Exploring Metaverse Addiction: Lenses of Technology Affordance and Compensatory Actualization

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Short Paper

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Abstract

As technology further evolves, the metaverse is becoming an increasingly plausible reality. In this process, it is crucial to consider potential risks that come with its development. This study focuses on the potential risk of metaverse addiction and considers the influencing factors from the perspective of technology affordance and virtual reality compensatory effect. Mainly, we identify metaverse affordances based on key characteristics (i.e., accessibility, immersion, spatiotemporality, sustainability, interoperability, and scalability). It also highlights two kinds of affordance actualization factors (i.e., escapism and digital perfectionism) that arise from virtual reality compensatory theory. The research model suggests that metaverse affordance is actualized through compensation, ultimately forming reliance behavior like an addiction. This conceptual research potentially contributes to further investigation of the dark side of the metaverse and provides insights into research considering the compensatory effects to mitigate potential risks and ensure the healthy development of the metaverse.

Introduction

A comprehensive and rich metaverse is expected to accelerate with the development of artificial intelligence (AI), virtual/augmented reality (VR/AR), 5G, and other technologies. Metaverse is "a self-sustaining, hyper spatiotemporal, and 3D immersive virtual shared space, created by the convergence of physically persistent virtual space and virtually enhanced physical reality" (Wang et al., 2022, p.4). In recent years, the metaverse has received renewed hype due to technological breakthroughs and expectations. Despite the existence of technical barriers and differing views on its future, the metaverse is expected to become the evolving paradigm of the next generation of the internet (TechTarget, 2023a). Metaverse has received worldwide attention, especially from tech giants like Facebook (Meta), Microsoft, and Tencent, based on expectations of reality and the prospect of future feasibility (Modelry, 2022).

At a time when capital and markets are excited about the development and future of the metaverse, its potential dangers should also be of concern. Metaverse offers lifelike experiences, equal access, better collaboration, and new business opportunities, but there are also some potential harms (TechTarget, 2022). Metaverse allows embodied social connections, immersive experiences, and compensation for reality, which could amplify the ills of social media and the Internet (TechTarget, 2022). In 2021, a report recognized that the metaverse could lead to unintended consequences for users and society, such as addiction to a simulated reality or virtual world, privacy, and mental health issues (Statista, 2021). In the virtual world, the impact of the existing dark side of information technology is likely to be significant and become more severe. Excessive immersion, embodiment, and disinhibition of interaction can lead to psychological and social problems (Dwivedi et al., 2022). As for the addictive nature of the metaverse, people only mention this potential harm, but it has not been considered and tested by academics. This paper, therefore, wants to examine the factors associated with metaverse addiction, which is the call of the previous

article (Dwivedi et al., 2022). Specifically, we want to answer the following questions: What affordances of the metaverse are linked to reliance like addiction? How does the compensatory effect of the metaverse to real life contribute to the development of addiction?

This study analyzes the factors influencing metaverse addiction based on technology affordance and virtual reality compensatory theory. By identifying corresponding technology affordances based on the unique features of the metaverse, we examine the roles of escapism and digital perfectionism as compensatory actualization. Through this analysis, we aim to gain a better understanding of how the metaverse can be used as a means of compensation for the real world, potentially leading to addictive behaviors.

Theoretical Background and Literature Review

Literature on Metaverse Research

The metaverse is essentially the future internet and is recognized as the evolving paradigm of web 3.0 (Wang et al., 2022), building new ecology and applications. Metaverse refers to "the 3D virtual shared world where all activities can be carried out with the help of augmented and virtual reality services" (Damar, 2021, p.1). Metaverse creates virtual experiences based on life scenarios in the physical world and embedded in our lives. By eliminating physical constraints and providing equal access, individuals in the metaverse can have lifelike experiences, interactions, and better collaboration. The deep interaction between the virtual world and the physical world fosters the compensatory role of the metaverse. The metaverse attracted much attention as soon as it was put forward. Still, it has gained popularity in recent years due to advances in related technology, such as extended reality, artificial intelligence, and blockchain. In the last two years, there has been an increasing amount of research related to the metaverse. Researchers focus on how to build the metaverse, deepening understanding from the perspective of technological advances and considering general issues related to its development, such as security and privacy issues (Dolata & Schwabe, 2023; Park & Kim, 2022; Wang et al., 2022; Weinberger, 2022). The IS researchers have explored the metaverse and discussed conceptual models early (Davis et al., 2009). More recently, researchers added the affordance perspective to examine the usage intention towards metaverse (Bao et al., 2022) and the playability of metaverse games (Shin, 2022). The study also considered the business value of metaverse by reviewing the literature (Polyviou & Pappas, 2022).

A synthesized opinion paper discusses the challenges and opportunities that may arise in the metaverse from a multidisciplinary perspective and analyzes its research value in different contexts, such as marketing, education, healthcare, and societal areas (Dwivedi et al., 2022). The negative impacts of the metaverse mentioned therein are the focus of this study, especially addictive behaviors due to the virtual reality compensatory effects. Metaverse addiction is a kind of deviant behavior in which users sacrifice their normal life, neglect important activities, and indulge in the metaverse. This behavioral disorder can be equated with addiction to the internet and gaming, which are currently in the spotlight and considered serious public health concerns (Turel et al., 2011). Those who are addicted to the metaverse are likely to face a range of adverse outcomes that may include deteriorating physical and mental health, reduced work and academic performance, and even criminal behavior. As the metaverse continues to gain momentum, it is becoming increasingly clear that it has the potential to be one of the most immersive and interactive virtual environments yet (Wasko et al., 2011). As experts have pointed out, a better understanding of the causes and effects of metaverse addiction is necessary if the metaverse's healthy development is expected (Deivedi et al., 2022; Statista, 2021).

Compensatory Effects in the Metaverse

The theory of compensatory internet use suggests that people turn to internet services like social media and online gaming as an adaptive reaction to alleviate negative feelings in real-life situations (Kardefelt-Winther, 2014). Previous research on the dark side of information technology use has shown that people go online to escape real-life issues or alleviate dysphoric moods, sometimes with negative results (Han et al., 2022; Hong et al., 2019). It has also been mentioned that the metaverse may be more addictive than video games for people who seek escape (TechTarget, 2022). The central idea of the virtual reality compensatory effect is that what people lack in the real world will strive to be compensated in the virtual world. People can build a virtual world to escape the "first life" and practice a "second life" where they can pursue perfectionism, which is not pursuable in real life. With its immersive and all-encompassing virtual environment, the

metaverse may present an even greater risk for individuals attempting to escape from reality and pursue perfection. Therefore, in examining the factors contributing to metaverse addiction, this study focuses primarily on two aspects of the virtual reality compensatory effect: escapism and digital perfectionism.

Escapism

Through virtual reality experience escapes, the metaverse "allow individuals to spend time in an immersive virtual environment and interact with content in a world that provides shelter and the illusion of an alternative reality" (Han et al., 2022). Escapism indicates that people want to leave the real world in which they live, both cognitively and emotionally (Henning & Vorderer, 2001). Metaverse must go through three phases in development: digital twins, digital natives, and surreality, meaning the continuous integration of virtual and reality (Wang et al., 2022). Through equal access to the virtual experience, the metaverse provides a virtual shelter for users and compensates them when they experience negative life situations. In this case, the compensatory escape effect supplied by the metaverse is significant.

Digital Perfectionism

As an alternative reality, the metaverse offers the individual the possibility of compensating for real life, especially in pursuing perfection. Digital perfectionism is the phenomenon that arises from technology and human interaction in a digital society (Xun et al., 2022). There are several reasons to consider digital perfectionism when examining metaverse addiction in terms of compensatory effects. First, users can experience heightened social connections and lifelike interactions in the metaverse, which fosters the climate with performance comparison. Second, the three phases of metaverse development are digital twins, digital natives, and surreality (Wang et al., 2022). In these phases, virtual activities and properties first imitate their physical counterpart and finally integrate physical and virtual worlds seamlessly. Metaverse can quantify users' behaviors and store them as a dataset in a server, which means that some potential estimates in the real world could be quantified in the metaverse and increase concerns and sensitivities about data presentations and perfect perceptions. The metaverse greatly compensates for reality by providing a more accurate representation and allows individuals to pursue perfection that is impossible to achieve in real life.

Metaverse Affordance

Previous research clarified that "a model for metaverse research must include both the technology capabilities of metaverses and the social interaction that takes place in the metaverse environment" (Davis et al., 2009). Taking the technology capabilities into consideration is valuable when examining user behaviors. The view of technology affordance is commonly used to interpret actionable properties by combining user goals and technical features (Markus & Silver, 2008). Studies will contextualize various affordances based on research interest. Adopting the technology affordance perspective could provide generalizable insights into metaverse addiction since affordances focus on common technical features of metaverse that align with user goals. To fully identify and consider the technology affordance of the metaverse, we first review the related research and then consider key features of the metaverse.

Several studies have considered the usage intention of metaverse, playability of metaverse games, and immersive VR by adopting technology affordance, as shown in Appendix A. One study considering the usage intention of metaverse has identified ubiquity, interoperability, and scalability as the antecedents of immersion, which further combined with perceived risks to influence usage intention (Bao et al., 2022). Two studies related to metaverse considered affordance and actualization (Dincelli & Yayla, 2022; Shin, 2022). After examining the technical capabilities, focal affordances of immersive VR were identified as embodiment, interactivity, navigability, sense-ability, and create-ability (Dincelli & Yayla, 2022). This study also considered the affordance actualization of immersive VR in organizations. A study has identified relevant affordance with actualization in metaverse games (Shin, 2022). The duality of affordance in the metaverse is characterized by instrumental affordance (immersion and presence) and affective affordance (empathy and embodiment).

Previous studies, however, lack consideration of the unique features of the metaverse. This study aims to articulate metaverse affordances by synthesizing metaverse features. This study adopted key characteristics of the metaverse identified by previous studies (Wang et al., 2022; Dionisio et al., 2013; Zhang et al., 2022)

and recognized corresponding affordances. *Accessibility* represents that the metaverse virtual space is accessible from all digital devices, and users' virtual identities remain constant across accesses (Dionisio et al., 2013). *Immersion* refers to the metaverse as a computer-generated virtual space that is realistic enough for the user to be psychologically and emotionally immersed in (Shin, 2022; Wang et al., 2022). *Spatiotemporality* indicates that "metaverse break the limitations of time and space, allowing users to shuttle through different worlds with different spatiotemporal dimensions and experience the alternate life of seamless scene transformation" (Wang et al., 2022). *Sustainability* means that "the metaverse maintains a closed economic loop and a consistent value system with a high level of independence" (Wang et al., 2022), facilitating open innovations, co-creation, and autonomous growth. *Interoperability* represents that metaverse allows users to seamlessly move and interchange digital assets across distinct platforms (Wang et al., 2022). *Scalability* indicates that the metaverse provides sufficient operational capacity to allow concurrent users to use it simultaneously without compromising the system's efficiency or user experience (Dionisio et al., 2013; Zhang et al., 2022).

Hypothesis Development and Research Model

As shown in Figure 1, we propose a research model based on technology affordance and virtual reality compensatory theory.

Figure 1. Research Model
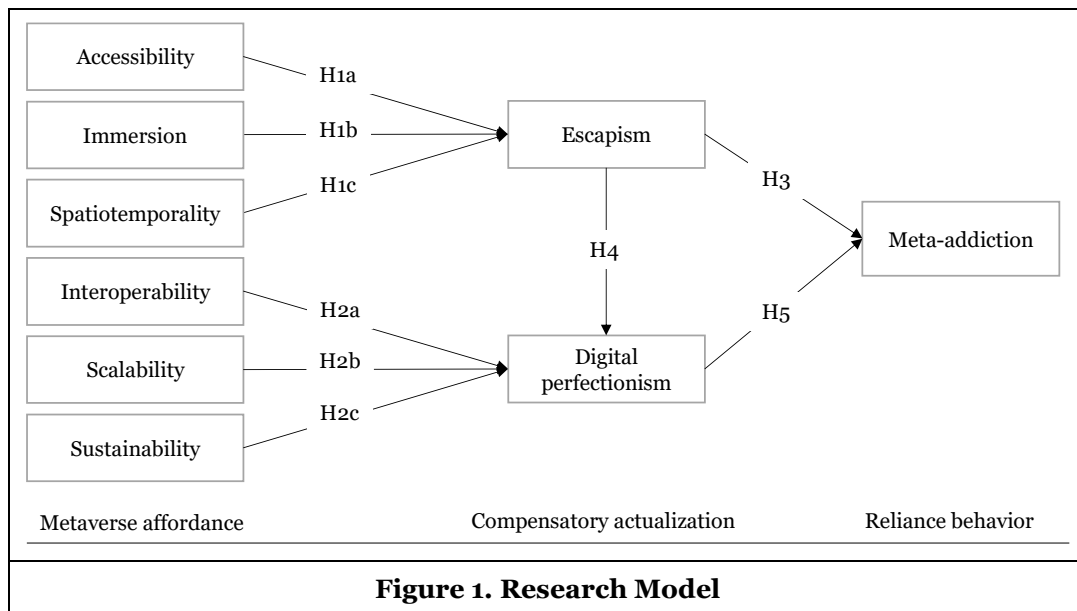
Metaverse Affordances and Compensatory Actualization

Significant innovations and advances in technologies will make the metaverse ubiquitous soon. People can access metaverse virtual space from digital devices and travel across different virtual worlds with constant virtual identities (Zhang et al., 2022). The ubiquitous metaverse facilitates individuals with convenient escape options, which compensate users by alleviating negative life situations and daily stresses of society. Immersion affordance of the metaverse is even more effective at compensating for escape than in the current online world. The study revealed that escapists perceive more immersive VR experiences to be more useful (Han et al., 2022). Users can immerse themselves in the metaverse psychologically and emotionally, which is called immersive realism (Wang et al., 2022). Expression and sensory perception like gestures, sight, touch, temperature, and balance could make virtual worlds more immersive and satisfy individuals with timely escape compensation when they encounter negative life emotions. The affordance of spatiotemporality offers the possibility to break the restrictions of time and space and allows users to travel freely in worlds with different spatiotemporal dimensions. For individuals who are confined to the real world and experience negative life situations, the metaverse is the place to escape and seek compensation. Thus, we hypothesize that escapism, as one compensatory actualization in the metaverse, can be affected by affordances of accessibility, immersion, and spatiotemporality.

H1a/b/c. Accessibility/Immersion/Spatiotemporality of the metaverse is positively related to the compensatory actualization of escapism.

Interoperability affordance in the metaverse means that users can seamlessly move across virtual worlds without interrupting the experience and continue the content creation without losing digital assets (Bao et al., 2022; Wang et al., 2022). These possibilities can compensate users with more opportunities to strive for high standards and digital perfection in the uninterrupted and interconnected metaverse world. Scalability affordance in the metaverse enables users to efficiently utilize the system concurrently, even with complex scenarios and interactions. Interactions of users or avatars in the metaverse are heightened in terms of types, ranges, and patterns (Wang et al., 2022). The metaverse will enable a richer social experience than today's Internet and gaming platforms (TechTarget, 2022). Increased user interactions can amplify the observational learning effect and the awareness of negative comments, deepening the need for high standards and perfection (Xun et al., 2022). Digital perfectionism can be enhanced and compensated for by the scalable metaverse with massive users. Sustainability of the metaverse, characterized by open innovation spaces and decentralized structures, enables individuals to create and collaborate in ways unbounded by the limitations of the physical world (Wang et al., 2022). The metaverse provides users with highly accurate and precise representations in an ideal environment, facilitating peerless collaboration and co-creation. The metaverse offers limitless opportunities for individuals to showcase their creativity and imagination, enabling them to achieve feats beyond the bounds of reality. As a result, the pursuit of high standards and perfection becomes more and more prominent. Thus, we propose that affordances of interoperability, scalability, and sustainability of the metaverse significantly impact the evolution of digital perfectionism.

H2a/b/c. Interoperability/Scalability/Sustainability of the metaverse is positively related to the compensatory actualization of digital perfectionism.

Compensatory Actualization and Metaverse Addiction

From the perspective of compensatory actualization, we explore the impact of escapism and digital perfectionism on metaverse addiction. Virtual reality compensatory effects support that people seek to compensate in the virtual world for what they lack in the real world. People experiencing negative life situations and unable to deal with psychological discomforts will escape to the virtual world and engage in excessive use (Kardefelt-Winther, 2014). Since the metaverse provides users with an immersive, interactive, spatiotemporal-free world, people with negative life experiences tend to escape and indulge in it. Self-indulgent escapism is often characterized by pleasurable that triggers feelings of euphoria and helps distract people from stress (Han et al., 2022). Research has found that "self-indulgent escapism is a rather ineffective and unhealthy coping strategy to deal with negative life circumstances" (Panova & Lleras, 2016). In the metaverse, the compensatory actualization of escapism will lead to metaverse addiction.

Individuals prone to escapism may be drawn to the metaverse to escape from their mundane daily lives. In the metaverse, they may immerse themselves in digital perfectionism, seeking to attain perfect digital experiences and interactions. This pursuit of digital perfectionism will likely give them a sense of control, satisfaction, and achievement in the virtual world that they may not have experienced in the physical world. People who are more inclined towards escapism are likely to be more invested in pursuing perfect digital experiences and interactions in the virtual world. Thus, we hypothesize as follows.

H3/4. Compensatory actualization of escapism in the metaverse is positively related to metaverse addiction/digital perfectionism.

According to virtual reality compensatory theory, people will compensate themselves in the virtual world if possible. From the perspective of perfectionism, pursuing perfection may lead to psychological disorders (Patterson et al., 2021). Psychological research suggests that people want to appear better than they are for self-enhancement and self-assessment (Strube & Roemmele, 1985). In the metaverse, "one can come up with better-looking, idealized avatars, forgetting the struggles of daily lives" (Dwivedi et al., 2022). The pursuit of perfection in the metaverse transcends the limitations of space and time and has more possibilities than in real life, leading to reliance. Thus, we hypothesize a positive relationship between digital perfectionism and metaverse addiction.

H5. Compensatory actualization of digital perfectionism in the metaverse is positively related to metaverse addiction.

Method

Pilot Data Collection

This study adopts a longitudinal field survey of current users of metaverse prototypes to validate the research model. Since longitudinal survey can reduce common method bias and establish causality, it is widely used to collect data in research related to the dark side of IT use (Gong et al., 2021). Many metaverse prototypes exist in different applications, such as Second Life, Roblox, Fortnite, Horizon World, Decentraland, Cryptovoxels (Wang et al., 2022; TechTarget, 2023b). The first pilot study listed the metaverse prototypes and asked the subjects to report the familiar metaverse prototypes. We found that over 62% (26/42) reported they were somewhat familiar with Roblox. Since a complete metaverse has not yet been realized, massively multiplayer online games are the experimental field before the practical application of the metaverse (Rockbridge, 2022). We will take Roblox (a global user-created game platform that allows players to create games and design items) as an example when collecting data because it basically contains the unique features of the metaverse (see Wang et al., 2022). The survey questionnaires are distributed through MTurk to access possible respondents. We first piloted 42 valid users to clarify the instructions and settings. The distributed survey in the first pilot study measured accessibility, immersion, spatiotemporality, interoperability, scalability, and sustainability. We used a seven-point Likert scale (1 = strongly disagree to 7 = strongly agree) for all items. The second pilot study will measure escapism, digital perfectionism, metaverse addiction, and other control variables. We tend to control the influences of demographic information (age, gender, education, income), familiarity, history, frequency, and social desirability bias.

Measures

Most measures are adapted from previously validated scales. Specifically, interoperability, accessibility, immersion, and scalability are adapted from previous studies (Bao et al., 2022; Shin, 2022). There are no existing mature scales of sustainability and spatiotemporality, and we generate measures by referring to create-ability (Dincelli & Yayla, 2022) and spatial affordance (Shin, 2022). Items are adapted from previous studies to measure escapism, digital perfectionism, and metaverse addiction (Gao et al., 2017; Xun et al., 2022; Turel et al., 2011). We treat interoperability, scalability, and sustainability as formative first-order constructs, while digital perfectionism is the formative second-order construct. Other constructs are reflective first-order constructs. We first generate new scales for sustainability and spatiotemporally by following instrumental development.

Preliminary Data Analysis

In the first pilot stage, we collected 42 samples. The proportion of gender (64.3% males and 35.7% female) and age distribution (77% between the ages of 25 and 54) are consistent with previous surveys of the metaverse that people who are familiar with metaverse tend to be male, younger than 55 years old, and have a bachelor's degree or higher (Rockbridge, 2022). As shown in Table 1, we tested the composite reliability (CR) and Cronbach's alpha of reflective constructs, which indicate acceptable reliability. The loadings and average variance extracted (AVE) were used to test the convergent validity. Discriminant validity was assessed by comparing the square root of the AVE of each construct and the correlations with other constructs (Fornell & Larcker, 1981). Cross-loadings and variance inflation factor (VIF) were calculated for formative constructs to test the discriminant validity and exclude the influence of multicollinearity.

Constructs and items	Loading
Accessibility (Adapted from Bao et al., 2022) (Cronbach's α=0.735; CR=0.835; AVE=0.558)	
Metaverse can be accessed anytime.	.711
Metaverse can be accessed on the move.	.736
Metaverse can be accessed anywhere.	.728
Scalability (Adapted from Bao et al., 2022)	
Metaverse enables enormous concurrent users.	-
Metaverse has no limitation on what users build and behave (scale the scene complexity).	-
Metaverse has no limitation on type, scope, and range of interactions, such as "the wave".	-

Immersion (Adapted from Hudson et al., 2019; Bao et al., 2022) (Cronbach's α=0.804; CR=0.803; AVE=0.577)	
I felt completely involved in the metaverse.	.750
I felt detached from the real world.	.826
I feel emotionally absorbed in the metaverse.	.804
I experience an altered sense of time in the metaverse.	.842
Interoperability (Adapted from Bao et al., 2022)	
Technically, the metaverse has the requisite software and hardware infrastructure to securely exchange information.	-
Metaverse enables multiple systems to share, interpret and use the exchanged information.	-
Metaverse facilitates the standardization of virtual worlds across various system providers based on a predefined set of agreed rules and processes.	-
Sustainability Developed (refer to Dincelli & Yayla, 2022; Wang et al., 2022)	
Metaverse maintains a closed economic loop.	-
Metaverse has a consistent value system with a high level of independence.	-
Metaverse is open, fostering creativity and innovation and inspiring users with a passion for digital content creation.	-
Metaverse is decentralized, eliminating risk and preventing being controlled.	-
Spatiotemporality Developed (refer to Shin, 2022) (Cronbach's α=0.683; CR=0.787; AVE=0.552)	
I feel like I am inside the area without limitations of time and space.	.749
I can freely shuttle across various worlds with different spatiotemporal dimensions in the metaverse.	.741
I can experience an alternate life with seamless scene transformation in the metaverse.	.739
Table 1. Analysis of Related Constructs in the Pilot Study	

Expected Contribution

In this study, we consider the potential negative effects in the development and realization of the metaverse, namely metaverse addiction. Through the lenses of technology affordance and virtual reality compensatory effects, we identified two compensatory factors of escapism and digital perfectionism as affordance actualization. This study proposes the framework of "metaverse affordance-compensatory actualization-reliance behavior" to explore the underlying mechanism of metaverse addiction.

This study is expected to have the following contributions. First, although the metaverse is in the infant stage, considering potential unintended psychological consequences is the call of the previous study (Dwivedi et al., 2022). This study potentially contributes to addiction research literature and enriches the understanding of metaverse addiction from the compensatory view, which supplements the virtual reality compensatory theory. Second, this study considers metaverse addiction by identifying technology affordances of the metaverse. Given that there are few studies on metaverse affordance, this study promotes further research on metaverse affordances from technological characteristics. Third, we identify two factors for compensatory actualization as escapism and digital perfectionism, which could supplement the understanding of affordance actualization (Anderson & Robey, 2017). In addition, by shedding light on the mechanisms of addiction, the findings can inform practitioners about important considerations when designing and implementing metaverse environments. Specifically, this study highlights the need to address certain issues in the real world that could impact the adoption and use of metaverse healthily. Individuals need to recognize that the metaverse is not a substitute for real-life experiences and interactions. Practitioners should promote the idea of a balanced approach to life, where individuals prioritize maintaining healthy relationships and experiences in both the virtual and physical worlds. The framework indicates that people can achieve a healthier utilization of the metaverse if altering the tendency to pursue escapism and digital perfectionism. Practitioners should consider these tendencies and set up a mechanism to protect individual well-being, such as setting up policies to limit time spent in the metaverse. This study emphasizes the importance of developing and using metaverse in a responsible manner and provides practical implications for practitioners and users alike.

The research has limitations that should be addressed. It needs to consider adequate control variables like social support and additional affordance in the metaverse, such as hedonic affordance. To improve the study, we will analyze initial participant feedback and optimize the research methodology and questionnaire design before collecting data from a representative sample to verify the research model empirically.

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Appendix A. Related Literature of Metaverse Affordance

Immersive VR (Dincelli & Yayla, 2022)
Embodiment: Users' tendency to perceive the virtual body they control as their own biological body and their actions in VR as their own actions in real life.
Navigability: Ability to freely move the avatar in a navigable space in the virtual environment.
Sense-ability: Ability to sense (e.g., touch, smell, hear, taste) in the virtual environment.
Interactivity: The extent to which users can engage in reciprocal or non-reciprocal interactions with virtual objects and agents.
Create-ability: Ability to create aspects that do not exist in the physical world and recreate existing aspects of the physical world to diminish negative and enhance positive aspects of it in VR.

Metaverse games (Shin, 2022)
Spatiality: Virtual elements are experienced spatially and temporally inside the XR world.
Virtuality: MG enables users to feel like they are there or are with others.
Immersion: MG enables users to immerse themselves within a certain story setting.
Utilitarian: Users engage in diverse useful functions through MG, such as playing, socializing, and self-fulfilling rewards.
Hedonic: MG allows users to experience a variety of hedonic pleasures.
Empathy: MG allows users to understand the feelings of another and correctly share these feelings with another in games.
Embodiment: The feeling of having a body in an extended reality experience.

Metaverse immersion (Bao et al., 2022)
Ubiquity: People inevitably inhabit, move, and interact with it at all times and in all situations.
Interoperability: Users of the metaverse should have full access to any environment without being disrupted by changing their login credentials or losing their digital assets.
Scalability: Metaverse allows efficient concurrent use of the system by massive numbers of users.