participants had not experienced it, they were allowed to exit the questionnaire in advance.

To compensate for the convenience sampling limitation, efforts were made to consider users from different regions across the country. The sample included Generation Z users from various professions and industries. A total of 350 questionnaires were collected, with 332 valid responses. (Table 3) presents the demographic information of the respondents.

Results

Common Method Bias. The data for this study were collected from a single source (participants or respondents), and the questionnaire format used was self-perceived self-reporting. This data collection method is susceptible to common method bias. To

Table 3 Sample characteristics.

Measure	Items	Number	Percent (%)
Gender	Male	153	46.1%
	Female	179	53.9%
Age	Under 18 years old	0	0%
	18-24	143	43.1%
	25-30	189	56.9%
	Above 30	0	0%
Education	Junior College	78	23.5%
	Bachelor	148	44.6%
	Master or above	106	31.9%
Occupation	Students (high school, college, graduate, etc.)	110	33.1%
	Clerk	105	31.6%
	Personnel (teachers, lawyers, doctors, civil servants,etc.)	82	24.7%
	Professional	25	7.5%
	Other	10	3%
Does the epidemic bring a lot of stress to your life and work?	Very little stress	6	1.8%
	No stress	25	7.5%
	Average	71	21.4%
	Quite stressed	123	37%
	Very stressed	107	32.2%
Do you like using the ZEPETO app?	Very dislike	14	4.2%
	Dislike	26	7.8%
	Commonly	60	18.1%
	Like	125	37.7%
	Very like	107	32.2%

mitigate the artificial covariation between predictor variables and criterion variables caused by the same measurement environment, contextual factors, and item characteristics, the research team intentionally designed the questionnaire items for different variables on separate pages during the data collection phase. This allowed respondents to have sufficient rest between pages, reducing the common method variance resulting from using the same scale. Additionally, the research team employed the Harman single-factor test, even conducting a principal component analysis, to examine the presence of common method bias. The 31 items were loaded together for exploratory factor analysis (CFA), and the results indicated a KMO value of 0.892 ($p < 0.05$), suggesting the suitability of the questionnaire data for factor analysis. It was found that 10 factors had eigenvalues greater than 1, and the first unrotated principal component accounted for 35.058% of the variance, which was less than the 40% threshold. This indicates that common method bias did not have a significant impact on this study (Shiau and Luo, 2012).

Tests of validity. The reliability and validity of the measurement model (as shown in Table 4) were examined. We employed the structural equation modeling (SEM) technique to test the research hypotheses and model fit, following the two-step approach proposed by Anderson and Gerbing (1988). The widely used software AMOS was chosen for the SEM analysis. To assess the adequacy of the measurements, this study examined the individual measurement reliability, convergent validity (using AMOS 27.0 and SPSS 27.0), and discriminant validity of the variables. The standardized factor loadings of each measurement item were calculated based on the established confirmatory factor analysis (CFA) model. Convergent validity and composite reliability were then obtained using the calculation formulas for AVE and CR. Generally, an AVE value greater than 0.5 and a CR value greater than 0.7 indicate acceptable consistency among measurement items (Fornell and Larcker, 1981). In this study, these

Table 4 Results of measurement model.

Construct	Item	Cronbach's Alpha	Factor Loading	AVE	CR
Aesthetic elements of website					
perception Unity	PU3	0.867	0.824	0.732	0.891
	PU2		0.882		
	PU1		0.860		
perception	PN3	0.885	0.828	0.720	0.885
Novelty	PN2		0.844		
	PN1		0.873		
Perception	PL3	0.882	0.821	0.718	0.884
Interactivity	PL2		0.886		
	PL1		0.833		
perception	PM3	0.895	0.811	0.747	0.899
Immersion	PM2		0.881		
	PM1		0.899		
Perceived Restoration					
Being away	BA3	0.897	0.837	0.745	0.897
	BA2		0.883		
	BA1		0.868		
Fascination	FN3	0.911	0.889	0.777	0.913
	FN2		0.910		
	FN1		0.844		
Compatibility	CP3	0.946	0.919	0.856	0.947
	CP2		0.922		
	CP1		0.934		
Extent	ET3	0.892	0.815	0.735	0.893
	ET2		0.875		
	ET1		0.881		
Place attachment	PA3	0.912	0.873	0.769	0.909
	PA2		0.899		
	PA1		0.859		
Loyalty	LA3	0.895	0.858	0.750	0.900
	LA2		0.904		
	LA1		0.835		

Note: *CR* Composition reliability, *AVE* Average variance extracted.

indicators were calculated using AMOS 27.0, and it was found that all CR values exceeded 0.7 and all AVE values exceeded 0.5, indicating good convergent validity and composite reliability of the measurement items.

Furthermore, discriminant validity was assessed by comparing the square root of the average variance extracted (AVE) with the correlation coefficients between each pair of constructs (Bagozzi and Yi, 1988; Wang et al. 2023). Table 5 presents the results, showing that the square root of AVE is higher than the correlation level between two specific factors. This indicates good discriminant validity between the variables.

Fit indices. The fit indices for both the research and measurement models were computed. Based on recommendations from previous studies (Henseler and Sarstedt, 2012; Yu et al. 2023; Wang et al. 2023), these indices are generally acceptable (Table 6).

Hypothesis tests. The results of the research model are presented in Fig. 2 and Table 7. All proposed hypotheses in this study received support and were found to be statistically significant at the 0.05 level. The evaluation of the hypothesis relationships was based on the explained variance of the dependent variables (R^2), path coefficients (β), and the significance levels obtained from the sampling method (Chin, 1998). The findings of this study indicate that loyalty to online digital art exhibitions among Z Generation youth is positively influenced by perceived recovery (β = 0.270,

Table 5 Correlation matrices and discriminant validity.

	1	2	3	4	5	6	7	8	9	10
1 Loyalty	**0.866**									
2 Place Attachment	0.810	**0.877**								
3 Extent	0.455	0.458	**0.857**							
4 Compatibility	0.517	0.533	0.405	**0.925**						
5 Fascination	0.467	0.513	0.453	0.397	**0.881**					
6 Being Away	0.439	0.448	0.300	0.299	0.305	**0.863**				
7 Perception Immersion	0.504	0.494	0.426	0.447	0.565	0.289	**0.865**			
8 Perception Interactivity	0.458	0.487	0.395	0.449	0.459	0.345	0.583	**0.863**		
9 Perception Novelty	0.386	0.389	0.342	0.356	0.278	0.444	0.375	0.395	**0.865**	
10 Perception Unity	0.436	0.434	0.304	0.404	0.339	0.433	0.514	0.575	0.383	**0.847**

Note: The items on the diagonal on bold represent the square roots of the AVE.

Table 6 Fit indices.

Fit indices	CMIN/DF	GFI	AGFI	CFI	TLI	RMSEA
Recommended values	<3	>0.80	>0.80	>0.90	>0.90	<0.08
Measurement model	1.283	0.919	0.895	0.987	0.984	0.029
Research model	2.046	0.856	0.830	0.945	0.940	0.056

Note: *CMIN* Chi-Square Minimum Fit Function, *DF* Degrees of Freedom, *CMIN/DF* Chi-Square to Degrees of Freedom ratio, *AGFI* Adjusted Goodness of Fit Index, *CFI* Comparative Fit Index, *TLI* Tucker-Lewis Index, *RMSEA* Root Mean Square Error of Approximation.

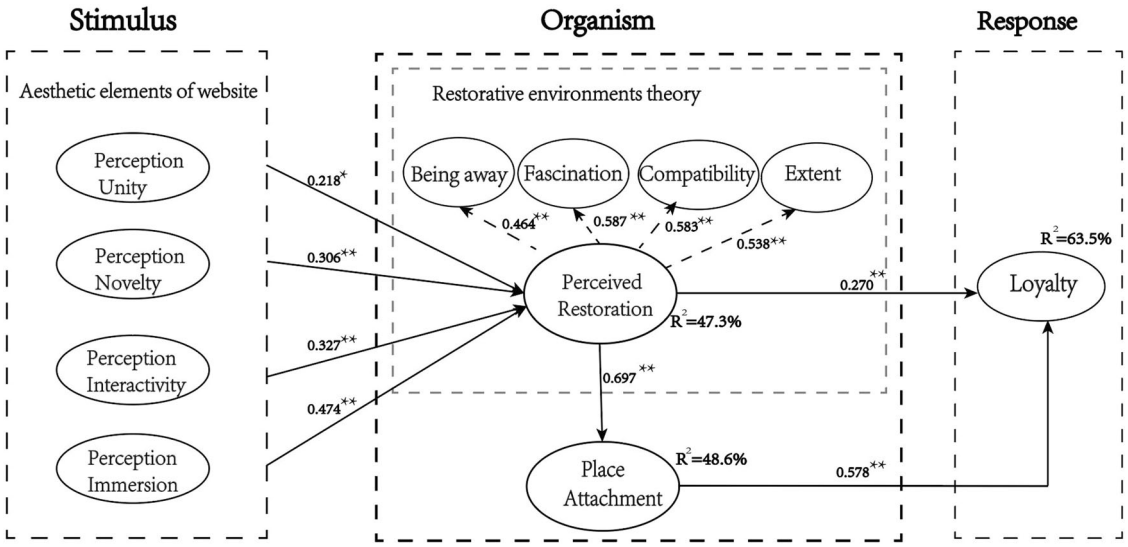

Fig. 2 Summary of the results.

$p < 0.001$) and place attachment ($\beta = 0.578$, $p < 0.001$), supporting H6 and H7. These variables collectively explain 63.5% of the variance in Z Generation users' loyalty.

Perceived recovery ($\beta = 0.697$, $p < 0.001$) significantly influences place attachment, supporting H5, and accounts for 48.6% of the variance.

Among the four dimensions of website aesthetics, perceived unity ($\beta = 0.218$, $p < 0.05$), perceived novelty ($\beta = 0.306$, $p < 0.001$), perceived interactivity ($\beta = 0.327$, $p < 0.001$), and perceived immersion ($\beta = 0.474$, $p < 0.001$) all have a positive and significant impact on perceived recovery, supporting H1, H2, H3, and H4. Together, they explain 43.7% of the variance.

Post analysis: tests of mediation effects. This study further explores the mediating role of place attachment between perceived restoration and loyalty. As shown in Table 8, the Sobel test statistics for place attachment are all greater than 1.96 and statistically significant. Additionally, the 95% confidence intervals from the bootstrapping analysis (based on 2000 simulations) do not include zero. This indicates that place attachment mediates the relationship between perceived restoration and loyalty (Efron and Tibshirani, 1998). Furthermore, the indirect effect of perceived restoration through place attachment on loyalty accounts for 59.9% of the total effect, indicating a partial mediating role (Baron and Kenny, 1986).

Conclusions and Discussion

This study constructs a new S-O-R model, combining website aesthetics and the therapeutic environment theory, to measure

Table 7 Results of the research model.

Hypothesis		Estimate	S.E.	C.R.	Results	R^2
H1	Perception Unity → Perceived Restoration	0.218	0.034	2.863*	Supported	47.3%
H2	Perception Novelty → Perceived Restoration	0.306	0.034	4.13**	Supported	
H3	Perception Interactivity → Perceived Restoration	0.327	0.032	4.031**	Supported	
H4	perception Immersion → Perceived Restoration	0.474	0.036	5.61**	Supported	
H5	Perceived Restoration → Place attachment	0.697	0.175	7.931**	Supported	48.6%
H6	Perceived Restoration → Loyalty	0.270	0.143	3.531**	Supported	63.5%
H7	Place Attachment → Loyalty	0.578	0.074	7.297**	Supported	

Note: $^{**}p < 0.001$; $^{*}p < 0.05$; *SE* Standard Error,*CR* Critical Ratio.

Table 8 Robust analysis: Mediating role of Place attachment.

Intermediate path	Point Estimation	Product of Coefficients		Bootstrapping				Proportion
				Biasias-corrected95% CI		Percentile 95% CI		
		SE	Z-value	Lower	Upper	Lower	Upper	
Perceived Restorative→Place Attachment→Loyalty	0.754	0.173	4.358	0.462	1.156	0.453	1.139	59.9%
Perceived Restorative→Loyalty	0.506	0.177	2.859	0.211	0.901	0.225	0.943	40.1%
Total Effects	1.259	0.243	5.181	0.896	1.835	0.895	1.833	

the psychological recovery (perceived recovery) of Z-generation young individuals in response to online digital art exhibitions. The study also examines the influence of perceived recovery on online digital art exhibition place attachment (i.e., place attachment) and the psychological benefits derived from frequent viewing of online digital art exhibitions (i.e., loyalty). The proposed model is tested using structural equation modeling (SEM). The specific research findings are as follows:

Firstly, our results reveal that the four design elements of website aesthetics (unity, novelty, interactivity, and immersion) are crucial factors in understanding Z-generation young individuals' perceived recovery, with immersion being the most influential element. In other words, the better the design effects of online digital art exhibition websites are perceived by Z-generation users, the greater the perceived recovery they experience. This finding supports previous studies, such as Jiang et al. (2016), which emphasized the impact of the four design elements of website aesthetics on Z-generation users' perceived aesthetics. Additionally, prior research has discussed the restorative potential of VR technology in artistic creation for art therapy (Hacmun et al. 2018), providing individuals with virtual online experiences. However, these studies did not specifically explore how different art forms impact individuals. This current study complements these findings by focusing on online digital art exhibitions as a specific case and incorporating the characteristics of the Z-generation, thus demonstrating the influence of online digital art exhibition aesthetics (unity, novelty, interactivity, and immersion) on the psychological responses of the Z-generation. Notably, novel website designs can capture individuals' attention (Powazek, 2006), while a consistent environment is more likely to attract participation. Interactive experiences immerse participants in a virtual environment, creating an illusion of "being there" (Sanchez-Vives and Slater, 2005). This combination of presence and modifiable environments in virtual reality allows for a shift in self-awareness (Slater et al. 2010) and is highly effective in inducing emotional responses (Vincelli, 1999; Vincelli et al. 2001; Riva et al. 2016). Online exhibitions continuously transcend the boundaries of media and form, exploring time and space. In the three-dimensional space of online digital exhibitions, Z-generation individuals establish multidimensional emotional experiences through immersive interaction with the exhibited artwork. The collision between individuals and art becomes a temporal process, where the focus is no longer solely on visual forms but rather on the subjective emotional experience through the environment, atmosphere, and subjective perception of the "scene." This provides Z-generation young individuals with physical, psychological, and spiritual relaxation and healing.

Secondly, perceived recovery has a positive and significant influence on place attachment and loyalty, with place attachment being the strongest. In other words, Z-generation individuals who experience perceived recovery from viewing online digital art exhibitions are more likely to develop attachment to these online exhibition environments, thereby retaining more loyal users. This finding is supported by previous research (Adevi and Mårtensson, 2013; Majeed and Ramkissoon, 2020), as well as Dargie (2020), who demonstrated that if individuals have a positive emotional attachment to a place, including preferences and familiarity, that place also holds healing potential. The therapeutic environment of online digital art exhibitions helps alleviate personal stress, promotes health and well-being, and encourages emotional connections with these places, thereby encouraging sustained exhibition viewing. As Winnicott (1971) pointed out in "The Potential Space," it is a psychological space where we can integrate love and hate, create, destroy, and recreate oneself, thus promoting self-development and psychological growth. In fact, online digital art exhibitions provide a unique space for the Z-generation group, bridging the gap between fantasy and reality while offering creativity and amusement, which establishes a favorable environment for therapy. It creates a sense of privacy and detachment from the external world, allowing individuals to immerse themselves in a private and dream-like space integrated with an immersive and dynamic environment. This fosters familiarity and attachment for the Z-generation users, increasing

their recognition and becoming loyal fans of the digital exhibition.

Thirdly, perceived recovery and place attachment serve as effective mediating factors in the relationship between website aesthetics and Z-generation users' loyalty to online digital exhibitions. Although website aesthetics do not directly influence the loyalty of Z-generation individuals to online digital exhibitions, they exert an indirect influence through perceived recovery and place attachment, with perceived recovery and place attachment acting as crucial mediating variables between website aesthetics and loyalty. Moreover, in terms of mediating effects, the indirect effect of perceived recovery-place attachment-loyalty is stronger than the direct effect of perceived recovery-loyalty. This means that the more Z-generation users perceive psychological recovery, the deeper their attachment to the online digital exhibition venue, which, in turn, influences their loyalty. Chen et al. (2023) suggested that people during and after the COVID-19 pandemic may develop a stronger attachment to places that offer healing and recovery. In future website design for online digital art exhibitions, curators and designers can leverage the relationship between website aesthetics, perceived recovery, and place attachment to create a comfortable online exhibition environment for Z-generation young individuals, thereby enhancing their happiness.

Implications, Limitations and Prospect

Theoretical contribution. Firstly, this study elucidates the logical relationship between website aesthetics and loyalty among the Z-generation group, constructing a new S-O-R research framework that incorporates website aesthetics, perceived recovery, place attachment, and loyalty. Leveraging the S-O-R theory to predict the psychological characteristics of Z-generation users in their engagement with online digital art exhibitions and their perception of healing, the study explains 68.5% of the variance in the loyalty behaviors of the Z-generation user group towards online digital exhibitions. It dissects the inherent logical connection between the stimulation of online digital art exhibition aesthetics and the process of psychological healing, which in turn influences place attachment and loyalty behaviors towards online digital exhibitions. By exploring and validating the soundness of its structural model, this research provides theoretical guidance for online curators, psychological counselors, and art therapists, contributing to the understanding of factors influencing the Z-generation's perception of healing and their loyalty towards online digital art exhibitions. While it is generally acknowledged by most researchers that art therapy is beneficial for individuals' psychological well-being (Scope et al. 2016; Sagan, 2012; Stuckey and Nobel, 2010), empirical studies on this topic are scarce. This study confirms that the aesthetic elements of online digital exhibition websites are highly appealing to Z-generation users, providing them an opportunity to escape daily stress and concerns, thereby facilitating greater psychological healing and fostering a deep attachment to online digital art exhibitions, which contributes to their loyalty. By elucidating the logical relationship between website aesthetics and loyalty through the mediation of perceived recovery and place attachment, it further enhances our understanding of the impact of art on individuals' psychological and emotional well-being.

Secondly, this study serves as an example of introducing the concept of loyalty from the discipline of product and service marketing into research on online digital art exhibitions. As the digital natives of the Z-generation in the digital era, they navigate various websites on a daily basis, and satisfaction is no longer the sole criterion for loyalty among contemporary young individuals. Loyalty towards websites has become more challenging for Z-generation users. Perceived recovery and place attachment, on the other hand, represent the true needs and desires within the Z-generation user group, ultimately shaping their loyalty towards online digital art exhibitions. This study complements and expands the understanding of loyalty in this context.

Thirdly, this study underscores another significant value: online digital art exhibitions, through their unique Internet aesthetic elements, offer an effective avenue for stress alleviation among Generation Z youths. Key among these elements is interactivity, which enhances engagement and a sense of control, allowing young individuals to interact with artworks through touch, clicks, or movements, thereby fostering a more immersive and relaxing experience. Furthermore, the immersive experiences, particularly those facilitated by virtual reality (VR) and augmented reality (AR) technologies, engross users completely in an artistic milieu, offering a brief respite from daily life stressors. Additionally, the role of sound in art exhibitions cannot be overlooked. Soft or harmonious sounds and music can significantly alleviate tension and create a relaxing atmosphere. Visual aesthetics, such as beautiful and captivating visual elements, not only provide visual pleasure but also contribute to psychological stress relief. The choice of colors and design of forms play a crucial role in creating a pleasurable visual experience, aiding viewers in feeling calm and relaxed. These elements collectively provide a platform for Generation Z to enjoy aesthetics while effectively mitigating psychological stress. Online digital art exhibitions have thus emerged as a vital channel for this generation to express themselves, experience new things, and seek psychological solace in their everyday lives.

Implication for practices. Firstly, this study provides practical insights for online curators and website designers, highlighting that digital technology exhibitions can surpass human creativity and imagination, offering unique and potential avenues for research and practice related to emotion-based design. Online digital art exhibitions, unconstrained by space and distance, have a broad audience and strong dissemination capabilities, making them the fastest and most effective platform for art therapy. The potential for psychological healing in online digital art exhibitions lies in their ability to transform users' perspectives, allowing for customizable environments that can vary based on the psychological needs of the individual. By combining the elements of aesthetics in online digital art exhibitions with immersive sensory experiences, a fantastic experience can be created within a protected and controlled environment. Humanistic theories in psychology emphasize the importance of perceiving clients' inner worlds through their personal perspectives, demonstrating significant potential for enhancing the effectiveness of art therapy. Future curators and psychological counselors should consider the applicability and extent of virtual reality media to meet clients' specific needs and create therapeutic environments tailored to those needs.

Secondly, this study also offers recommendations for practitioners of online digital art exhibitions to better cater to the personalized services for the Z-generation. Our findings indicate that Z-generation users, as a distinct group, place greater emphasis on sensory experiences and enjoyment. Creating an attractive website aesthetic experience is essential to enhance the core creativity of online digital art exhibitions and maximize the innovative value within similar products (Zeng et al. 2012). Furthermore, the competitive environment demands that managers possess the ability to capture and convert trending information and continuously innovate online digital exhibition activities to maintain the vitality of the exhibitions. Through website aesthetic design, narrative storylines, and gamified

interactive formats, underpinned by multimedia technology, the online digital exhibition experience can go beyond the traditional single-purpose service model, offering high-quality experiences for Z-generation users. By understanding the consumption tendencies of the Z-generation and aligning with their preferences, a better grasp of the future direction of online art exhibition design can be achieved.

Thirdly, this research contributes practical insights for advancing the transformation and future development of physical art exhibitions and museums in the post-COVID-19 era. Although our study highlights numerous positive impacts of digital art on Generation Z, it equally underscores the importance of recognizing potential negative effects. Critical considerations include the disconnection from real-life experiences due to an over-reliance on digital media, the impacts of excessive screen time on vision and sleep quality, and the potential adverse effects of digital interactions on interpersonal communication skills (Odgers et al. 2020). Therefore, the challenge lies in attracting Generation Z from online to offline viewing experiences. This can be achieved by integrating online and offline experiences, thereby enhancing the accessibility and engagement of art and cultural content, especially for the young and technologically savvy audience. For instance, leveraging social media and digital marketing strategies can augment their appeal. Museums and art exhibitions can utilize these platforms to preview upcoming works, share behind-the-scenes stories, and provide interactive elements such as online Q&A sessions or virtual tours, thereby sparking young people's interest in physical visits. Simultaneously, these strategies can help museums and art exhibitions establish deeper connections with younger audiences, aiming to better serve the public while maintaining their core roles in culture and education. This comprehensive perspective is not only invaluable for users and creators of digital art but also directs future researchers to investigate these negative impacts. Through this balanced exploration, our study not only supports the positive application of digital art but also cautions against its potential risks, thereby guiding the healthy and responsible use of online digital art in the future.

Limitations and future research. While this study yields valuable conclusions, it acknowledges certain limitations that pave the way for future research. Primarily, the empirical research focused predominantly on Generation Z, potentially limiting the sample's representativeness given the widespread impact of the pandemic on the psychological well-being of all demographic groups. Future research should extend its scope to explore how different age groups cope with psychological health challenges through various means. Additionally, the assumptions regarding the behavior of Generation Z are not without limitations. Future studies could delve deeper into understanding the behavioral patterns of Generation Z, specifically how they seek assistance in facing psychological challenges and their behavioral motivations and preferences under varying psychological states. Moreover, this study did not consider the viewing and engagement duration of Generation Z in online digital art exhibitions. To address this, future research plans involve two primary methodologies. First, the collection and analysis of data pertaining to users' specific engagement duration on exhibitions, including page viewing time and interaction frequency. Second, through surveys and brief interviews, insights will be garnered on how users perceive the time invested in artworks and its impact on their understanding and experience of the art. Such approaches will enable a more nuanced understanding of user engagement patterns and how these patterns influence their art experience. Exploring the depth of user engagement in online art exhibitions presents a clear direction for future research. This holistic approach will not only enrich our understanding of digital art engagement but also contribute to the broader discourse on digital consumption behaviors in the post-pandemic era.

Data availability

The datasets analyzed during the current study are available in the Dataverse repository: https://doi.org/10.7910/DVN/X3YR5G.

Received: 18 July 2023; Accepted: 16 January 2024;
Published online: 13 February 2024

References

Abdelaal MS, Soebarto V (2019) Biophilia and Salutogenesis as restorative design approaches in healthcare architecture. Architectural Sci Rev 62:195–205. https://doi.org/10.1080/00038628.2019.1604313

Adevi AA, Mårtensson F (2013) Stress rehabilitation through garden therapy: The garden as a place in the recovery from stress. Urban Forest Urban Green 12:230–237. https://doi.org/10.1016/j.ufug.2013.01.007

Agrawal S, Simon A, Bech S, Bærentsen K, Forchhammer S (2020) Defining Immersion: Literature Review and Implications for Research on Audiovisual Experiences. J Audio Eng Soc 68:404–417. https://doi.org/10.17743/jaes.2020.0039

Ahmedien D (2022) SDGs in new-media arts for science. *EMBO reports* 23. https://doi.org/10.15252/embr.202255594

Altman I, Low SM (1992) Place attachment. Springer, New York

Anderson JC, Gerbing DW (1988) Structural equation modeling in practice: A review and recommended two-step approach. Psychological Bull 103:411–423. https://doi.org/10.1037/0033-2909.103.3.411

Bagozzi RP, Yi Y (1988) On the evaluation of structural equation models. J Acad Mark Sci 16:74–94. https://doi.org/10.1007/bf02723327

Baron RM, Kenny DA (1986) The Moderator–Mediator Variable Distinction in Social Psychological research: Conceptual, strategic, and Statistical considerations. J Personal Soc Psychol 51:1173–1182

Bassiouni DH, Hackley C (2014) "Generation Z" children's adaptation to digital consumer culture: A critical literature review. J Customer Behav 13:113–133. https://doi.org/10.1362/147539214x14024779483591

Beardsley MC (1998) Aesthetics : problems in the philosophy of criticism. Ind. Hackett, Indianapolis

Becker KL (2021) We want connection and we do not mean wi-fi: Examining the impacts of covid-19 on gen z's work and employment outcomes. Manag Res Rev 45:684–699. https://doi.org/10.1108/mrr-01-2021-0052

Bennett R, Rundle-Thiele S (2002) A comparison of attitudinal loyalty measurement approaches. J Brand Manag 9:193–209. https://doi.org/10.1057/palgrave.bm.2540069

Boley BB, Strzelecka M, Yeager EP, Ribeiro MA, Aleshinloye KD, Woosnam KM et al. (2021) Measuring place attachment with the Abbreviated Place Attachment Scale (APAS). J Environ Psychol 74:101577. https://doi.org/10.1016/j.jenvp.2021.101577

Bowlby J (1982) Attachment and loss: Retrospect and prospect. Am J Orthopsychiatry 52:664–678. https://doi.org/10.1111/j.1939-0025.1982.tb01456.x

Chang SH, Chih WH, Liou DK, Hwang LR (2014) The influence of web aesthetics on customers' PAD. Computers Hum Behav 36:168–178. https://doi.org/10.1016/j.chb.2014.03.050

Chebat JC, Slusarczyk W (2005) How emotions mediate the effects of perceived justice on loyalty in service recovery situations: an empirical study. J Bus Res 58:664–673. https://doi.org/10.1016/j.jbusres.2003.09.005

Chen SL, Hsu HT, Chinomona R (2023) How Tourists' Perceived Risk Affects Behavioral Intention through Crisis Communication in the Post-COVID-19 Era. Mathematics 11:860. https://doi.org/10.3390/math11040860

Chin WW (1998) The partial least squares approach for structural equation modeling

Clements JM (2020) Knowledge and Behaviors Toward COVID-19 Among US Residents During the Early Days of the Pandemic: Cross-Sectional Online Questionnaire. JMIR Public Health Surveill 6:e19161. https://doi.org/10.2196/19161

Collado S, Staats H (2016) Contact with Nature and Children's Restorative Experiences: An Eye to the Future. Front Psychol 7:1885. https://doi.org/10.3389/fpsyg.2016.01885

Dargie E (2020) Attachment Theory in Practice: Emotionally Focused Therapy (EFT) with Individuals, Couples, and Families. J Sex Marital Ther 46:717–719. https://doi.org/10.1080/0092623x.2020.1794183

Deng L, Poole MS (2010) Affect in Web Interfaces: A Study of the Impacts of Web Page Visual Complexity and Order. MIS Q 34:711. https://doi.org/10.2307/25750702
Dixon S (2015) Digital Performance: A History of New Media in Theater. Mit Press, Cambridge, Mass
Efron B, Tibshirani R (1998) *An introduction to the bootstrap*. Boca Raton, Fla Chapman & Hall/Crc
Evangelista F, Al E (1984) Principles of marketing management. Manila: National Book Store
Feen-Calligan H, Grasser LR, Nasser S, Sniderman D, Javanbakht A (2023) Photovoice techniques and art therapy approaches with refugee and immigrant adolescents. Arts Psychother 83:102005. https://doi.org/10.1016/j.aip.2023.102005
Fornell C, Larcker DF (1981) Structural Equation Models with Unobservable Variables and Measurement Error: Algebra and Statistics. J Mark Res 18:382. https://doi.org/10.2307/3150980
Ghani JA, Deshpande SP (1994) Task Characteristics and the Experience of Optimal Flow in Human—Computer Interaction. J Psychol 128:381–391. https://doi.org/10.1080/00223980.1994.9712742
Giannini T, Bowen JP (2022) Museums and Digital Culture: From Reality to Digitality in the Age of COVID-19. Heritage 5:192–214. https://doi.org/10.3390/heritage5010011
Goessling KP (2019) Youth participatory action research, trauma, and the arts: designing youthspaces for equity and healing. Int J Qualitat Stud Educ 33:12–31. https://doi.org/10.1080/09518398.2019.1678783
Gupta N (2020) Singing Away the Social Distancing Blues: Art Therapy in a Time of Coronavirus. *Journal of Humanistic Psychology*, 002216782092780. https://doi.org/10.1177/0022167820927807
Hacmun I, Regev D, Salomon R (2018) The Principles of Art Therapy in Virtual Reality. Front Psychol 9:2082. https://doi.org/10.3389/fpsyg.2018.02082
Hartig T, Korpela K, Evans GW, Gärling T (1997) A measure of restorative quality in environments. Scand Hous Plan Res 14:175–194. https://doi.org/10.1080/02815739708730435
Hassenzahl M (2004) The Interplay of Beauty, Goodness, and Usability in Interactive Products. Hum-Comput Interact 19:319–349. https://doi.org/10.1207/s15327051hci1904_2
Henseler J, Sarstedt M (2012) Goodness-of-fit indices for partial least squares path modeling. Comput Stat 28:565–580. https://doi.org/10.1007/s00180-012-0317-1
Hernández-Mogollón JM, Di-Clemente E, Campón-Cerro AM (2020) Culinary travel experiences, quality of life and loyalty Spanish J Market ESIC 24:425–446. https://doi.org/10.1108/sjme-11-2019-0094
Holmes EA, O'Connor RC, Perry VH, Tracey I, Wessely S, Arseneault L et al. (2020) Multidisciplinary research priorities for the COVID-19 pandemic: a call for action for mental health science. Lancet Psychiatry 7:547–560. https://doi.org/10.1016/s2215-0366(20)30168-1
Hossain MM, Tasnim S, Sultana A, Faizah F, Mazumder H, Zou L et al. (2020) Epidemiology of mental health problems in COVID-19: a review. F1000Research 9:636. https://doi.org/10.12688/f1000research.24457.1
Jeong JH, Lee KH (2006) The physical environment in museums and its effects on visitors' satisfaction. Build Environ 41:963–969. https://doi.org/10.1016/j.buildenv.2005.04.004
Jiang Z (Jack), Wang W, Tan BCY, Yu J (2016) The Determinants and Impacts of Aesthetics in Users' First Interaction with Websites J Manag Inf Syst 33:229–259. https://doi.org/10.1080/07421222.2016.1172443
Johnson AD (2016) The Artist-Activist: History and Healing through Art. Black Hist Bull 79:27–33. https://doi.org/10.1353/bhb.2016.0011
Joo S, Yeon Lee J (2011) Measuring the usability of academic digital libraries. Electron Libr 29:523–537. https://doi.org/10.1108/02640471111156777
Kaplan S (1995) The restorative benefits of nature: Toward an integrative framework. J Environ Psychol 15:169–182. https://doi.org/10.1016/0272-4944(95)90001-2
Kelz C, Evans GW, Röderer K (2013) The Restorative Effects of Redesigning the Schoolyard. Environ Behav 47:119–139. https://doi.org/10.1177/0013916513510528
Kim JO, Lee JE, Kim NJ (2014) An Influence of Outdoor Recreation Participants' Perceived Restorative Environment on Wellness Effect, Satisfaction and Loyalty. SHS Web of Conferences 12:01082. https://doi.org/10.1051/shsconf/20141201082
Kim S (2019) Why Should GUI Designers Create Visual Novelties? : The Mechanisms of First Impression Formation in User Experience. Arch Des Res 32:31–43. https://doi.org/10.15187/adr.2019.05.32.2.31
Kirillova K, Lehto X (2016) Aesthetic and Restorative Qualities of Vacation Destinations: How are They Related? Tour Anal 21:513–527. https://doi.org/10.3727/108354216X14653218477651
Lavie T, Tractinsky N (2004) Assessing dimensions of perceived visual aesthetics of web sites. Int J Hum-Comput Stud 60:269–298. https://doi.org/10.1016/j.ijhcs.2003.09.002
Lee J, Kyle G, Scott D (2012) The Mediating Effect of Place Attachment on the Relationship between Festival Satisfaction and Loyalty to the Festival Hosting Destination. J Travel Res 51:754–767. https://doi.org/10.1177/0047287512437859
Liu H, Liu W, Yoganathan V, Osburg VS (2021) COVID-19 information overload and generation Z's social media discontinuance intention during the pandemic lockdown. Technol Forecast Soc Change 166:120600. https://doi.org/10.1016/j.techfore.2021.120600
Lorenzo-Romero C, Constantinides E, Alarcón-del-Amo MC (2013) Web Aesthetics Effects on User Decisions: Impact of Exposure Length on Website Quality Perceptions and Buying Intentions. J Internet Commer 12:76–105. https://doi.org/10.1080/15332861.2013.763695
Majeed S, Ramkissoon H (2020) Health, Wellness, and Place Attachment During and Post Health Pandemics. *Frontiers in Psychology* 11. https://doi.org/10.3389/fpsyg.2020.573220
Martindale C, Moore K, Borkum J (1990) Aesthetic Preference: Anomalous Findings for Berlyne's Psychobiological Theory. Am J Psychol 103:53. https://doi.org/10.2307/1423259
Masoudi M, Shekarriz F, Farokhi S (2015) The effect of web interface features on consumer online purchase intentions. Manag Sci Lett 5:709–714. https://doi.org/10.5267/j.msl.2015.5.002
McCaffrey R (2007) The Effect of Healing Gardens and Art Therapy on Older Adults With Mild to Moderate Depression. Holist Nurs Pract 21:79–84. https://doi.org/10.1097/01.hnp.0000262022.80044.06
Mehrabian A, Russell JA (1974) *An Approach to Environmental Psychology*. MIT Press (MA)
Novak TP, Hoffman DL, Yung YF (2020) Measuring the Customer Experience in Online Environments: A Structural Modeling Approach. Mark Sci 19:22–42. https://doi.org/10.1287/mksc.19.1.22.15184
Odgers CL, Schueller SM, Ito M (2020) Screen Time, Social Media Use, and Adolescent Development. Ann Rev Dev Psychol 2. https://doi.org/10.1146/annurev-devpsych-121318-084815
Oliver RL (1999) Whence Consumer Loyalty? J Mark 63:33–44. https://doi.org/10.2307/1252099
Overgaard I, Sørensen NØ (2015) Can an art museum help in combating loneliness? J Appl Arts Health 6:187–203. https://doi.org/10.1386/jaah.6.2.187_1
Packard S, Berlyne DE (1975) Aesthetics and Psychobiology. Leonardo 8:258. https://doi.org/10.2307/1573258
Parsons AL (2006) Emotional Design: Why We Love (or Hate) Everyday Things20063Donald A. Norman. Emotional Design: Why We Love (or Hate) Everyday Things. New York, NY: Basic Books, A member of the Perseus Books Group 2004. 257 pp. $15.95 (paperback). J Consum Mark 23:115–116. https://doi.org/10.1108/07363760610655069
Pasini M, Berto R, Brondino M, Hall R, Ortner C (2014) How to Measure the Restorative Quality of Environments: The PRS-11. Procedia - Soc Behav Sci 159:293–297. https://doi.org/10.1016/j.sbspro.2014.12.375
Paul C (2015) *Digital art*. London: Thames & Hudson. 30. 2015
Peacock K (2012) Museum Education and Art Therapy: Exploring an Innovative Partnership. Art Ther 29:133–137. https://doi.org/10.1080/07421656.2012.701604
Powazek D (2006) Design for community. New Riders
Pretty GH, Chipuer HM, Bramston P (2003) Sense of place amongst adolescents and adults in two rural Australian towns: The discriminating features of place attachment, sense of community and place dependence in relation to place identity. J Environ Psychol 23:273–287. https://doi.org/10.1016/s0272-4944(02)00079-8
Qiu M, Zhang J (2021) Exploring the perceived restorativeness of natural soundscapes under the global pandemic of COVID-19: A moderated mediation model. PLOS ONE 16:e0256855. https://doi.org/10.1371/journal.pone.0256855
Ramezani Nia M, Shokouhyar S (2020) Analyzing the effects of visual aesthetic of Web pages on users' responses in online retailing using the VisAWI method. J Res Interact Mark 14:357–389. https://doi.org/10.1108/jrim-11-2018-0147
Rankin AB, Taucher LC (2003) A Task-oriented Approach to Art Therapy in Trauma Treatment. Art Ther 20:138–147. https://doi.org/10.1080/07421656.2003.10129570
Ratcliffe E, Korpela KM (2016) Memory and place attachment as predictors of imagined restorative perceptions of favourite places. J Environ Psychol 48:120–130. https://doi.org/10.1016/j.jenvp.2016.09.005
Raymond CM, Brown G, Weber D (2010) The measurement of place attachment: Personal, community, and environmental connections. J Environ Psychol 30:422–434. https://doi.org/10.1016/j.jenvp.2010.08.002
Riva G, Baños R M, Botella C, Mantovani F, Gaggioli A (2016) Transforming Experience: The Potential of Augmented Reality and Virtual Reality for Enhancing Personal and Clinical Change. Front Psychiatry 7:164. https://doi.org/10.3389/fpsyt.2016.00164

Roberts S, Camic PM, Springham N (2011) New roles for art galleries: Art-viewing as a community intervention for family carers of people with mental health problems. Arts Health 3:146–159. https://doi.org/10.1080/17533015.2011.561360
Rosenbaum MS (2009) Restorative servicescapes: restoring directed attention in third places. J Serv Manag 20:173–191. https://doi.org/10.1108/09564230910952762
Ryu K, Jang SS (2007) The Effect of Environmental Perceptions on Behavioral Intentions Through Emotions: The Case of Upscale Restaurants. J Hosp Tour Res 31:56–72. https://doi.org/10.1177/1096348006295506
Sagan O (2012) Connection and reparation: Narratives of art practice in the lives of mental health service users. Counsel Psychol Q 25:239–249. https://doi.org/10.1080/09515070.2012.703128
Sanchez-Vives MV, Slater M (2005) From presence to consciousness through virtual reality. Nat Rev Neurosci 6:332–339. https://doi.org/10.1038/nrn1651
Sathiyavany N, Shivany S (2018) E-Banking Service Qualities, E-Customer Satisfaction, and e-Loyalty: A conceptual Model. Int J Soc Sci Humanit Invent 5:4808–4819. https://doi.org/10.18535/ijsshi/v5i6.08
Schenkman BN, Jönsson FU (2000) Aesthetics and preferences of web pages. Behav Inf Technol 19:367–377. https://doi.org/10.1080/014492900750000063
Schweitzer M, Gilpin L, Frampton S (2004) Healing Spaces: Elements of Environmental Design That Make an Impact on Health. J Alternative Complementary Med 10:S-71–S-83. https://doi.org/10.1089/acm.2004.10.s-71
Scope A, Uttley L, Sutton A (2016) A qualitative systematic review of service user and service provider perspectives on the acceptability, relative benefits, and potential harms of art therapy for people with non-psychotic mental health disorders. Psychol Psychotherapy: Theory, Res Pract 90:25–43. https://doi.org/10.1111/papt.12093
Seemiller C, Grace M (2018) Generation Z: A century in the making. Routledge, London
Shen CC, Wang D, Loverio JP (2022) Influence of Consumer Landscape on Place Attachment in Agritourism—The Case of Huatung, Taiwan. Agriculture 12:1557. https://doi.org/10.3390/agriculture12101557
Shiau WL, Luo MM (2012) Factors affecting online group buying intention and satisfaction: A social exchange theory perspective. Comput Hum Behav 28:2431–2444. https://doi.org/10.1016/j.chb.2012.07.030
Shin Seung A, Jang JO, Kim JK, Cho EH (2021) Relations of Conspicuous Consumption Tendency, Self-Expression Satisfaction, and SNS Use Satisfaction of Gen Z through SNS Activities. Int J Environ Res Public Health 18:11979. https://doi.org/10.3390/ijerph182211979
Simanowski R (2011) *Digital Art and Meaning : Reading Kinetic Poetry, Text Machines, Mapping Art, and Interactive Installations*. University Of Minnesota Press -06-16
Slater M, Spanlang B, Sanchez-Vives MV, Blanke O (2010) First Person Experience of Body Transfer in Virtual Reality. PLoS ONE 5:e10564. https://doi.org/10.1371/journal.pone.0010564
Solway R, Thompson L, Camic PM, Chatterjee HJ (2015) Museum object handling groups in older adult mental health inpatient care. Int J Ment Health Promot 17:201–214. https://doi.org/10.1080/14623730.2015.1035520
Sonderegger A, Sauer J (2010) The influence of design aesthetics in usability testing: Effects on user performance and perceived usability. Appl Ergonomics 41:403–410. https://doi.org/10.1016/j.apergo.2009.09.002
Straub D, Gefen D (2004) Validation Guidelines for IS Positivist Research. Commun Assoc Inf Syst 13:380–427. https://doi.org/10.17705/1cais.01324
Stuckey HL, Nobel J (2010) The Connection Between Art, Healing, and Public Health: A Review of Current Literature. Am J Public Health 100:254–263. https://doi.org/10.2105/ajph.2008.156497
Stylos N, Rahimi R, Okumus B, Williams S (2021) Generation Z marketing and management in tourism and hospitality : the future of the industry. Switzerland: Palgrave Macmillan, Cham
Su HJ, Cheng KF, Huang HH (2011) Empirical study of destination loyalty and its antecedent: the perspective of place attachment. Serv Indust J 31:2721–2739. https://doi.org/10.1080/02642069.2010.511188
Tan BYQ, Chew NWS, Lee GKH, Jing M, Goh Y, Yeo LLL et al. (2020) Psychological Impact of the COVID-19 Pandemic on Health Care Workers in Singapore. Ann Intern Med 173:317–320. https://doi.org/10.7326/m20-1083
Tcha-Tokey K, Christmann O, Loup-Escande E, Richir S (2016) Proposition and Validation of a Questionnaire to Measure the User Experience in Immersive Virtual Environments. Int J Virtual Real 16:33–48. https://doi.org/10.20870/ijvr.2016.16.1.2880
Tuch AN, Presslaber EE, Stöcklin M, Opwis K, Bargas-Avila JA (2012) The role of visual complexity and prototypicality regarding first impression of websites: Working towards understanding aesthetic judgments. Int J Hum-Comput Stud 70:794–811. https://doi.org/10.1016/j.ijhcs.2012.06.003
Udsen LE, Jorgensen AH (2005) The aesthetic turn: unravelling recent aesthetic approaches to human-computer interaction. Digit Creat 16:205–216. https://doi.org/10.1080/14626260500476564
Ulrich R (1984) View through a window may influence recovery from surgery. Science 224:420–421. https://doi.org/10.1126/science.6143402
Ulrich RS (1979) Visual landscapes and psychological well-being. Landsc Res 4:17–23. https://doi.org/10.1080/01426397908705892
Vashisht D, Chauhan A (2017) Effect of game-interactivity and congruence on presence and brand attitude. Mark Intell Plan 35:789–804. https://doi.org/10.1108/mip-01-2017-0018
Vincelli F (1999) From Imagination to Virtual Reality: The Future of Clinical Psychology Cyberpsychol Behav 2:241–248. https://doi.org/10.1089/109493199316366
Vincelli F, Molinari E, Riva G (2001) Virtual reality as clinical tool: immersion and three-dimensionality in the relationship between patient and therapist. In Medicine Meets Virtual Reality 551–553. https://doi.org/10.3233/978-1-60750-925-7-551
Wang G, Huang L, Xu C, He K, Shen K, Liang P (2022) Analysis of the Mediating Role of Place Attachment in the Link between Tourists' Authentic Experiences of, Involvement in, and Loyalty to Rural Tourism. Sustainability 14:12795. https://doi.org/10.3390/su141912795
Wang R, Zhao J, Meitner MJ, Hu Y, Xu X (2019) Characteristics of urban green spaces in relation to aesthetic preference and stress recovery. Urban Forestry Urban Green 41:6–13. https://doi.org/10.1016/j.ufug.2019.03.005
Wang YJ, Minor MS, Wei J (2011) Aesthetics and the online shopping environment: Understanding consumer responses. J Retail 87:46–58. https://doi.org/10.1016/j.jretai.2010.09.002
Wang CL, Dai J, Zhu KK, Yu T, Gu XQ (2023) Understanding the Continuance Intention of College Students Toward New E-learning Spaces Based on an Integrated Model of the TAM and TTF. *International Journal of Human Computer Interaction* https://doi.org/10.1080/10447318.2023.2291609
Williams DR, Patterson ME, Roggenbuck JW, Watson AE (1992) Beyond the commodity metaphor: Examining emotional and symbolic attachment to place. Leis Sci 14:29–46. https://doi.org/10.1080/01490409209513155
Winnicott DW (1971) Playing and reality. Taylor & Francis Ltd
Witmer S, Luke J, Adams M (2000) Exploring the Potential of Museum Multiple-Visit Programs. Art Educ 53:46. https://doi.org/10.2307/3193839
Yu T, Dai J, Wang CL (2023) Adoption of blended learning: Chinese university students' perspectives. Humanit Soc Sci Commun 10:390. https://doi.org/10.1057/s41599-023-01904-7
Yu YY, Liang Q, Liu LJ (2023) Impact of population ageing on carbon emissions: A case of China's urban households. Struct Change Econ Dyn 64:86–100. https://doi.org/10.1016/j.strueco.2022.12.001
Zeng L, Proctor RW, Salvendy G (2012) User-based assessment of website creativity: a review and appraisal. Behav Inf Technol 31:383–400. https://doi.org/10.1080/01449291003686203
Zhang Q, Tian Z, Shi J, Guo W (2021) The Relationship between Watching Motivation, Perceived Value, Place Attachment and Behavioral Loyalty: A Case of China Tennis Open. Asia Pac J Appl Sport Sci 2:27–44. https://doi.org/10.46695/ascs.2.2.2
Zhao W, Li H, Zhu X, Ge T (2020) Effect of Birdsong Soundscape on Perceived Restorativeness in an Urban Park. Int J Environ Res Public Health 17:5659. https://doi.org/10.3390/ijerph17165659
Zhu L, Li H, Wang, FK, He W, Tia Z (2020) How online reviews affect purchase intention: a new model based on the stimulus-organism-response (S-O-R) framework. *Aslib Journal of Information Management* ahead-of-print. https://doi.org/10.1108/ajim-11-2019-0308

Acknowledgements

This research was supported by the National College Student Innovation and Entrepreneurship Training Program of China (Grant No. 202210337027, No. 202210337003).

Author contributions

Conceptualization: Y.X., C.W.; methodology, Y.X., C.W.; software, Y.X., C.W; writing-original draft preparation, Y.X., Y.D.; writing-review and editing, Y.X., X.T., C.W.; supervision, Y.D., S.Z.; project administration, C.W.; funding acquisition, C.W. All authors read and approved the final manuscript. All authors have read and approved the re-submission of the manuscript.

Competing interests

The authors declare no competing interests.

Ethical approval

The study obtained approval from the Research Ethical Board at Zhejiang University of Technology. Although no specific approval number was assigned, the research was conducted in accordance with the ethical guidelines set forth by the university. Simultaneously, in studies involving human participants, all procedures adhered to the ethical

standards of the institutional and/or national research committee, as well as the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent

The researcher sought and gained the consent of the participants to take part in the study. Out of the 387 sampled participants, all 387 accepted and voluntarily participated in the study after the researcher assured them of anonymity and that their responses were solely for academic purposes (https://www.nature.com/palcomms/author-instructions/submission-instructions#Ethicalstatements).

Additional information

Supplementary information The online version contains supplementary material available at https://doi.org/10.1057/s41599-024-02718-x.

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