

# Mindfulness in internet and new media

**Edited by**

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# Mindfulness in internet and new media

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# Editorial: Mindfulness in internet and new media

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## KEYWORDS

mindfulness, meditation, internet, new media, loving kindness meditation (LKM)

## Editorial on the Research Topic Mindfulness in internet and new media

In the rapidly evolving landscape of the digital age, our relationship with the internet and new media has become more intertwined than ever before. We find ourselves immersed in a virtual world, constantly bombarded by information, and connected to a global network of individuals. This Research Topic, “*Mindfulness in internet and new media*,” explores the complex interplay between our digital lives and the practice of mindfulness.

Mindfulness, a mental state characterized by awareness and presence in the moment, has gained increasing attention in recent years for its potential to enhance wellbeing and cognitive functioning. As we navigate the ever-expanding digital realm, questions arise about how mindfulness can be applied to foster a more balanced and harmonious relationship with the internet and new media.

## The evolution of digital mindfulness

The roots of mindfulness trace back to ancient contemplative practices, but in today's context, it has taken on new dimensions. In this Research Topic, we delve into how mindfulness has adapted and evolved to meet the challenges of the digital age. Our contributors explore various aspects of digital mindfulness, ranging from its impact on mental health to its role in cultivating meaningful connections in online communities.

## Articles in this Research Topic

The first article in this Research Topic, “*The effect of animation-guided mindfulness meditation on the promotion of creativity, flow, and affect*,” by [Chen et al.](#), explores the innovative use of animation in mindfulness practices. This research investigates how animation can enhance the effectiveness of mindfulness meditation, fostering creativity and emotional wellbeing. The study's findings provide insights into the potential for technology to augment traditional mindfulness practices ([Chen et al.](#)).

In “Effects of online mindfulness-based interventions on the mental health of university students: A systematic review and meta-analysis,” Gong et al. conduct a comprehensive analysis of existing research in the field. This article synthesizes the current state of knowledge regarding the impact of online mindfulness interventions on the mental health of university students. The findings have implications for educators and mental health professionals working with the student population in digital spaces (Gong et al.).

Gu et al. delves into the world of social media in “The effect of trait mindfulness on social media rumination: Upward social comparison as a moderated mediator.” This study explores how individual differences in mindfulness can influence our online behaviors, specifically focusing on the phenomenon of social media rumination. By highlighting the role of upward social comparison, the research provides insights into the dynamics of social media use (Gu et al.).

The article titled “A study on the relationship between mindfulness and work performance of web editors: Based on the chain mediating effect of workplace spirituality and digital competencies” by He et al. take a workplace perspective. It investigates how mindfulness practices can enhance the performance of web editors. The study introduces the concept of workplace spirituality and digital competencies as key mediators, offering a holistic view of the relationship between mindfulness and work outcomes in the digital age (He et al.).

“Techno-psychological approach to understanding problematic use of short-form video applications: the role of flow” by Huang et al. offer a perspective on problematic technology use. Focusing on short-form video applications, this research explores the concept of flow as a driver of excessive engagement. Understanding the role of flow in technology addiction is crucial for developing interventions and strategies to promote healthy digital behaviors (Huang et al.).

Kuang et al. examine the impact of mindfulness in the workplace in “The effect of employee mindfulness in the new media industry on innovative behavior: The chain mediating role of positive emotion and work engagement.” This study highlights how mindfulness practices can enhance innovative behavior among employees in the new media sector, emphasizing the importance of positive emotions and work engagement in this process (Kuang et al.).

In “Effects of animated pedagogical agent-guided loving-kindness meditation on flight attendants’ spirituality, mindfulness, subjective wellbeing, and social presence,” Liu et al. explore the use of mindfulness in the airline industry. This research introduces animated pedagogical agents to guide meditation practices, demonstrating how technology can facilitate mindfulness and enhance wellbeing in specific occupational settings (Liu et al.).

“Parental intervention strategies and operating mechanism on adolescent social media use—The concept of literacy improvement based on interaction” by Wang and Chen focus on the critical issue of adolescent social media use. This article discusses parental intervention strategies and the concept of literacy improvement through interaction. Understanding how parents can guide their

children’s digital interactions is crucial for promoting responsible internet use among youth (Wang and Chen).

Wang et al. address the design of mindfulness information in “Designing mindfulness information for interaction in social media: The role of information framing, health risk perception, and lay theories of health.” This research investigates how the presentation of mindfulness content can influence user engagement and health perceptions on social media platforms. It sheds light on the design principles that can make mindfulness information more effective in digital contexts (Wang et al.).

“The effect of mindfulness intervention on internet negative news perception and processing: An implicit and explicit approach” by Yang et al. delves into the impact of mindfulness on our consumption of online news. This study employs both implicit and explicit measures to understand how mindfulness interventions can influence our perception and processing of negative news, offering novel insights into the intersection of mindfulness and media consumption (Yang et al.).

You and Liu investigate the relationship between mindfulness and online behaviors in “The effect of mindfulness on online self-presentation, pressure, and addiction on social media.” This article explores how mindfulness can mitigate the pressures associated with online self-presentation and addiction tendencies on social media platforms. It underscores the potential for mindfulness to promote healthier digital interactions (You and Liu).

Finally, “A study of the factors influencing HIV-preventive intentions among ‘hookup’ application users” by Li and Li explore the complex world of dating and hookup applications. This research examines the factors that influence HIV-preventive intentions among users of these apps, shedding light on the intersection of technology, sexual health, and mindfulness (Li and Li).

## The significance of mindfulness in the digital age

Our contributors have illuminated various dimensions of mindfulness in the context of internet and new media. Together, their work underscores the significance of cultivating mindfulness in an era dominated by screens and constant connectivity.

Collectively, the articles in this Research Topic offer a comprehensive exploration of mindfulness in the digital age. They underscore the significance of mindfulness in helping us navigate the complexities and challenges of the internet and new media. Here are some key takeaways: enhance creativity and emotional wellbeing, improve student mental health, understand social media behavior, improve work performance, change problematic media use behaviors, foster innovation, enhance the wellbeing, guide parent education, guide interaction design, perception, and processing of negative news, online self-presentation and addiction and sexual health decisions.

## Conclusion

As we conclude this expansive Research Topic on “Mindfulness in internet and new media,” we extend our heartfelt gratitude

to the authors, reviewers, and readers who have contributed to this comprehensive exploration of the intersection between mindfulness and the digital landscape. The research presented here underscores the vital role that mindfulness plays in helping us navigate the complexities and challenges of the internet and new media. It offers a roadmap for cultivating a more balanced, mindful, and ethical engagement with the digital world.

In an era where the internet and new media are integral to our daily existence, the practice of mindfulness becomes more than just a tool for personal wellbeing—it becomes a means to navigate the digital landscape with clarity, balance, and intention.

## Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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# The Effect of Animation-Guided Mindfulness Meditation on the Promotion of Creativity, Flow and Affect

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Creativity is so important for social and technological development that people are eager to find an easy way to enhance it. Previous studies have shown that mindfulness has significant effects on positive affect (PA), working memory capacity, cognitive flexibility and many other aspects, which are the key to promoting creativity. However, there are few studies on the relationship between mindfulness and creativity. The mechanism between mindfulness and creativity is still uncertain. Meditation is an important method of mindfulness training, but for most people who do not have the basic training, it's difficult to master how to get into a state of mindfulness. Animation has been shown by many studies to help improve cognition and is often used as a guiding tool. Using animation as the guiding carrier of meditation is more convenient and easier to accept. Therefore, this study adopted the intervention method of animation-guided meditation, aiming to explore: (1) the effect of animation-guided meditation on enhancing creativity; (2) the role of flow and emotion in the influence of mindfulness on creativity. We advertised recruitment through the internal network of a creative industrial park, and the final 95 eligible participants were divided into two groups: animation ( $n=48$ ) and audio ( $n=47$ ) guided meditation. The animation group was given an animated meditation intervention, and the audio group was given an audio meditation intervention, both interventions were performed 3 times a week and last for 8 weeks. Results: (1) Animation-guided meditation significantly increased participants' mindfulness and creativity levels; Significantly reduced their cognitive load compared to audio-guided meditation. (2) Mindfulness has a significant direct effect on creativity, and significant indirect effects on creativity; Flow and PA act as the mediating variable. Conclusion: (1) Mindfulness, flow, and PA all helped to improve the subjects' work creativity. In addition to the direct positive impact of mindfulness on creativity,

mindfulness can also have an indirect positive impact on creativity through flow and PA. (2) Compared with audio, animation can significantly reduce cognitive load and help improve users' cognitive ability, which is more suitable for the guidance materials of mindfulness meditation to enhance the effect of meditation.

**Keywords:** animation guided meditation, mindfulness, creativity, flow, positive affect

## INTRODUCTION

### Meditation and Creativity

Creativity is indispensable to the development of human civilization and plays a vital role in the field of human cultural life. It is creativity that has led to so many new inventions and discoveries in human society (Kaufman, 2018). With the trend of intelligent technology, information network and economic globalization, science and technology are changing with each passing day. In this era of encouraging innovation, people are eager to find a simple way to enhance creativity (Sternberg et al., 2020). Creativity includes the ability to create, to generate new and unknown ideas or products, to invent or express imagination and intelligence, and to inspire the power of imagination and invention (El-Murad and West, 2004). The definition of creativity varies, but most scholars agree that creativity is related to three key thinking abilities: divergent thinking, distant association and insight (Dietrich and Kanso, 2010; Sawyer, 2011; Zhang et al., 2020).

Meditation originated in Buddhism, and as meditation became more popular, scholars began to study its physiological and behavioral effects, including its impact on human creativity (Sarath, 2006). Meditation is a combination of emotional and attentional techniques for relaxation, and mindfulness meditation is the most popular form of meditation (Charoensukmongkol and Puyod, 2020). Mindfulness is defined as a nonjudgmental awareness that trains the meditator to focus on the present moment (Agnoli et al., 2018). Mindfulness is also known as a flexible state of mind in which people are actively engaged in the present moment, are more aware of new things, and are more sensitive to external stimuli and environmental changes (Charoensukmongkol and Pandey, 2021). Attention and awareness are key components of mindfulness (Charoensukmongkol, 2019a). Through attention training, people can control their physical and mental activities and get rid of negative emotions (Glicksohn and Ben-Soussan, 2020). Meditation training can also improve cognitive functions such as attention and memory (Lebuda et al., 2016b). As mindfulness meditation has evolved, and more people benefit from mindfulness meditation, there is a trend toward mindfulness-based "cognitive behavioral therapy." This can largely be attributed to the apparent efficacy of mindfulness meditation in emotional management, interpersonal communication and cognitive function (Charoensukmongkol, 2017). Mindfulness meditation has been found to be associated with improved cognitive function, working memory and the ability to flexibly switch ideas, helping to suppress mental wandering (Charoensukmongkol, 2019b).

Many previous studies have found that mindfulness improves creativity. Divergent thinking is a way of thinking that produces

many novel ideas. Mindfulness meditation requires individuals to be open to perception and acceptance of any sensory and external stimuli, and this tolerance and acceptance can promote divergent thinking (Henriksen et al., 2020). Henriksen et al. (2020) found a significant positive correlation between the level of mindfulness and the score of creative expression. Research by Richard et al. (2017) explored the relationship between mindfulness and insight, which is an important component of creative thinking. The resolution of Epiphany problems is easily hindered by automatic language conceptualization processes, and mindful meditation involves "unconceptualized consciousness," whose purpose is to limit an individual's ability to automatically activate language conceptualization from previous experiences. Therefore, Tan et al. (2021) propose that mindfulness may contribute to the resolution of insight problems. The results showed that the level of mindfulness was positively correlated with the problem solving rate of insight problems, but not with the problem solving rate of non-insight reasoning problems. Furthermore, the positive correlation between mindfulness and insight remained after controlling for positive emotions and mindful manipulation, suggesting that the relationship between mindfulness and insight was not affected by positive emotions. The results also showed that participants in the mindful group performed significantly better on insight questions than the control group, while there was no significant difference between the two groups on non-insight questions. This provides strong support for a positive correlation between mindfulness and creativity. The study of Ostafin and Kassman (2012) mindfulness-creativity showed that the resolution rate of insight problems in the mindfulness training group was significantly higher than that in the sham training group and the control group, but there was no difference between the sham training group and the control group, proving that mindfulness can improve creativity rather than the placebo effect. Therefore, based on the above results, we can predict that there is a positive correlation between mindfulness and creativity, and mindfulness training may help improve creativity.

There are some common features between mindfulness and flow in that both emphasize focus on the present moment (Wright et al., 2006). Norisworthy et al. (2017) found that flow requires unconscious attention to specific tasks in the present moment. Some scholars have suggested that being present is an effective strategy for achieving flow (Rogatko, 2009; Weinstein et al., 2009; Landhäuser and Keller, 2012). Mindfulness helps people maintain awareness of the present moment, and thus may be the basis of flow (Kaufman et al., 2009; Aherne et al., 2011; Briegel-Jones et al., 2013). Flow and mindfulness are both important concepts in positive psychology that have been shown to play a positive role in



stimulating and promoting creativity (Schutte and Malouff, 2020). Csikszentmihalyi first linked flow experiences to creativity in 1997, arguing that flow is an important precursor to high levels of creativity and innovation (Csikszentmihalyi, 1997). Flow is a peak experience of high immersion in the task at hand, and it is easier to experience flow when the challenge of the task matches the individual's skill set (Csikszentmihalyi and Rathunde, 1993). Creative thinking processes such as insight often occur in the process of reorganizing problem situational information, which often requires remote connection of thinking information, and all these processes require higher attention of individuals (Kounios and Beeman, 2014). Flow is a state of ecstasy when the attention is highly focused on the task at hand. In flow state, creativity is more easily stimulated (Cseh, 2016). When consciousness and spirit are highly focused, the phenomenon of insight is more likely to occur, thus stimulating and promoting creativity (Yang et al., 2019).

Both mindfulness and flow have been proven to have strong emotional regulation effects (Liu et al., 2021a), significantly enhancing positive affect (PA) and reducing negative affect (NA; Liu et al., 2021b,c). Since the 1990s, psychological researchers have conducted numerous studies on the relationship between emotional states and creativity. According to the emotion expansibility and construction theory (Van Cappellen et al., 2021), PA will expand the thinking space and cognitive scope of individuals in a short time, enhance the flexibility of individual thinking, and facilitate the improvement of creativity (West and Fredrickson, 2020). On the contrary, NA is not conducive to the improvement of individual creativity, because NA will reduce the individual's cognitive range and thinking space (Liu et al., 2020). Baron and Tang (2011) investigated the relationship between emotion and creativity using emotional heuristics and conceptual categorization task execution. The results showed that the experiment-induced active association made the subjects generate more concept categories in the concept classification task, and the active association also made the subjects generate more unusual associations for neutral words. Benedek et al. (2014) also found that PA can promote creative problem solving. Chen and Hou (2016) studied the relationship between creativity and emotion and found that creativity was negatively correlated with NA. Research shows that negative emotions, like depression and anxiety, can get in the way of creative problem solving. He suggests that short-term mind-body conditioning training can improve the cognitive neural mechanisms of creativity. NA reduces the possibility of creative problem solving by limiting people's attention and ossifying their responses. Davis et al. (2017) also suggested that excessive anxiety would hinder the generation of new and innovative ideas.

To sum up, both mindfulness and flow have positive effects on creativity. Mindfulness may be the basis for the flow experience. Both mindfulness and flow can significantly improve PA. And PA can increase cognitive flexibility and improve the ability of long-distance association, thus promoting creativity. Therefore, flow and PA may play a certain mediating effect on the influence of mindfulness on creativity.

## Animation and Cognitive Load

The widespread use of computers has made multimedia interventions in learning more and more common. Animation is favored by educators, and learners can also refer to the corresponding animation to enhance the learning effect. Animation is a dynamic image, which will change its properties over time to express the functional meaning, use method, state or state transformation of the image itself (Yang et al., 2018). Animation as a way of presentation in teaching has three characteristics: (1) attracts learners' attention and stimulate learning motivation; (2) describes events that have motion or trajectory; (3) explains complex concepts or phenomena (Aysolmaz and Reijers, 2021). According to congruence principle, the external representation of the animation needs to be highly consistent with the internal information to be expressed, so that the animation can be more easily interpreted and comprehended (Tversky et al., 2002).

Cognitive Load refers to the sum of psychological resources necessary for information processing. Cognitive load theory holds that human cognitive resources (mainly reflected in working memory capacity) are limited. Limited working memory capacity makes it difficult for people to process multiple kinds of information at the same time (Sweller, 1994). If they engage in several activities at the same time, there will be the problem of resource allocation, which follows the principle of "more here and less here, but the total amount remains unchanged." When a material contains multiple elements interacting with each other, it will increase the cognitive load of learners. If the total amount of Cognitive resources needed in the process of problem solving or learning exceeds the total amount of individual Cognitive resources, it will cause Cognitive overload and affect the effect of learning or problem solving (Sweller, 2011).

According to the different sources of cognitive load, Sweller divided cognitive load into intrinsic cognitive load (ICL), extraneous cognitive load (ECL) and germane cognitive load (GCL; Sweller et al., 1998). (1) ICL refers to the complexity of learning materials – how many elements are composed and how these elements affect each other. When there are many components and their interactions are complex, the ICL is high. ICL is related to the degree of correlation between the complexity of learning materials and the level of learners' previous knowledge and experience. If the learning materials are complex and the learners lack previous knowledge and experience in this field, they need to process multiple elements at the same time, thus increasing the working memory burden and producing a high ICL. If a learner has more prior knowledge and experience in a certain field, he or she will have less ICL when learning the same material than a learner with less prior knowledge and experience, because the complexity of the learning material is reduced for them (Szulewski et al., 2020). (2) ECL depends on the way information is designed, the way materials are organized and the way they are presented. It is caused by psychological activities that do not directly contribute to learning in the process of learning, which is also known as invalid cognitive load and has a hindering effect on learning. When the information is not well designed, learners must engage in irrelevant or ineffective cognitive processing, which

will result in ECL. For example, if the teaching materials include text and diagram, but the text and diagram are not completely consistent in content, it will cause ECL to learners, thus affecting the learning effect. When the information is well designed, the ECL is minimized (Permana et al., 2019). (3) GCL, also known as effective cognitive load, occurs when learners do not use up all cognitive resources in learning a task, and then learners can use the remaining cognitive resources in processing directly related to learning. GCL enables learners to add more advanced conscious cognitive processing (such as reorganization, abstraction, comparison, reasoning, etc.) into the processing activities of working memory. Such processing also increases cognitive load, but rather than impeding learning, it promotes it. The three components of cognitive load can be added, and the allocation of cognitive resources follows the principle of more of this and less of that, with the total amount unchanged. If the total amount of the three cognitive loads does not exceed the total amount of working memory resources, learning can be successfully completed; otherwise, it is not conducive to learning (Albus et al., 2021).

Compared to text, static graphics and pure sound, animation have the following advantages in reducing cognitive load.

1. Reduce ECL. Since the ECL is mainly caused by the organization and presentation of learning materials, optimizing the presentation of learning materials is an important way to reduce the ECL of learners. The study showed that the animation samples presented by the integration of audio-visual and audio-visual methods in multimedia teaching could reduce the cognitive load of learners, and the effect was better than that presented by visual or auditory methods alone, and the learners' transfer performance was higher. Some scholars suggested that watching and listening channels use different types of working memory through different information processing methods. Therefore, animation presents information in both audio and visual way, which increases the capacity of the total working memory and reduces the cognitive load of using a single channel to present information, thus leading to better learning effect (Mousavi et al., 1995).
2. Increase GCL. Researchers treated motivation as a variable by using real learning materials in real Settings (De Backer et al., 2022). They suggest that motivation may be a key factor in instructional design to promote learners' learning and improve their academic performance. Recently, many researchers found that learners' self-interpretation technique is an effective method to increase GCL. Studies have shown that animations can attract users' attention and motivate them to learn (van Brussel et al., 2021). Researchers proposed that inductive learning strategies and meta-cognitive monitoring cues can increase learners' GCL and improve their transfer performance. Meta-cognitive monitoring is a kind of control of learners' learning process, which enables learners to focus more attention on learning content and carry out learning more deeply. Although meta-cognitive monitoring activities also consume cognitive resources and increase cognitive load, these cognitive

resources are used in activities directly related to learning, which can improve the learning effect. Therefore, the increase of GCL can help reduce the overall cognitive load (De Backer et al., 2022).

## Research Purpose, Model and Hypotheses

Meditation practice requires the practitioner to master certain methods and techniques, and it is difficult for beginners without training experience to enter the state of mindfulness. The systematic study of mindfulness meditation usually takes weeks or even months. How to find a simple and easy way to let inexperienced beginners, busy professionals in a relatively short time to master the method of meditation quickly into the meditation state. Animation is often used as the carrier of training learning and description materials, with a better guiding effect. Many studies have shown that animation can improve people's comprehension and cognitive ability of learning material. Animation is used to make guiding content, and sound and pictures are used to make the subjects relax, so that the subjects can consciously pay attention to their own attention, so as to guide them into a relaxed state. The holistic mind-body conditioning training does not require efforts to control the mind and emphasizes the harmony and balance between the body and the mind, leading the subjects into a meditative state. Therefore, this study uses animation as the guide material carrier of meditation, aiming to explore: (1) the effect of animation-guided meditation on enhancing creativity; (2) to explore the role of flow and affect in the influence of mindfulness on creativity.

Based on the above literature review, we can draw the model framework (Figure 1) of this study and put forward the research hypotheses.

*Hypothesis 1:* Compared with other forms of meditation learning materials, animation can significantly reduce subjects' cognitive load and significantly improve their meditation effect (mindfulness, flow, PA and creativity).

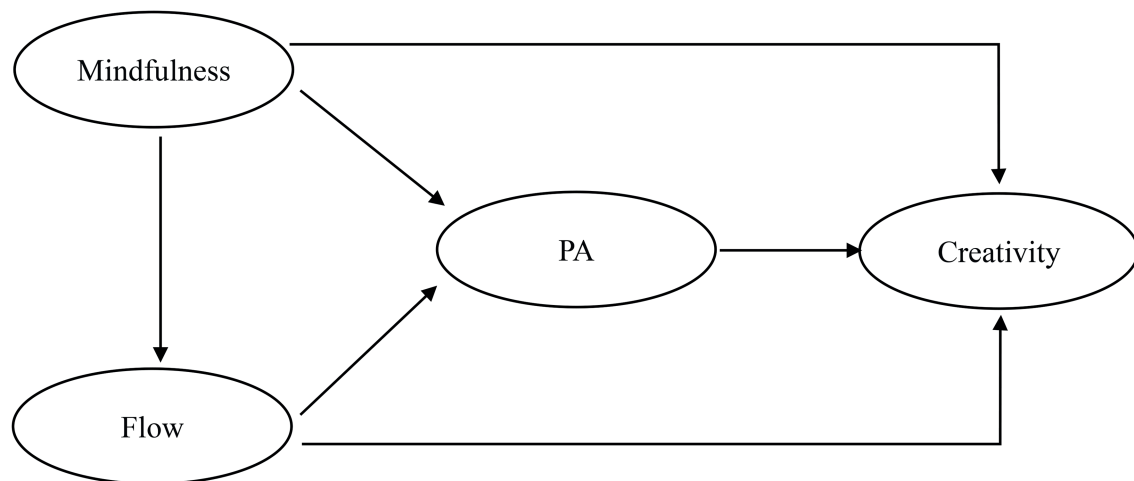
*Hypothesis 2:* Mindfulness has a direct positive effect on creativity, and has indirect positive effects on creativity through flow and PA.

## MATERIALS AND METHODS

### Participants

The participants of this study are employees working in the creative industry (Digital media, film post-production, animation, game development and other companies) in China. We advertised recruitment through the internal network of a creative industrial park. One hundred subjects were recruited, and the final 95 eligible participants were divided into two groups: animation ( $n = 48$ ) and audio ( $n = 47$ ) guided meditation, and strictly match the proportion of the gender and education levels, so there was no significant difference in demographic factors between the two groups (Table 1). The informed consent of each participant was obtained.





**FIGURE 1 |** Research model.

**TABLE 1 |** Demographic characteristics of participants.

Characteristic		Total	Animation	Audio
Age (SD)		34.57 (8.13)	33.72 (8.45)	35.41 (7.96)
Gender	Male (%)	71 (75%)	36 (75%)	35 (74%)
	Female (%)	24 (25%)	12 (25%)	12 (26%)
Education	Associate degree (%)	31 (33%)	16 (33%)	15 (32%)
	Bachelor degree (%)	46 (48%)	23 (48%)	23 (49%)
	Master degree (%)	18 (19%)	9 (19%)	9 (19%)

## Measures

1. Work creativity scale (WCS). These tests adopt the form of subjective self-evaluation, objective score, easy to operate, but also greatly save measurement time. WCS was originally created by Zhou and George in 2001 (Zhou and George, 2001). The scale consists of 13 items and is graded on a 5-point scale (1=Strongly disagree and 5=totally agree). The higher the score, the more obvious the creativity tendency of the individual is. Since this study focuses on the creativity of employees in creative industries, WCS is used as a tool to measure creativity. The Chinese version of WCS was adapted by Xu et al. which has good validity (Xu et al., 2014). In this study, Cronbach's alpha was 0.87.
2. Mindful Attention Awareness Scale (MAAS), which is used to measure the overall tendency of individuals to pay Attention to and become aware of the present experience in daily life. The scale has 15 items and is scored on a 6-point scale (1=always, 6=always not). Individuals were asked to rate how often they were in states such as autopilot thoughts or occupied thoughts. The MAAS scale developed by Brown and Ryan has a small number of questions, simple operation and highlights the important component of mindfulness, "attention-awareness," which is one of the most commonly used tools in the measurement of mindfulness (Brown and

Ryan, 2003). The Chinese version of MAAS was adapted by Deng et al. which has good validity (Deng et al., 2012). In this study, Cronbach's alpha was 0.93.

3. The Short Dispositional Flow Scale 2 (SDFS-2). This nine item self-report measure is an abbreviated version of the long DFS-2 (Jackson et al., 2008). It is purported to include 9 dimensions and 9 items (one item for one dimensions): challenge-skill balance, action-awareness merging, clear goals, unambiguous feedback, concentration on task, sense of control, loss of self-consciousness, time transformation, and autotelic experience. Items are rated on a 5-point Likert scale, ranging from 1 (never) to 5 (always), to measure the frequency of flow characteristics experienced. By summing the responses of the items, an overall dispositional flow score is generated, which may range from 9 to 45. Higher scores indicate higher levels of dispositional flow. Preliminary studies have shown that the short scale well represents the previously validated longer version, indicating that it is an appropriate and reliable empirical measure of dispositional flow (Jackson et al., 2008). The Chinese version of SDFS-2 was adapted by Liu et al. which has good validity (Liu et al., 2012). In this study, Cronbach's alpha was 0.89.
4. The Positive and Negative Affect scale (PANAS), developed by Watson et al. (1988), is used to measure participants' positive and negative emotional experiences. PANAS contains two dimensions: positive emotional experiences and negative emotional experiences. Each dimension has 10 items, for a total of total 20 items. Participants answer using a five-point Likert scale, whereby 1 means "none at all," and 5 means "all the time." Each subscale is individually scored, and the two subscales are summed to derive a total score. Previous studies have shown that PANAS has good validity (Horwood and Anglim, 2019). The Chinese version of PANAS, adapted by Sheldon et al. has good validity (Sheldon et al., 2004), has the same two-factor structure. In the current study, the Cronbach's alpha of each sub dimension: (1) PA (0.91); (2) NA (0.92).

5. Brunken classified various methods for assessing cognitive load in two dimensions: objective reality and causality. Objectivity is divided into two categories: based on subjective, self-reported data or based on objective observations of behavior, performance, or psychophysical states; Causality also falls into two categories: whether the observed phenomenon contributes directly or indirectly to cognitive load. Each method has its own advantages and disadvantages, such as physiological measurement is relatively straightforward, but at present it requires expensive equipment. Therefore, self-report method is still widely used at present. This study mainly used direct measures in the subjective dimension: subjects' self-reported stress level and material difficulty, and indirect measures in the objective dimension: measures of meditation effects (mindfulness, flow, affect and creativity; Brunken et al., 2003). In this study, Cronbach's alpha was 0.90.

## Experimental Procedure

We advertised on the intranet of a creative industrial park and the employees who were interested and eligible to participate in our study provided their registration information. The recruiting advertisement said that there was a free mindfulness meditation training program to help regulate mood and boost creativity. Interested employees can sign up. Inclusion criteria were: (1) adults aged 18 years or older; (2) able to speak and read in Chinese sufficiently to complete the questionnaire; (3) have at least 1 year working experience in creative industry. Exclusion criteria were: (1) self-reported depression, anxiety, bipolar disorder, substance abuse or suicide; (2) prior experience with mindfulness meditation. Three materials for guiding meditation were used in this experiment: text, audio and animation. The information content contained in the three media materials is the same, and they all explain and guide how to conduct mindfulness meditation. The audio files used in the experiment included a human reading instructions and soothing music in the background. The audio file and the animation file were exactly the same in the sound part, the only difference was that the animation file had pictures, while the audio file had no picture. The content of the text file is the corresponding text of the human reading instructions in the audio and animation. Text files were used to assess cognitive load during pre-test to establish a baseline for cognitive load.

Participants complete an online consent form through a secure online survey platform, provide media materials, demographic information and the following questionnaires (pre-test): (1) MAAS; (2) PANAS; (3) DFS-2; (4) WSC; (5) SLS. It took approximately 20 min to answer the questionnaire. In order to establish a baseline for cognitive load, participants in both groups were assessed during pretest using the instruction manual to guide mindfulness meditation. Animation group received animation meditation intervention 3 times a week for 8 weeks; the audio group received the same frequency and duration of audio meditation intervention. Both the two groups were invited to a 20-min zoom webinar which provided an overview of how to use the animated and audio meditations. All participants began the 8-week study on the Monday following the zoom

webinar. At the end of the intervention period (week 8), participants completed the same questionnaire again (**Figure 2**).

This study followed an online funnel reporting procedure. To recruit subjects who were oblivious to the experimental conditions and naively used animated meditations, the funnel report helped to obtain a homogeneous sample in both groups. Participants were given the opportunity to record any number of questionnaires anonymously and could withdraw at any stage.

## Data Analysis

SPSS 22 software was used for ANOVA. Partial least squares (PLS) 3 is used to assess the reliability and discriminant validity, and verify the path relationship of the research model. The significance level was set to 0.05.

## RESULTS

### Analysis of Variance

In order to compare the guidance effect of different media forms (animation and audio) on mindfulness meditation. This study conducted six 2 (Time: Pre, Post)  $\times$  2 (Group: Audio, Animation) ANOVA with repeated measures on mindfulness (MAAS), positive affect (PA), negative affect (NA), flow (DFS-2), work creativity (WSC), and cognitive load (CLS). In order to test for the effects of group type differences in how different guidance media influence the effect of mindfulness meditation, the two factors (gender and education) were controlled and excluded from the ANOVA. The values of  $p$  Box's test and Mauchly's test were all greater than 0.05, showed that the observed covariance matrices of the dependent variables are equal across groups, indicating that these data were suitable for ANOVA. The descriptive statistics are presented in **Table 2**, and the results of the ANOVA are presented in **Table 3** and **Figure 3**.

According to the results of ANOVA, both animation and audio guided meditation can significantly improve participants' mindfulness and flow level, and reduce NA. In addition, the animation guided meditation significantly increased the subjects' level of work creativity and PA, and significantly reduced the cognitive load on the meditation guided material. In the comparison between the two groups, the animation-guided meditation significantly increased participants' mindfulness and creativity levels and significantly reduced their cognitive load compared to audio-guided meditation. There was no significant difference in affect performance between the two groups, but there was a significant interaction effect (Time  $\times$  Group) of PA. Hypothesis 1 is basically supported.

### Partial Least Squares

To assess the reliability, the composite reliability (CR) and the average variance extracted (AVE) are calculated. **Table 4** shows that the CRs of the constructs range from 0.946 to 0.973, which are all above the 0.70 recommended level. The AVEs of the items range from 0.541 to 0.783, which are all above the 0.50 recommended level.

To assess the discriminant validity, **Table 5** shows that the squared root of the AVE of each construct is larger than its

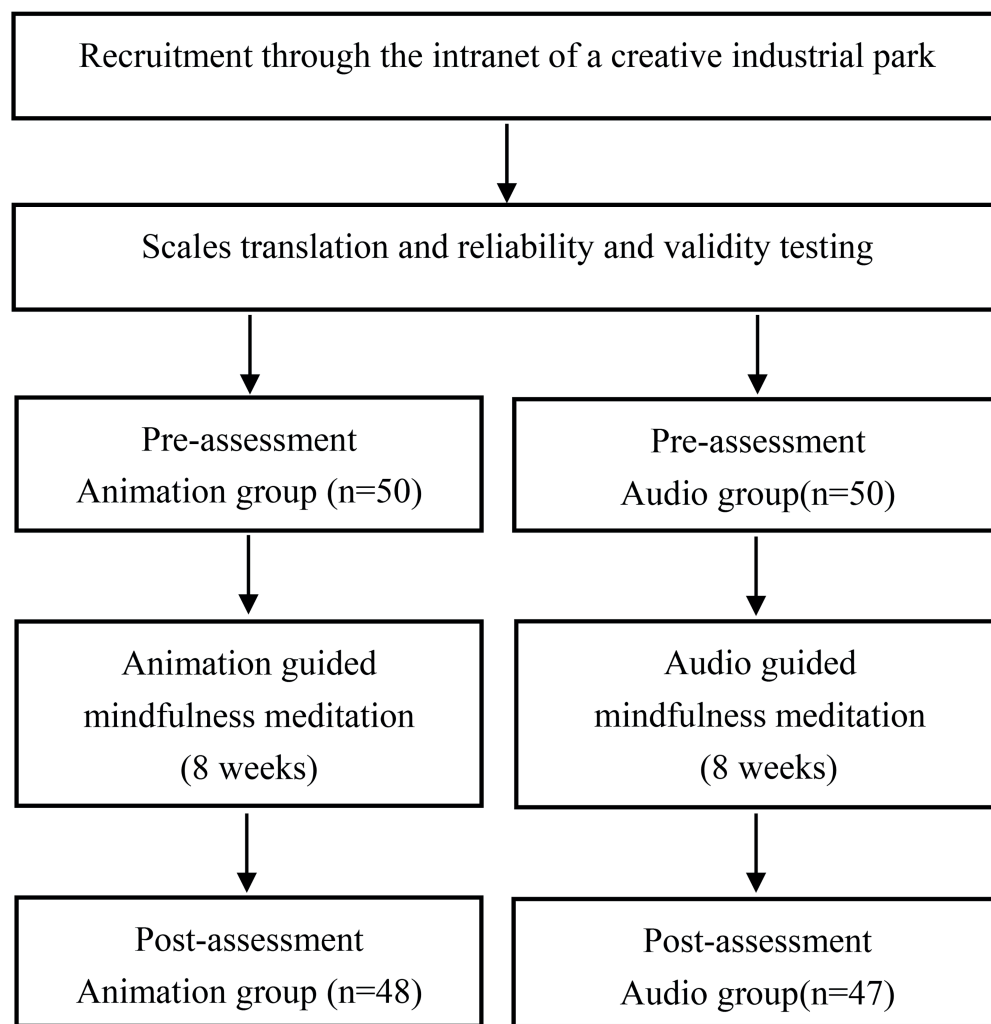


FIGURE 2 | Procedure flow chart.

TABLE 2 | Descriptive statistics.

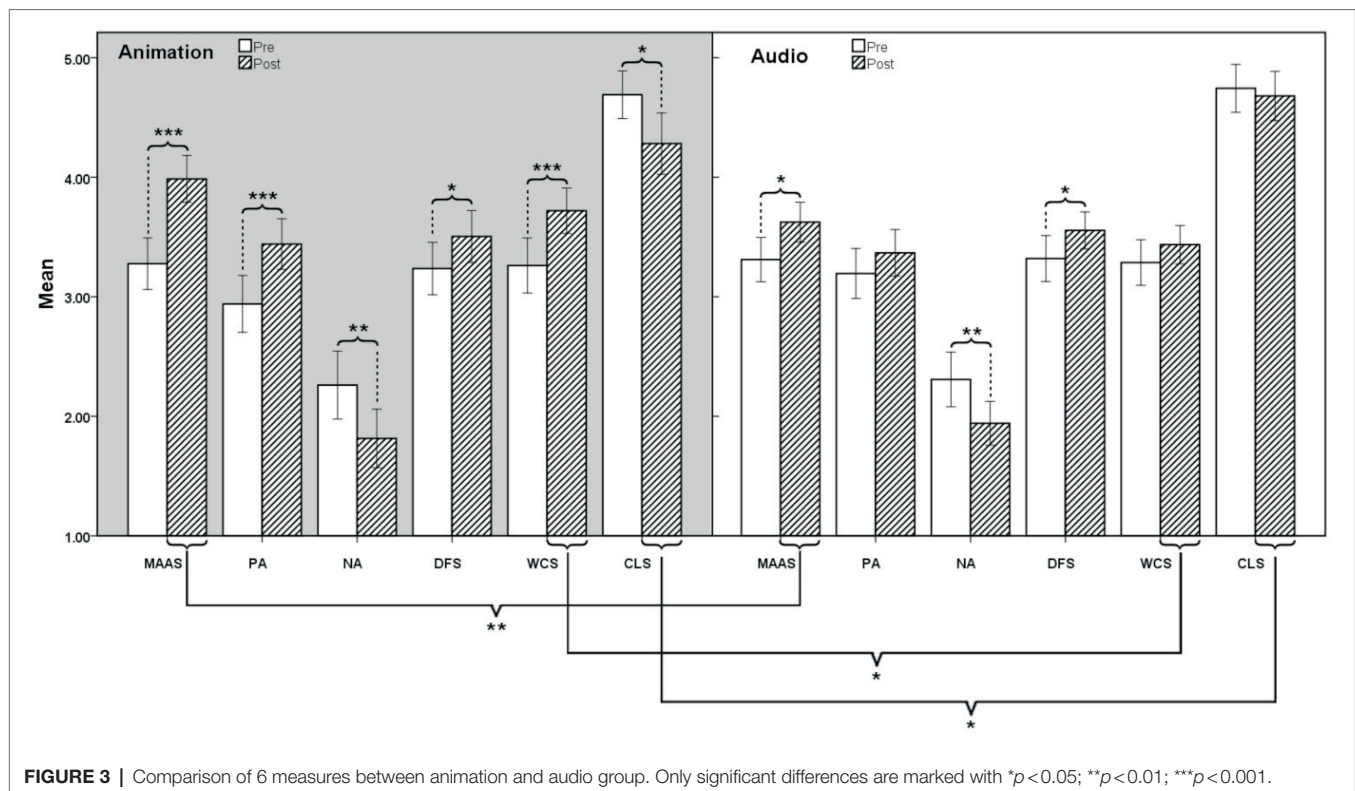
Group	Measure	Mean (SD)	
		Pre	Post
Animation	MAAS	3.277(0.745)	3.986(0.675)
	PA	2.940(0.817)	3.440(0.730)
	NA	2.261(0.979)	1.815(0.843)
	DFS-2	3.236(0.754)	3.504(0.749)
	WCS	3.261(0.794)	3.719(0.654)
	CLS	4.689(0.687)	4.281(0.885)
Audio	MAAS	3.311(0.630)	3.624(0.568)
	PA	3.195(0.713)	3.368(0.663)
	NA	2.308(0.777)	1.941(0.623)
	DFS-2	3.320(0.656)	3.555(0.528)
	WCS	3.287(0.649)	3.436(0.548)
	CLS	4.743(0.682)	4.679(0.701)

correlations with other constructs. Therefore, the reliability and discriminant validity are supported by all of the constructs in this study.

TABLE 3 | ANOVA results.

Measure	Variable	F	p	$\eta^2$
MAAS	Time***	30.875	< 0.001	0.249
	Group	2.740	0.101	0.029
	Time xGroup*	4.636	0.034	0.047
PA	Time***	17.434	< 0.001	0.158
	Group	0.511	0.476	0.005
	Time xGroup*	4.119	0.045	0.042
NA	Time***	23.590	< 0.001	0.202
	Group	0.357	0.552	0.004
	Time xGroup	0.227	0.635	0.002
DFS-2	Time**	10.442	0.002	0.101
	Group	0.338	0.563	0.004
	Time xGroup	0.044	0.834	<0.001
WCS	Time***	17.724	< 0.001	0.160
	Group	1.229	0.270	0.013
	Time xGroup*	4.601	0.035	0.047
CLS	Time*	5.170	0.025	0.053
	Group*	4.072	0.046	0.042
	Time xGroup	2.754	0.100	0.029

\* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .



**FIGURE 3 |** Comparison of 6 measures between animation and audio group. Only significant differences are marked with \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .

**TABLE 4 |** Reliability and Convergent validity of constructs.

Construct	Reliability		Convergent validity
	Cronbach's Alpha	CR	AVE
MAAS	0.940	0.946	0.541
PA	0.953	0.960	0.706
NA	0.970	0.973	0.783
DFS-2	0.941	0.951	0.683
WCS	0.968	0.972	0.727

**TABLE 5 |** Inter-construct correlations and discriminant validity.

	DFS-2	MAAS	NA	PA	WCS
DFS-2	0.826				
MAAS	0.528	0.736			
NA	-0.112	-0.115	0.885		
PA	0.712	0.634	-0.156	0.840	
WCS	0.694	0.727	-0.191	0.650	0.853

**Table 6** summarizes the theoretical effect size results for  $R^2$  and  $f^2$ .  $R^2$  is the index of coefficient of determination of the endogenous variables.  $R^2$  greater than 0.67 indicates strong explanatory power;  $R^2$  between 0.33 and 0.67 indicates moderate explanatory power;  $R^2$  less than 0.19 indicates weak explanatory power. And  $f^2$  is the influence index of exogenous variables on endogenous variables.  $f^2$  greater than 0.35 indicates high

**TABLE 6 |** Theoretical effect sizes for  $R^2$  and  $f^2$ .

	$R^2$	$f^2$				
		DFS-2	MAAS	NA	PA	WCS
DFS-2	0.508			0.078	1.048	0.663
MAAS		1.031		0.131	0.476	0.697
NA	0.113					0.147
PA	0.747					0.194
WCS	0.836					

impact effect;  $f^2$  between 0.15 and 0.35 indicates moderate effect;  $f^2$  less than 0.15 indicates low impact effect. According to the results in **Table 6**, the structural model of this study has an acceptable evaluation validity.

The specific  $\beta$  value and corresponding  $t$ -value and significance of each path are shown in **Table 7**, the results was calculated using the bootstrapping method and repeated sampling 5,000 times.

From the model of research framework in **Figure 4**, we can see that mindfulness has a significant direct effect on creativity, and significant indirect effects on creativity in which flow and PA acts as the mediating variable and has a significant partial mediating effect, so hypothesis 2 is also supported.

## DISCUSSION

### Mindfulness and Creativity

The study found a positive correlation between levels of mindfulness and creativity. This is consistent with our research

**TABLE 7 |** Path coefficients of research framework.

	$\beta$	SD	Confidence interval		Significance	
			2.50%	97.50%	t	p
Direct effects						
DFS-2—>PA	0.271	0.120	0.098	0.562	2.256	0.024
DFS-2—>WCS	0.627	0.074	0.526	0.819	9.046	<0.001
MAAS—>DFS	0.470	0.153	0.167	0.731	3.079	0.002
MAAS—>PA	0.547	0.129	0.235	0.721	4.239	<0.001
MAAS—>WCS	0.714	0.120	0.450	0.900	5.946	<0.001
PA —>WCS	0.311	0.116	0.017	0.467	2.690	0.007
Indirect effects						
MAAS—>PA—>WCS	0.478	0.070	0.360	0.618	6.796	<0.001
MAAS—>DFS-2—>WCS	0.523	0.081	0.359	0.656	6.466	<0.001
DFS-2—>PA—>WCS	0.229	0.101	0.010	0.389	2.273	0.023
MAAS—>DFS-2—>PA—>WCS	0.163	0.069	0.007	0.277	2.373	0.018
Total effects						
MAAS—>WCS	0.908	0.096	0.683	1.042	9.461	<0.001
DFS-2—>WCS	0.734	0.112	0.485	0.896	6.556	<0.001

hypothesis. Previous studies have found that the higher the level of mindfulness, the better the performance of creativity, and mindfulness training has a significant promotion effect on creativity (Byrne and Thatchenkery, 2019; Ngo et al., 2020). Lebudu et al. (2016a) conducted a meta-analysis of the relationship between mindfulness and creativity, and the results also supported the positive correlation between mindfulness and creativity. Focusing on the present, the core element of mindfulness, allows subjects to remain aware for a long time and promotes mental activity, thus helping to stimulate creativity (Henriksen et al., 2020). Non-judgmental acceptance, another core element of mindfulness, enables employees to accept multiple information and break fixed thinking, making it easier for them to clash and brainstorm ideas, which is conducive to employees' coming up with innovative ideas. Experimental studies of mindfulness in business Settings have also shown that increasing mindfulness levels can improve employee creativity and avoid mental exhaustion (Lomas et al., 2019). Mindfulness helps trainers to free their attention from the internals of problems, view them in a more inclusive and accepting way, and promote their ability to shift perspectives (Lebudu et al., 2016b). Through this process, practitioners separate their thinking from patterns that hinder the creative process and are no longer bound by habitual responses, thus preventing individuals from falling into stereotyped thinking (Lippelt et al., 2014). Stereotyped ways of thinking can prevent individuals from looking at problems from new perspectives, thus hindering creativity. Mindfulness, a form of introspection, requires people to bring their attention to the present moment. This reassessment leads to a reorganization of the problem situation, which also leads to a deeper understanding of the current problem (Wiranti and Inten, 2012). In addition, mindfulness improves the ability to regulate emotions, which is considered a potential contributor to creativity (Henriksen et al., 2020). Among the cognitive and affective factors of mindfulness, perspective-shifting ability and emotion regulation ability are important factors promoting creativity. Mindfulness implies an unjudgmental awareness of

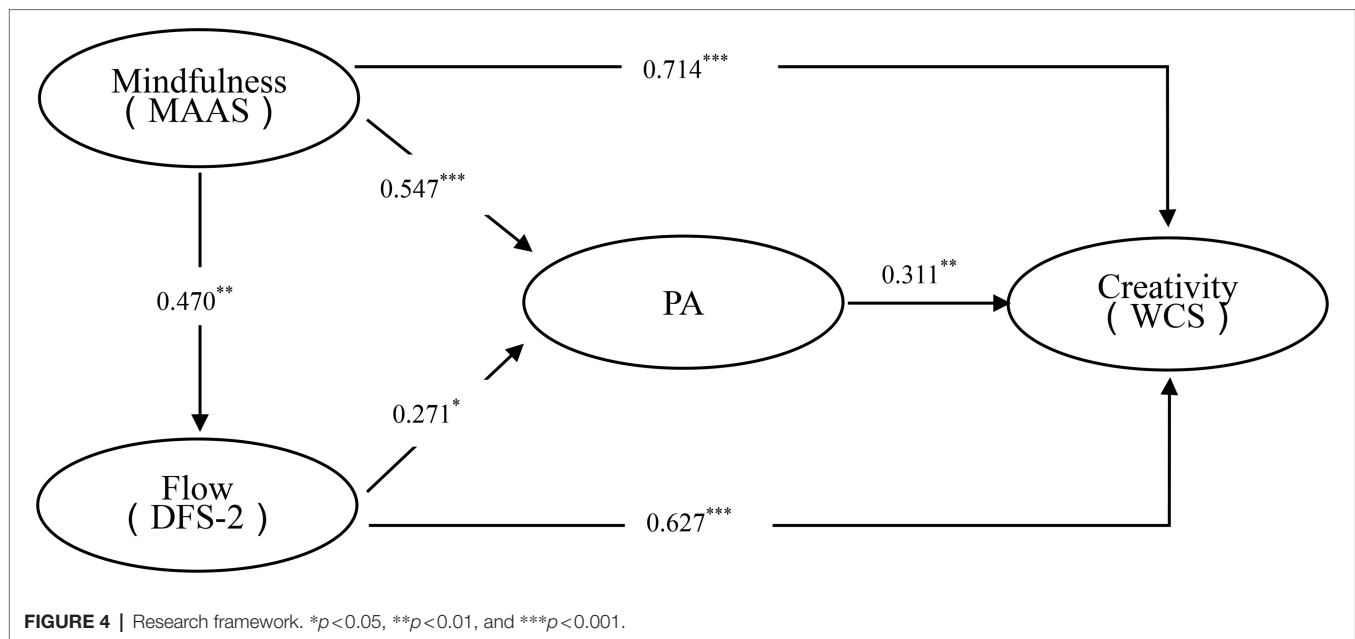
the present and requires a conscious break from the automatic mental processes of cognitive evaluation (e.g., good and bad, useful and useless; Shen et al., 2021). In order to gain insight into an object and put forward new ideas and solutions, it is necessary to examine the object objectively and calmly and avoid relying on previous empirical assumptions (Karwowski, 2021). Breaking previous assumptions and building new knowledge means a certain degree of creativity. Therefore, individuals with higher level of mindfulness have higher awareness and concentration, can break through stereotyped thinking and avoid adopting immutable methods to solve problems. At the same time, they can accurately judge and calmly analyze things, and eventually come up with new ideas, showing high creativity (Bartlett et al., 2019).

## Flow and Creativity

The results of the correlation analysis between flow and creativity in this study show that creativity has a significant positive correlation with flow. And flow positively predicts creativity. It shows that if subjects can have clear goals and devote themselves to an activity they are interested in, they can only pay attention to the development and changes at this moment, so that they can exert greater creative potential (Schutte and Malouff, 2020). The findings are consistent with Csikszentmihalyi's conclusion that fluid experiences can be important forerunners of high levels of creativity and innovation. In the process of creativity, emotions and flow will be involved. Without positive emotional support, creativity can hardly be maintained (Csikszentmihalyi, 2015).

Mindfulness promotes the flow at the beginning, because both mindfulness and flow are focused on awareness of the present moment (Wright et al., 2006). But when the level of mindfulness is high, mindfulness will have an inhibitory effect on flow, because if go further on the basis of awareness, mindfulness requires maintaining awareness of external stimuli and inner activities, and flow requires further ecstasy, complete





absorption and immersion in the task, so at this time the two have different development paths (Sheldon et al., 2015). The results of this study found that both the animation group and the audio group significantly improved mindfulness and flow. The animation group has a significant improvement in mindfulness than the audio group, but there is no significant difference in flow, which also confirms this view.

## Affect and Creativity

This study found a significant positive correlation between PA and creativity. This is consistent with previous theories and research conclusions. From the perspective of psychology, PA can create a positive psychological state and open mind, promote the cognitive flexibility of individuals, expand their cognitive range, improve the speed of information processing, and improve the cognitive fluency and response level (de Rooij and Vromans, 2020). On the other hand, NA will narrow an individual's attention, confining it to narrow details, reducing their cognitive flexibility and expansibility, and thus inhibiting an individual's creative potential (He et al., 2020). Dan (2021) found that people with higher PA levels have greater cognitive flexibility, which enables him or her to accept different cognitive elements and connect them to find creative solutions. PA has been found to enhance cognitive flexibility and promote creativity by creating more diverse connections between perception and thought (Hensley, 2020). PA allows people to think flexibly and generate more novel ideas. In general, highly creative individuals are more emotionally stable and have higher energy levels (Tavares, 2016). Some studies have found that PA expands attention span and promotes the formation of distant associations. Some scholars suggested that PA enhances the ability to switch between global attention mode and local attention mode and the ability to choose between different perspectives (Rego et al., 2012). Conversely, NA states (such as anxiety and depression)

are associated with attentional deficits and maladjustment of cognitive control mechanisms, and NA often leads to a narrowing of attention span (Leung et al., 2021). Therefore, NA should have the effect of impeding cognitive flexibility and creative problem solving. In addition, from the neurophysiological perspective, PA can promote the secretion of dopamine in the brain, and dopamine released by the anterior cingulate cortex can regulate and improve the cognitive fluency, cognitive reorganization, process focusing and information integration of the brain, thus stimulating a higher level of creativity (Parke et al., 2015). Mooer et al. (2018) reached a similar conclusion through cognitive neural experiments. Their results showed that the visual cortex of the brain can process more information when the subjects are in a positive mood, but when subjects were in a bad mood, their ability to acquire information was significantly limited.

The results showed that emotional regulation partially mediated the relationship between mindfulness and creativity, suggesting that mindfulness not only directly affected creativity, but also indirectly affected creativity through the two dimensions of emotion. When individuals have a high level of mindfulness, they will focus on their current internal experience without judgment and are more likely to generate PA and maintain happiness, thus actively accepting more new things and generating more new ideas (Ovington et al., 2018). Individuals with low level of mindfulness are more difficult to detect their own emotional changes and adjust them. When he or she is in a negative emotional state, his or her creativity is negatively affected (Henriksen et al., 2020).

## Advantages of Animation

Well-designed animation helps mentally visualize a process or program, leading to a reduction in cognitive load (Höfler and Leutner, 2011). Animations provide a more realistic representation

of content and explicitly describe dynamic information without the need for users to infer content, thus saving cognitive effort on the psychological construction of animation by users (Tunuguntla et al., 2008). By clearly showing the micro steps required between each important change, the animation adapts to the presentation of a continuous phenomenon, since the user do not need to infer how the phenomenon changes from one step to the next (Tversky et al., 2020). It can be seen from the results that animation is more consistent with the congruence principle of content expression than audio. The animation gives a more complete explanation to the information. Although more elements are added to the animation and the form of expression looks more complicated, but these elements can help explain the concepts and steps of meditation. The degree of complexity may not be the key factors affecting comprehensibility, but rather whether relevant to the message you want to convey (Chen et al., 2021). Animation tells a relatively complete story, explaining the concept and the context of the original information. From the perspective of communication, the interpretation of a particular information may not be independent of context, and the influence of contextual clues may be sensitive (Vigoroso et al., 2020). Therefore, although animation has more information than audio, most of them are closely related to the theme and conform to the principle of consistency, helping users to deepen their understanding of meditation and significantly reducing the cognitive load.

We used cartoon anthropomorphic figures in the animation to demonstrate the movements and essentials of meditation. Because there is both empirical and theoretical evidence to support that animation is an effective way to learn human motion (de Koning et al., 2019). It has been indicated in many studies that animation has great advantages in depicting human-motor skills and many studies used mirror–neuron theory to explain this phenomenon (Brucker et al., 2021). Researchers proposed that humans may have evolved the ability to learn certain types of knowledge effortlessly, such knowledge is called biologically primary knowledge, and human motion belongs to this kind of knowledge (Geary, 2008). Further, Researchers suggested that humans may have evolved specific components of working memory that allow us to naturally acquire visualizations involving human motion (Ayres, 2020). This mirror neuron system and related motion processors are likely to be the key physiological structures that allow humans to participate in learning through observation and imitation (Brucker et al., 2021). In contrast, learning biological secondary knowledge (Geary et al., 2021) such as mechanical systems, or using static graphics to represent human motion, may require more working memory resources, because we do not have the same biological advantages (Chandler, 2009). This phenomenon explains why it is easier to understand animations that depict primary knowledge, than the animations that depict secondary knowledge. Because primary knowledge is relatively easy to obtain, it will not consume a large amount of working memory resources like secondary knowledge, and do not add too much cognitive load (Carreño et al., 2021). Thus, when users watch animations of primary knowledge, they can manage transient visualization more effectively than the animations of secondary knowledge, thereby reducing cognitive load (Ayres et al., 2019).

## Research Limitations and Future Research

This study explores the relationships among mindfulness, flow, affect and creativity, and the advantages of animation-guided meditation, and draws some practical conclusions. However, due to the human resources, material resources and time, it also has the following limitations:

(1) The subjects of this study are all employees of creative industry, who are characterized by high level of wisdom, active thinking and positive and stable emotions. In addition, the sample size is not large enough and the region is not broad enough. Whether the selected subjects are representative and whether the results are universally applicable needs further investigation and verification. (2) This paper adopts the self-reported work creativity scale suitable for evaluating employees' creativity, which may not fully illustrate the situation of the subjects. (3) Due to the limited research conditions, this study adopted a horizontal study, but there is a possibility of change in mindfulness, emotion and creativity, especially the change of emotion is quite frequent, so this may affect the results of the study. (4) This study is a short-termed intervention, with no follow-up measures. The increase in creativity may be a short-term effect, whether it can be sustained in the long term needs to be further verified by future studies.

Combined with the limitations of this study, the following suggestions are put forward for future research: (1) future research should expand sample size and sample range types as much as possible to improve sample representativeness and universality of research results. (2) In future studies, creativity measurement tools should be further improved to make a more comprehensive evaluation of creativity. (3) Future research can consider using the method of combining horizontal and vertical research to dynamically grasp the relationship between variables, so as to make the research data more convincing and the research results more rigorous. (4) Multiple and longer-term measurements of creativity will be conducted in future studies to verify the sustainability of creativity enhanced by mindfulness meditation.

## CONCLUSION

Mindfulness, flow, and PA all helped to improve the subjects' work creativity. In addition to the direct positive impact of mindfulness on creativity, mindfulness can also have an indirect positive impact on creativity through flow and PA, and flow and PA play a partial mediating role. Compared with static text, graphics and audio, animation can significantly reduce cognitive load and help improve users' cognitive ability, which is more suitable for the guidance and illustration materials of mindfulness meditation to enhance the effect of meditation.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

The study was approved by the Ethics Committee of Chang Gung University (IRB No: 201902226B0) and the study protocol was carefully reviewed to ensure compliance with the Ethics guidelines of the Chinese Psychological Society. The patients/ participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

HC contributed with data collection, findings interpretation, and paper preparation. CL contributed with the experimental design, data collection, statistical analysis, and findings interpretation. C-HC and Y-LC were in charge of data collection, helped to prepare the experimental sites, and assisted with data collection. FZ, KW, D-HH, and C-YL assisted in the data collection and evaluation of the findings, as well as conceiving the project and participating in its interpretation. W-KC was

responsible for the study's conception and design, as well as the interpretation of the findings and paper writing. All authors contributed to the article and approved the submitted version.

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# Effects of animated pedagogical agent-guided loving-kindness meditation on flight attendants' spirituality, mindfulness, subjective wellbeing, and social presence

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Loving-kindness meditation (LKM) was first practiced by Buddhists and then developed by clinical psychologist. Previous studies on LKM have mainly focused on the impact of real person-guided meditation on depression, anxiety, and other negative psychology. During the COVID-19 pandemic, this study explored the effect and mechanism of media-guided LKM on the improvement of social presence, mindfulness, spirituality, and subjective wellbeing (SWB). From the viewpoint of positive psychology, this study compared the different media effects of animated pedagogical agent (APA)-guided LKM and audio-guided LKM. A total of 82 flight attendants were recruited from airlines; then, they were randomly assigned to two groups: APA group (41 participants) and audio group (41 participants), which both underwent an 8-week LKM training intervention. The aforementioned four main variables were measured pre and post the meditation experiment. The results indicated that both APA-guided meditation and audio-guided meditation significantly improved subjects' spirituality and SWB. Compared with audio-guided meditation, APA-guided meditation significantly improved the subjects' spirituality, SWB, and social presence. Audio-guided meditation has no significant effect on social presence. This study highlights APA-guided meditation has

a positive effect on spirituality, SWB, and social presence, which may provide individuals with a simple and easy method to improve their mental health.

#### KEYWORDS

animation guidance, loving-kindness meditation, mindfulness, spirituality, subjective wellbeing

## Introduction

The COVID-19 outbreak is considered to be the seminal event and major health crisis in the history of the world today (Sachs et al., 2020). Airline cabins are public places that gather many people, service is accomplished through interaction between staff and guests, and some airlines have seen outbreaks and cases of COVID-19 (Pombal et al., 2020). In addition, many airlines experienced severe layoffs during the pandemic, and the COVID-19 pandemic has had a significant impact on the mental health of flight attendants (Görlich and Stadelmann, 2020). On the one hand, flight attendants shape the image of the airline, and on the other hand, they are also related to aviation safety, so the mental health of flight attendants is very important (Grout and Leggat, 2021). Previous research has found that the quality of vertical communication implemented by airline management can reduce job insecurity among flight attendants during the COVID-19 pandemic in 2019 (Charoensukmongkol and Suthatorn, 2021). In addition to alleviating flight attendants' anxiety, depression, and other negative emotions, loving-kindness meditation (LKM) training was found to improve flight attendants' subjective wellbeing (SWB). Due to the impact of the epidemic, offline activities were increasingly restricted. In the post-epidemic era, many offline activities in the past have turned to online alternatives (Onderdijk et al., 2021), and online learning has become an important way of remote education. Online meditation training overcomes the limitations of time and space in traditional meditation training, making learning more flexible and convenient (Cavalera et al., 2019). Students can practice meditation at anytime and anywhere, which is more in line with the busy life pace of flight attendants.

However, due to the nature of remote education that the teaching and learning are separated in time and space, online learning is mostly realized in the virtual learning environment of human-computer interaction, and there is a lack of face-to-face communication between learners and teachers (Heradio et al., 2016). In the process of human-computer interaction, some real social clues are virtually filtered out, leading to the decrease of online communication emotions, thus reducing the learning effect (Themeli and Bougia, 2016). Some studies show that social presence can promote social interaction in virtual learning environment, enhance online learners' sense of interaction, and

improve learning effect (Cheng and Wang, 2019). In virtual learning environment, social presence is an important concept to describe how to conduct virtual social interaction. Social presence was regarded as an attribute of media, and the degree of social presence varies with different media (Short et al., 1976). Therefore, this study aims to compare audio and animation to find out which media form is more suitable for the online training of LKM for flight attendants and remotely intervene their mental health to improve their SWB.

## Loving-kindness meditation, mindfulness, spirituality, and subjective wellbeing

Loving-kindness meditation is a special meditation to cultivate compassion (Chen et al., 2021), and this kind of compassion is a kind of unconditional and undifferentiated goodwill to all living beings, that is, this goodwill is not affected by kinship or interest relations (Liu et al., 2022). The main function of LKM is that it can be practiced to regulate real-time emotions in life when the mood is low, and long-term practice of LKM is conducive to long-term emotion regulation. LKM can help practitioners counter negative experiences of stress, pain, and mental illness (Zeng et al., 2019).

Mindfulness is about being aware in a certain way, purposefully aware, living in the moment, and without mental judgment. Mindfulness was negatively correlated with emotional exhaustion among call center workers in the Philippines (Charoensukmongkol and Puyod, 2022), anxiety in English speech class of College students in Thailand (Charoensukmongkol, 2019), and perceived stress among Thai flight attendants (Suthatorn and Charoensukmongkol, 2022) and was positively correlated with the cross-cultural sales performance of Thai international trade fair salespeople (Charoensukmongkol and Pandey, 2021). Both LKM and mindfulness are derived from Buddhism and emphasize the focus on the present, and both can improve emotional wellbeing, so some studies suggest that there is a certain correlation between the two (Fredrickson et al., 2017).

Spirituality is a person's pursuit and experience of connection with the essence of life. It includes three dimensions:



connection to oneself, connection to others and nature, and connection to transcendental experience. Previous research has explored the antecedent variables of spirituality and found that LKM can facilitate personal spiritual growth by moving away from a preoccupation with the actions and reactions of the self and enhancing a connection to the universal human experience of altruism, love, and compassion (Kristeller and Johnson, 2005; Liu et al., 2020b). LKM can internally enhance the unified inner connection of the individual and externally enhance altruism, transcend egocentrism, and feel a sense of energetic connection to other beings in the universe (McClintock et al., 2016).

Subjective wellbeing consists of two parts, namely, cognitive component and affective component (Diener et al., 2018). Cognitive component refers to life satisfaction, which is an individual's overall summary, cognition, and evaluation of his life and is a key indicator of SWB. The cognitive component is a more effective positive measure, independent of the affective component (Moore and Diener, 2019). Emotional components are divided into positive and negative emotions, which are relatively independent and subordinate to SWB (Jebb et al., 2020). Previous studies have found that SWB is positively correlated with mindfulness and spirituality (Liu et al., 2020a), and LKM can improve the mindfulness, spirituality, and SWB of flight attendants (Liu et al., 2020b).

## Social presence

The theory of social presence was first proposed by Short et al. (1976) that social presence refers to the degree to which a person is regarded as a “real person” and the perceived degree of connection with others in the process of communication through media. In short, social presence is the ability to connect or perceive media and is regarded as an attribute of media. Gunawardena and Zittle (1997) suggested that social presence was not only an attribute of media, but also a psychological perception generated in the process of human interaction with media. Garrison et al. (1999) defined social presence as the ability of participants to attempt to project themselves socially and emotionally as real people through the use of communication media. Rogers and Lea (2005) argued that social presence is the sense of immersion caused by learners' perception of belonging and identity in online learning groups, and the sense of “being on the scene” of users in virtual or intermediary environments. Biocca et al. (2003) suggested that social presence is “the feeling of being with others” in a virtual environment. The “others” mentioned here include other humans and other anthropomorphic forms of expression (e.g., agent and avatar) presented by technological media (e.g., text, image, video, and animation). This sense of social presence is not the existence of physical facts, but the existence of psychological perception (Biocca et al., 2003). The different viewpoints of the above scholars are only from different angles to look at

social presence, and they are not opposed to each other. In a word, social presence is not only a media attribute, but also a psychological perception generated by users when they communicate with media (Triberti et al., 2018).

## Animated pedagogical agent

Face-to-face communication was thought to provide the highest level of social presence, while computer-mediated communication (such as email) was once thought to be associated with lower levels of social presence due to the reduced ability of this medium to convey social cues (e.g., facial expressions, gestures, and sounds) (Short et al., 1976). With the rapid development of digital media technology, diversified media content provides more and more abundant social clues and improves the sense of social presence of computer media. In social presence theory, teaching is understood as a communicative behavior, that is, a social activity that depends on the social partnership between teachers and learners (Mayer and DaPra, 2012), and social interaction is an important mechanism of teaching and learning activities (Chin et al., 2016). Traditional classroom teaching involves face-to-face learning, with teachers explaining important knowledge and often using social cues such as gestures and expressions to guide attention and help students understand the content (Wang et al., 2018). Animated pedagogical agent (APA) is a cartoon character implanted in multi-media materials. APA can not only convey some social cues through humanoid features, but also use anthropogenic non-verbal behaviors (e.g., gestures, body movements, and facial expressions) in network situations as social cues to promote learning (Chin et al., 2016). These APAs have a positive impact on factors such as learner attention, perception of material, and learning performance (Mayer and DaPra, 2012). Thus, when an APA is integrated into a multi-media environment, it increases the learner's social response and promotes their interest in learning tasks (Chin et al., 2011). In addition, these agents are able to establish a simulated person-to-person social interaction to simulate learner–teacher communication (Hong et al., 2014). APAs act as personal mentors and advise learners to enjoy and stay in a computer-based learning environment to enhance their sense of social presence (Hong et al., 2014).

Many previous studies have found that adding APA in a multi-media environment can promote users' learning of multi-media courses, promote learners to process materials more actively, and form better learning results (Yung and Paas, 2015). Chin et al. (2016) found that adding APA into the computer-aided learning system can successfully improve students' learning interest and motivation. In virtual learning environments, the enhanced social presence of learners' perception of APA can effectively improve their learning outcomes (Wang et al., 2018). Previous studies on the impact of APA on students' learning performance

in multi-media teaching found that learners in the APA group had better learning performance than those without the APA group (Mayer and DaPra, 2012). Moreno et al. (2001) found that learners in an environment with APA had better learning performance than in an environment with only text and image resources. Studies on the influence of APA on learners' subjective feelings show that in multi-media learning, APA can significantly reduce learners' perception of task difficulty, stimulate their interest in learning, enhance their confidence in learning, and make it easier for learners to conduct meaningful learning (Chin et al., 2011). In addition, studies exploring the influence of APA on the distribution of learners' attention and meaning found that communication between learners and APA was similar to interpersonal communication in real life (de Back et al., 2021). The use of APA in multi-media learning will not only affect learners' attention allocation and subjective feelings, but also have a positive impact on their learning performance (Dunsworth and Atkinson, 2007).

## Research purposes and hypotheses

The mental health of flight attendants has been greatly affected during the COVID-19 pandemic. On the one hand, flight attendants shape the image of the airline, and on the other hand, they are closely related to aviation safety. During the epidemic, most offline group meditation training institutions were closed, so online LKM training is a good choice. According to the theory of social presence, using cartoon images as virtual meditation instructors, namely adding APA to LKM online training, can attract participants' attention and improve their interest in learning. At the same time, the interaction between APA and participants also contains rich social clues, which can improve participants' social presence and thus improve the training effect.

There are few studies exploring influence of APA on the effect of online meditation training, and this study attempted to fill this gap. Therefore, the purpose of this study was to compare the different effects of online LKM training between participants in the APA-guided LKM meditation group (APA group) and participants in the control group without APA-guided LKM training (audio group) and to examine whether APA-guided online LKM training can improve the social presence, mindfulness, spirituality, and subjective wellbeing of flight attendants.

Based on the above theories, we propose the following hypotheses:

Hypothesis 1. The post-test scores of social presence, mindfulness, spirituality, and subjective wellbeing in APA group were significantly higher than the pre-test scores.

Hypothesis 2. The post-test scores of social presence, mindfulness, spirituality, and subjective wellbeing in APA group were significantly higher than those in audio group.

## Methods

### Participants

The participants of this study are flight attendants working in an airline company in China. We have posted a recruitment advertisement for online LKM training on the internal network of a domestic airline, saying that LKM is a self-exploration activity that helps the practitioners to better understand themselves, release pressure, regulate emotions, and improve happiness. Flight attendants who were interested and qualified to participate in our LKM study provided their registration information. Finally, 82 eligible participants were recruited. The participants were divided into two groups: APA ( $n = 41$ )- and audio ( $n = 41$ )-guided meditation and strictly match the proportion of the gender and education levels, so the differences in demographic factors such as age composition and sex ratio composition between the two groups were not statistically significant (Table 1). The informed consent of each participant was obtained.

### Instruments

Mindfulness Attention Awareness Scale (MAAS) is used to measure individuals' trait mindfulness, which was developed by Brown and Ryan (Brown and Ryan, 2003) and was revised in Chinese by Deng et al. (2012). This scale is unidimensional structure, 15 items, six-point Likert scale, with "1" to "6" indicating "almost always" to "almost never." The higher the score, the more the mindfulness. Of the many instruments that measure trait mindfulness, the MAAS is the most widely used (Ryan et al., 2021). Numerous studies have shown that the MAAS has good validity in culturally diverse populations with different experiences of mindfulness

TABLE 1 Demographic characteristics of participants.

Characteristic		Total	APA	Audio
Age (SD)		28.48 (7.25)	27.64 (7.63)	29.32 (6.92)
Gender	Male (%)	32 (39%)	16 (39%)	16 (39%)
	Female (%)	50 (61%)	25 (61%)	25 (61%)
Education	High school degree (%)	7 (8%)	4 (10%)	3 (7%)
	Associate degree (%)	44 (54%)	22 (54%)	22 (54%)
	Bachelor degree (%)	31 (38%)	15 (36%)	16 (39%)

meditation (MacKillop and Anderson, 2007). In this study, Cronbach's alpha was 0.92.

The Spiritual Attitude and Involvement List (SAIL) was developed by de Jager Meezenbroek et al. (2012). The scale is based on the consideration that spirituality is a universal human experience and is appropriate for measuring the level of spirituality in people of different religious and non-religious faiths. It has 26 items and six dimensions (including meaning, belief, acceptance, concern for others, connection to nature, and spiritual involvement dimensions). A six-point Likert scale is used, ranging from 1 to 6 on a scale of "not at all" to "very well," with higher scores indicating higher levels of spirituality (de Jager Meezenbroek et al., 2012). The scale has been translated into several languages and used in many countries and has shown good validity (Jirasek and Hurych, 2018). In this study, Cronbach's alpha was 0.91.

Subjective wellbeing uses the Satisfaction with Life Scale (SWLS) and the Positive and Negative Affect Scale (PANAS) to measure SWB. The SWLS was developed by Diener, Emmons, Larsen, and Griffin (Diener et al., 1985), and its Chinese version was revised by Wu and Yao (Wu and Yao, 2006). The scale has five items and a seven-point Likert scale ranging from "completely disagree" to "strongly agree." The higher the score, the more satisfied with your life. In this study, Cronbach's alpha was 0.89. Positive and Negative Affect Scale (PANAS) was developed by Watson, Clark, and Tellegen (Watson et al., 1988), and its Chinese version was revised by Sheldon (Sheldon et al., 2004). The scale consisted of 20 items, a five-point Likert scale ranging from "none at all" to "all the time." Higher scores indicate more frequent occurrence of the corresponding emotion. In this study, Cronbach's alpha was 0.88. The standard score for life satisfaction was added to the standard score for positive emotions and subtracted from the standard score for negative emotions as the score for subjective wellbeing (Diener et al., 1985).

Social Presence Scale (SPS) measures the social presence of a medium and was first developed by Gunawardena and Zittle who divided social presence into three dimensions: emotional response, interaction response, and cohesive response. The scale has 17 questions and is scored on a five-point Likert scale: "5" indicates very tedious, and "1" indicates very stimulating (Gunawardena and Zittle, 1997). Previous studies have shown that the SPS has good validity (Song et al., 2021). The Chinese version of SPS was adapted by Zou et al. (2021) presenting the same structure. In this study, Cronbach's alpha was 0.93.

This study chose SPS as the measuring tool of social presence, because Gunawardena and Zittle studied social presence under the background of online education and developed this scale (Gunawardena and Zittle, 1997), which is close to the research topic of this study. This study also focuses on online education and compares the different effects of animation and audio media on LKM online training

effect and social presence. Previous studies have also used SPS to measure social presence in online nursing courses (Burruss et al., 2009).

## Loving-kindness meditation intervention

In this study, the image of APA was designed as a cute anthropomorphic cat (see Figure 1), because cats are generally regarded as gentle and lovely. At the same time, we designed different facial expressions and body movements for APA to cooperate with the explanation of different contents. The audio material of meditation instruction is voice explanation recording, which only contains simple voice narration and soothing music in the background. Animation materials for meditation instruction are composed of APA and audio material. The audio-guided materials and the APA-guided materials were exactly the same in the sound part. The only difference was that the animation-guided materials contained visual information such as APA cartoon images and animation, while the audio materials only contained auditory information without visual information.

The animation and audio production materials were adapted from previous research, and the production process included designing and drawing APA cartoon characters using drawing software (SAI). Then, animation software (Flash) was used to create interactive animations in SWF format with a resolution of  $1,920 \times 1,080$  pixels. Finally, voice actors were invited to record narration materials. The animation and audio can be watched for 5 min at a time and can be repeated in a loop. APA-guided meditation animation and audio were eventually uploaded to the website to facilitate monitoring and assessment of each user's viewing time and meditation practice time per day. Using these data, the researchers calculated and assessed whether the 8-week period of effective intervention was sufficient. Meditation intervention materials are designed to provide online training of LKM intervention for flight attendants during the epidemic, mainly providing animation and audio guidance for flight attendants to learn LKM.

The meditation animation and audio introduce methods of compassion meditation, which include putting yourself in a comfortable position first to prepare for blessings and then spreading blessings to that object in four ways: (1) may you have no enemies; (2) may you have no pain; (3) may you have no disease; (4) may you have your own happiness. The order of the objects of blessing is as follows: (1) bless oneself; (2) bless the loved ones; (3) bless neutral people, that is, people who do not like or dislike them; (4) bless those whom you hate; (5) bless all people or all living beings.

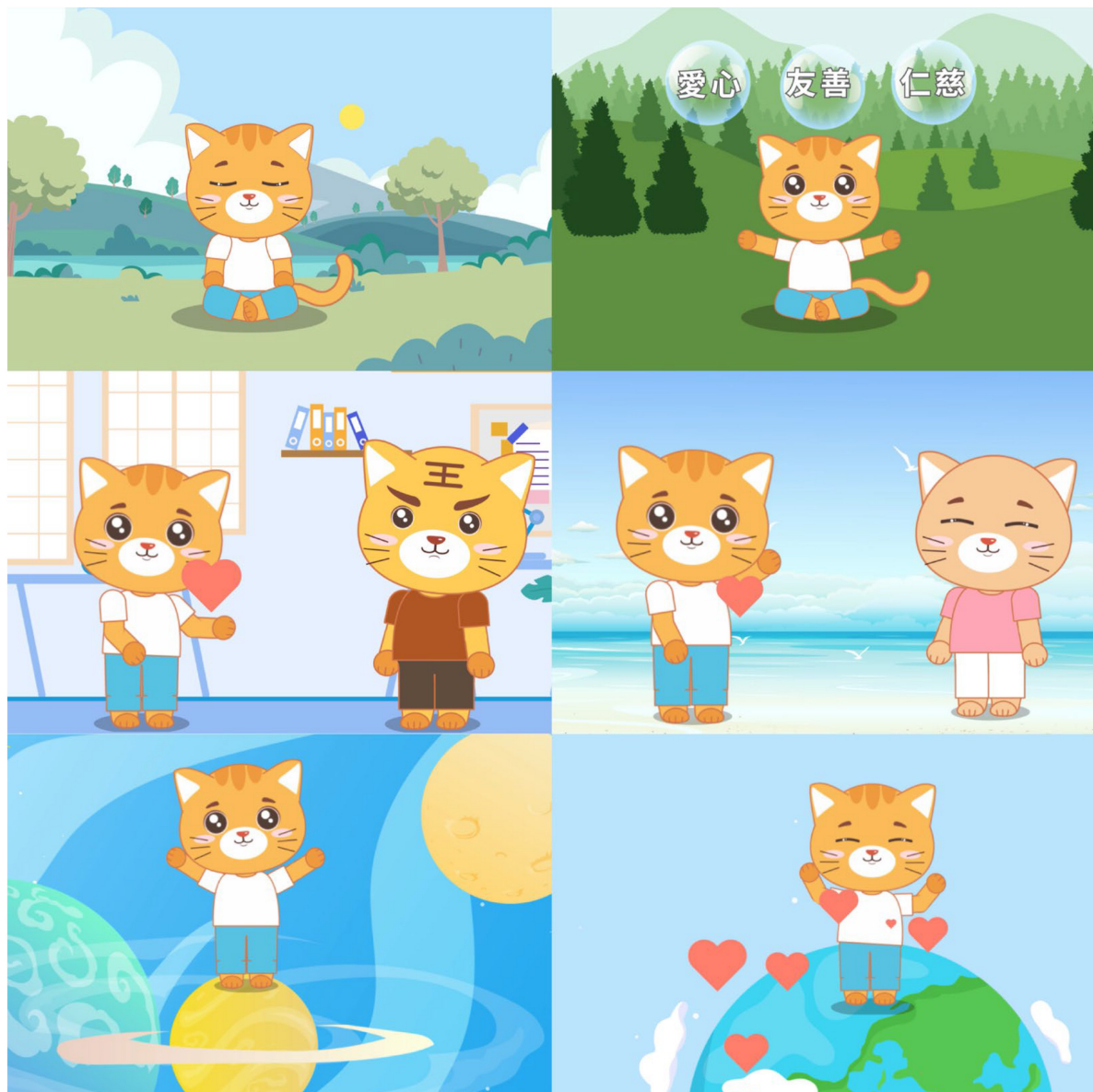


FIGURE 1  
Animated pedagogical agent (APA) cartoon image design.

## Procedure and design

We advertised on an airline intranet and flight attendants who were interested and eligible to participate in our LKM study provided their registration information. Inclusion criteria were as follows: (1) adults aged 18 years or older; (2) able to speak and read in Chinese sufficiently to complete the questionnaire; (3) worked as a flight attendant for at least 1 year. Exclusion criteria were as follows: (1) self-reported depression, anxiety, bipolar disorder, substance abuse, or suicide; (2) prior experience with LKM or mindfulness meditation.

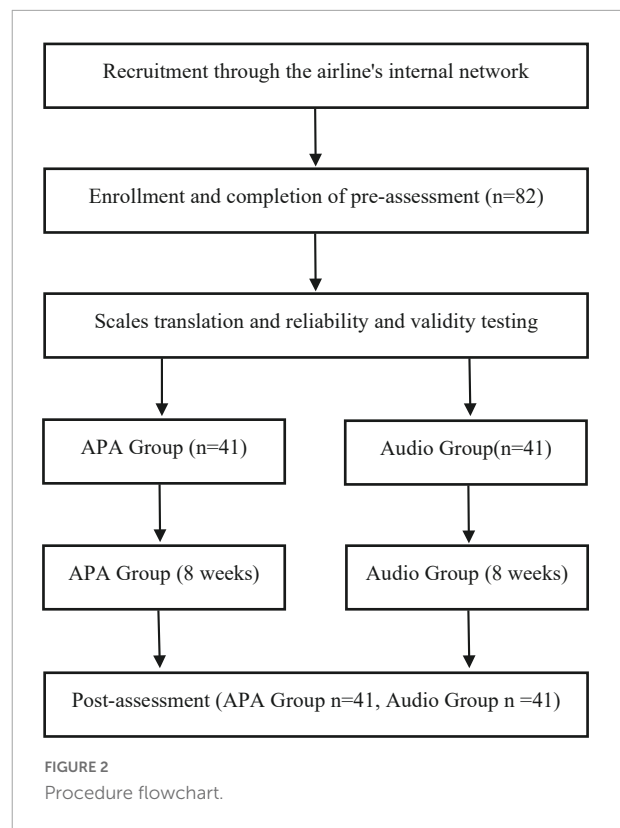
In this study, a two-arm randomized controlled trial was conducted. The intervention condition was APA-guided LKM exercise, and the control condition was audio-guided LKM exercise. A 2 (group)  $\times$  2 (time) parallel experimental design was used in this study. Group members were assigned to groups using random sequence codes generated by SPASS 22 software. These code lists, initially labeled “Group A” and “Group B,” were provided to participants who were randomly assigned to either group A or group B using a 1:1 allocation ratio and strictly match the proportion of the gender and education levels. The interveners were not given a grouping list during the intervention. After the data analysis was completed, the



group members informed the data analyst and the experimental interventionist of the meaning of each group in the group list. Double blindness is realized by this program.

We randomly assigned 82 eligible participants to either animation intervention group (41 participants) or the audio meditation intervention group (41 participants). During the experiment, members of the two groups flew on separate flights without any contact. To maintain engagement and control attrition, there was a pre- and post-experiment trial fee of RMB 50 per participant at the beginning of the survey to increase their motivation. If the animated meditation or audio meditation was used for more than half an hour per day during the 8-week meditation intervention (the amount of time each user spent using the animation and audio per day was visible through the video monitoring software), a test fee of RMB 100 was given at the end of the 8-week intervention. Those who drop out or fail to meet the daily usage time within the 8 weeks will not receive the RMB 100 test fee.

Participants complete an online consent form through a secure online survey platform, provide demographic information, and complete the following questionnaires (pre-test): (1) Mindfulness Attention Awareness Scale (MAAS); (2) Spiritual Attitudes and Involvement Inventory (SAIL); (3) Positive and Negative Affect Scale (PANAS); (4) Satisfaction with Life Scale (SWLS); (5) Social Presence Scale (SPS, Social Presence Scale is based on the text introduction to compassionate meditation as a baseline). It took approximately 20 min to answer the questionnaire. The APA group was given an animated meditation intervention 3 times a week for 8 weeks, and the audio group was given an audio meditation intervention. Both the two groups were invited to a 20-min zoom webinar which provided an overview of how to use the animated and audio meditations. All participants began the 8-week study on the Monday following the zoom webinar. At the end of the intervention period (week 8), participants completed the same questionnaire again (post-test) and were compensated with an additional RMB 100 (Figure 2). This study followed an online funnel reporting procedure. Participants were asked whether they knew the purpose of the study and the topic being investigated and whether they knew the same questions in the pre-test and post-test. To recruit subjects who were oblivious to the experimental conditions and naively used animated meditations, the funnel report helped to obtain a homogeneous sample in both groups. Participants were given the opportunity to record any number of questionnaires anonymously and could withdraw at any stage. The study was approved by the ethics committee of the Chang Gung University (IRB No: 201901236B0), and the protocol was carefully reviewed to ensure that it complied with the ethical guidelines of China Psychological Association.



## Data analysis

SPSS 22 software was used for statistical analysis of the data in this study. The confidence interval was set as 95%, and the significance level was set as 0.05. In this study, descriptive statistics were used to describe the distribution of basic data of subjects, and ANOVA was used to compare the differences pre- and post-intervention and between groups.

## Results

Four 2 (Group Type: APA, Audio)  $\times$  2 (Time: Pre, Post) ANOVA with repeated measures was conducted on mindfulness (MAAS), spirituality (SAIL), SWB, and social presence (SPS). To test for the effects of group type differences in how different guidance media influence the effect of LKM meditation, the two factors (gender and education) were controlled and excluded from the ANOVA. The  $p$ -values of Box's test and Mauchly's test were all greater than 0.05, which showed that the observed covariance matrices of the dependent variables are equal across groups, indicating that these data were suitable for ANOVA.

The results of the ANOVA are presented in Table 2 and Figure 3, and the descriptive statistics are presented in Table 3. We found a significant main effect of time for spirituality, SWB, and social presence. There was a significant main effect of group

TABLE 2 ANOVA results.

Measure	Variable	F	p	$\eta^2$
MAAS	Time	2.679	0.104	0.033
	Group	0.001	0.973	< 0.001
	Time $\times$ Group	0.405	0.527	0.005
SAIL	Time***	26.750	< 0.001	0.251
	Group*	4.197	0.044	0.050
	Time $\times$ Group	2.776	0.100	0.034
SWB	Time***	27.826	< 0.001	0.258
	Group	1.696	0.196	0.021
	Time $\times$ Group*	5.655	0.020	0.066
SPS	Time***	13.210	< 0.001	0.142
	Group	1.326	0.253	0.016
	Time $\times$ Group*	4.484	0.035	0.054

Only significant differences are marked with \*; \* $p$  < 0.05; \*\*\* $p$  < 0.001.

for spirituality, and a significant interaction between time and group for SWB and social presence.

## Discussion

### Why mindfulness is not significant

Neither the APA-guided LKM nor the audio-guided LKM improved the participants' mindfulness. Mindfulness

can generally be defined as non-judgmental awareness of the mind, body, and external environment in each present moment. Mindfulness consists of three key components: (1) non-judgmental; (2) live in the moment; (3) internal and external awareness. The practice of LKM begins with blessing oneself, spreads to friends, and eventually to strangers. From the object's point of view, the object of LKM is rough and open (Komagata and Komagata, 2010). In practicing LKM, the multiple changes of objects in a short period of time can lead to disorganization of the mind, leading to a higher degree of inattention, which is definitely not good for the promotion of mindfulness, because the state of mindfulness requires clear internal and external awareness (Sheldon et al., 2015). In practicing LKM, the participants' perception of the external environment was impaired not only because the object of the blessing required extreme concentration, but also because the internal perception was also affected by the repeated changes of the blessed object, which affected the participants' mindfulness (Zeng et al., 2017).

### Animated pedagogical agent-guided loving-kindness meditation improves social presence

The results showed that APA-guided LKM training significantly improved participants' social presence, while audio-guided LKM intervention had no significant effect on

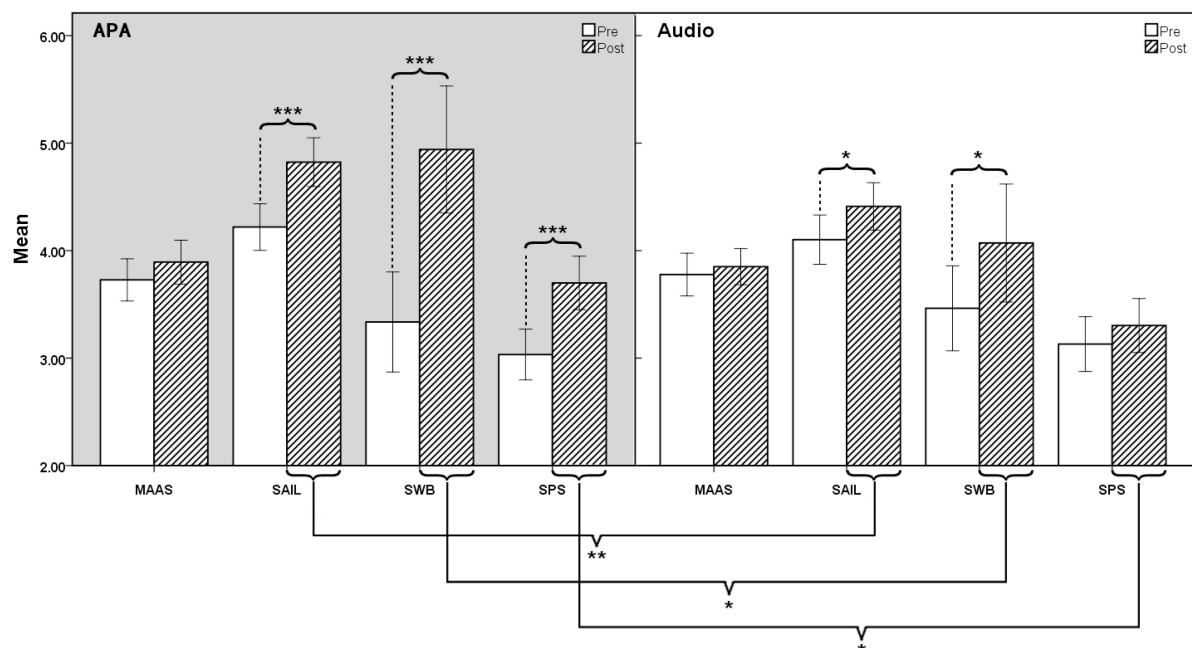


FIGURE 3

Comparison of four measures between animated pedagogical agent (APA) and audio group. \* $p$  < 0.05; \*\* $p$  < 0.01; \*\*\* $p$  < 0.001.

**TABLE 3** Means and standard deviations for each measure of each group, pre- and post-assessment.

Group	Measure	Mean (SD)	
		Pre	Post
APA	MAAS	3.728 (0.623)	3.893 (0.648)
	SAIL	4.219 (0.687)	4.823 (0.719)
	SWB	3.336 (1.473)	4.941 (1.873)
	SPS	3.033 (0.749)	3.699 (0.789)
Audio	MAAS	3.778 (0.630)	3.851 (0.534)
	SAIL	4.102 (0.726)	4.411 (0.698)
	SWB	3.463 (1.252)	4.071 (1.740)
	SPS	3.131 (0.807)	3.303 (0.796)

social presence of participants. The reason may be that the cartoon anthropomorphic image of APA induces automatic social responses in the subjects. Visual information of APA provides a means to be recognized and identified, which can enhance users' sense of participation in the virtual environment (Nowak and Biocca, 2003). The idea is that people automatically react socially to entities that look or behave like humans. Thus, if an agent looks or acts like a person, people will react socially to it in the same way they would react to another person (Reeves and Nass, 1996). There is behavioral and neuropsychological evidence that humans are hardwired to respond to intentional social cues from entities and that human-like entities may get more special attention (Nowak and Biocca, 2003). APA in a virtual environment can activate selective neuropsychological responses that result in the user's perception of these entities as "living" rather than "inanimate" (Gainotti et al., 1995). In other words, APA can activate people's tendency to respond socially. This could mean that people are reluctant to distinguish between humans and non-humans in the face of APA with human-like morphology and behavior, because humans tend to be confused about what is real and perceived to be real, and people automatically use social rules to guide their behavior toward these media (Nowak and Biocca, 2003). Unlike physical environments, social communication in virtual environments may be based on limited social cues (Hess et al., 2009). APA can enable users to generate strong automatic social responses from fewer social cues and enhance social presence (Benford et al., 2001). The social cues APA conveys can trigger patterns of social dialog in users. Once users are aware that social interactions are taking place, they use the rules of human interaction to treat these interactions with APA as social partners (Mayer and DaPra, 2012). Even when users are well aware that APA is not a true mentor but merely a pedagogical agent, they still have a social reaction to APA (Dunsworth and Atkinson, 2007). Users have a social reaction to APA, and the social cues of animated characters increase the social presence (Di Natale et al., 2022). Thus, subjects in the

APA group experienced a greater social presence than those in the audio group.

## Animated pedagogical agent-guided loving-kindness meditation improves spirituality and subjective wellbeing

It can be seen from the results that the spirituality and SWB of subjects were significantly improved by APA-guided LKM training, and the significance was higher in the APA group than in the audio group. The reason may be that APA helped improve the learning outcomes of the subjects and helped them to perform better LKM exercises, which led to more significant improvements in spiritual and SWB. Animation is more vivid than audio and conveys more social cues. The vividness of media was considered to influence users' perception of social existence (Lombard and Ditton, 1997), because the increased vividness can provide additional social clues, allow users to better identify various social cues presented in human-computer interaction, and increase users' perception of social presence (Moreno et al., 2001). Therefore, APA's cartoon images are more vivid, which can increase users' perception of social existence, while less vivid audio cannot fully convey key social cues (e.g., facial expressions, gestures, and body movements) due to the lack of important visual information and may lead to lower social existence. Daft and Lengel (1986) argued that the level of social presence was highly correlated with the number of social cues in the media. Social presence is the detection of specific cues in a virtual environment that may be related to the behavior of other entities (Triberti et al., 2018). In addition, social presence is not limited to media interaction, but is described as a basic psychological process that exists in real environments and daily life (Triberti et al., 2018). Given enough social cues, users can easily perceive their interactions with animated characters as social interactions. Bringing verbal (oral) and non-verbal social cues (e.g., facial expressions, gestures, and body movements) into a multi-media environment can simulate the interaction between people, thus promoting user's participation in the learning process (Moreno et al., 2001). Once this simulated person-to-person connection is established, social communication between students and APA is considered natural and automatic, following the rules of human communication, just as in real person-to-person conversations (Dunsworth and Atkinson, 2007). Participants naturally engage in a subject-user relationship, just as they would interact with a tutor or teacher in a classroom (Lin et al., 2013). Thus, in this case, the user has an underlying motivation to understand the information presented to him/her and is more likely to process the information in depth to achieve meaningful learning (Lin et al., 2013). A lively pedagogical agent helps to improve learning performance and outcomes by maintaining the user's attention and engaging the user in the cognitive process of

teaching (Yung and Paas, 2015). APA can help users gain a deeper understanding of the topic they are learning, just as users learn from real teachers (Wang et al., 2018). To sum up, the APA convey social cues (e.g., expressions, gestures, and body movements) launched the user's social interaction model (i.e., the APA as real interaction partners), which in turn leads to the participants more effort to understand the material being presented (i.e., the cognitive process of organization and integration), leading to better LKM learning outcomes (significantly improved spirituality and SWB).

## Advice for flight attendants

This study explored the impact of APA-guided LKM on flight attendants' mindfulness, spirituality, SWB, and social presence and provided a reference for how to improve flight attendants' subjective wellbeing in a simple and practical way in the post-epidemic era. Airlines can establish a more standardized, systematic, and operable online LKM intervention program to improve the stress resistance and self-regulation ability of flight attendants and their mental health, thus helping to improve the overall service level of airlines and the market competitiveness of air transport. Airline purser can include animation-guided LKM training in the flight process, such as LKM guided by animation for 10 min in each pre-flight preparation, to cultivate flight attendants' subjective wellbeing. Alternatively, flight attendants could be guided to reassess their positive and negative emotions to improve their ability to regulate those emotions and thus improve their ability to communicate with passengers. After the flight, LKM guided by animation can be used to improve the negative emotions of airline service personnel, help flight attendants effectively adjust and reduce psychological pressure, and reduce work anxiety. Compassion meditation can stimulate more positive emotions. At the same time, the training of compassion meditation for flight attendants is not only beneficial to individual physical and mental health, but also helps them quickly adapt to the new environment and work and face the negative emotions caused by conflicts with passengers with a good attitude.

## Research limitations and future studies

Due to the limited human and material resources, funds, and time, this study still has the following limitations and deficiencies: (1) The analysis of mindfulness, spirituality, social presence, and SWB is conducted on a holistic scale without analyzing its subdimensions; (2) in terms of research tools, the measurement in this study was a self-reported scale, which was subjective in the self-report of the subjects, and the study lacked objective measures such as physiological indicators and behavior. SPS was used as a measure of social presence in this

study. Since APA was introduced into online education research in this study, some scholars pointed out that SPS may not be suitable for measuring social presence generated by artificial entities. Therefore, a more suitable scale will be selected to evaluate the social presence generated by APA in future studies; (3) samples were taken from a single unit, limited by factors such as the number of personnel, research funds, and nature of work, so the sample size was small; (4) due to the particularity and nature of the sample working environment, whether the results of this study can be extended to other populations requires further research verification.

Based on the limitations of this study, we put forward the following prospects for future studies: (1) Future studies will further conduct in-depth analysis on the subscales and subdimensions of each variable to explore the interaction between each dimension; (2) in addition to the use of self-reporting scales, more physiological objective evaluation indicators (such as EEG) will be added in future studies. A measure more suitable for evaluating the social presence of artificial entities (such as APA) will also be selected; (3) future studies will further expand the sample size and scope and further verify the generalizability and universality of the current results in other populations.

In addition, the following suggestions are put forward for the practical application of the research results: (1) Future studies should carry out online positive psychological intervention for people from different industries; (2) future studies should combine objective measurements such as physiological indicators and behavior to further explore the effects of online positive psychological intervention on subjects' positive psychology; (3) future mental health workers should develop different cartoon characters according to different types of meditation to compare the experimental effects when using animation to improve the positive psychology of subjects.

## Conclusion

This study draws the following conclusions. First, both APA-guided LKM and audio-guided LKM significantly improved subjects' spiritual and SWB; second, APA-guided LKM significantly improved subjects' social presence, but audio-guided LKM had no significant effect on social presence; Third, compared with audio-guided LKM, APA-guided LKM significantly improved the subjects' spirituality and SWB. Finally, we contribute to the literature of LKM and provide a deeper understanding of APA-guided LKM by linking mindfulness, spirituality, and SWB. Compared to audio materials, APA-guided LKM exercises significantly improved subjects' spirituality, SWB, and social presence and enhanced their meditative effects. APA-guided online meditation as a simple and easy way of meditation training also has a certain practice and promotion value.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

The studies involving human participants were reviewed and approved by the Chang Gung University Ethics Committee (IRB No: 201901236B0). The patients/participants provided their written informed consent to participate in this study.

## Author contributions

HC contributed with data collection, finding interpretation, and manuscript preparation. CL contributed to the experimental design, data collection, statistical analysis, and finding interpretation. C-HC and Y-LC were in charge of data collection, helped to prepare the experimental sites, and assisted with data collection. FZ, KW, D-HH, and C-YL assisted in the data collection and evaluation of the findings, as well as conceiving the project and participating in its interpretation. W-KC was responsible for the study's conception and design, as well as the interpretation of the findings and manuscript writing. All authors read and approved the final version and submitted for publication.

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

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# A techno-psychological approach to understanding problematic use of short-form video applications: The role of flow

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Short-form video applications (SVAs) have been gaining increasing popularity among users, which has raised the concern of problematic SVA use. Flow—a positive experience in which individuals feel immersion, enjoyment, temporal dissociation, and curiosity—contributes to the development of problematic SVA use. Most of the prior research examined the motivations of flow and the self-traits that trigger flow, but paid limited attention to the technological affordances of smartphone applications that facilitate users' flow. Algorithm recommendation, multimodality, and low-cost interaction are three affordances of SVAs. Thus, drawing upon the stimulus-organism-response (S-O-R) framework, this study proposes a mediation model to examine how these affordances influence problematic SVA use through flow. An online survey ( $N = 621$ ) showed that algorithm recommendation was negatively associated with problematic SVA use but was not significantly correlated to flow. Multimodality was directly and positively associated with problematic SVA use. Meanwhile, the relationship between these two variables were mediated by flow. Low-cost interaction had an indirect link with problematic SVA use via flow, while the direct link between them was not significant. The results suggest that low-cost interaction is the affordance that is most likely to trigger flow and problematic SVA use, followed by multimodality. However, algorithm recommendation seems to be an affordance that is less likely to facilitate flow or cause problematic SVA use. Our proposed model not only enriches the S-O-R framework in the digital environment, but also denotes a techno-psychological approach to examine problematic use of SVAs and other digital applications. Moreover, the findings offer practical implications for optimizing SVAs' technological affordances to properly manage problematic SVA use.

## KEYWORDS

problematic SVA use, technological affordances, recommendation algorithm, multimodality, low-cost interaction, flow



## Introduction

If you have ever used short-form video applications (SVAs, e.g., TikTok), you may have such a feeling that “a perceived minute spent on SVAs actually takes several hours in life” (Guangming Daily, 2021). The setting of full-screen auto-play and the customized recommendations of vivid contents afford users immersive experiences when using SVAs (Zhang et al., 2019; Zhao, 2021). These user experiences made SVAs increasingly popular in recent years. By the end of 2021, the number of SVA users in China has reached 934 million, witnessing an increase of 60.8 million users compared with 2020 (China Internet Network Information Center, 2021). Moreover, TikTok, a popular SVA worldwide, has received more than a billion active monthly users by the third quarter of 2021 across the globe (Daily Economic News, 2021).

However, overuse of SVAs tends to result in negative consequences. In the year of 2021, users across China spent approximately 2 h on SVAs on average each day (China Network Audiovisual Program Service Association, 2021). Moreover, news media frequently reported how excessive SVA use impaired heavy users’ physical health and psychological wellbeing. For instance, during the addictive use of SVAs, teenagers tended to imitate characters in the short-form videos, which rendered them vulnerable to the undesirable or maladaptive behaviors performed by some characters (People’s Daily, 2022). Besides, spending too much time on SVAs distracted young adults from work, reducing work efficiency or exacerbating procrastination (Guangming Daily, 2022). Additionally, a growing number of seniors have become increasingly glued to SVAs, and their unlimited use has impaired eyesight, caused cervical spine deformity, and triggered family disputes (China Daily, 2021).

Scholars have termed the above-mentioned phenomena as problematic SVA use, which describes an individual’s inability to control SVA use and the associated outcomes (Wang et al., 2021; Huang et al., 2022a). Drawing on prior research (Zhang et al., 2019; Liu et al., 2021; Wang et al., 2021; Huang et al., 2022a), problematic SVA use consists of four dimensions: (1) loss of control, namely, engaging in compulsive SVA usage for uncontrolled time duration; (2) withdrawal, that is, experiencing unpleasant feelings with suspension of SVA use; (3) craving, that is, going through mood changes if SVAs are not available; and (4) negative life consequences, referring to the physical and psychological impairment due to excessive SVA use.

Considering that SVAs are a newly developed web-based application installed on smartphones, research on problematic smartphone use and problematic Internet use offers insights into understanding problematic SVA use. Prior studies mainly adopted the psychopathological approach and the compensatory use approach to examine users’ problematic use of various web-based technologies. The psychopathological approach assumes that individuals

with predisposed psychopathologies, such as depression, social anxiety, and substance dependence, are vulnerable to maladaptive cognitions and social isolation, which leads to problematic SVA or Internet use behaviors (Davis, 2001; Elhai and Contractor, 2018; Elhai et al., 2020). By contrast, the compensatory use approach is developed from the uses and gratifications theory and sees individuals as active actors (Elhai et al., 2017). This approach posits that individuals use online applications to regulate their negative emotions, while the addiction-like symptoms resulting from overuse are unintended side effects (Kardefelt-Winther, 2014; Wegmann and Brand, 2019).

Despite the different assumptions about the nature of users, the psychopathological approach and the compensatory use approach have one thing in common: the positive feelings generated from using the web-based technologies could either help users with psychopathological conditions regain meaning or compensate for users’ stressful life situations. These positive feelings, resulting from the reward mechanism of the human brain, are the key to developing problematic use behaviors (Koob and Le Moal, 2008). Notably, flow—an optimal experience in which an individual is fully immersed in an activity due to a feeling of energized focus, full involvement, enjoyment, and success in the process of the activity (Csikszentmihalyi, 1990)—is the key indicator of the reward mechanism that explains people’s problematic use of smartphones and various online applications (Thatcher et al., 2008; Khang et al., 2013; Mazzoni et al., 2017; Wang, 2020; Barberis et al., 2021; Brailovskaia et al., 2021). Nevertheless, most of these studies examined the motivations of flow or the self-traits that are highly likely to trigger flow (Khang et al., 2013; Mazzoni et al., 2017; Wang, 2020; Barberis et al., 2021), whereas paid limited attention to the technological characteristics of the web-based applications that facilitate users’ flow.

Given that the technological features of SVAs play an important role in the development of problematic SVA use (Zhang et al., 2019), this study focuses on the technological antecedents of flow. Drawing on the stimulus-organism-response framework (Fang et al., 2017, 2021; Tuncer, 2021), we examine how three technological affordances of SVAs, namely, recommendation algorithm, multimodality, and low-cost interaction afford users’ experience of flow, which in turn, contribute to their problematic use of SVAs. By testing the mediating role of flow between three affordances and problematic SVA use, we propose a technopsychological approach to understand the problematic use of SVAs. Such an approach not only helps us differentiate between how certain technological affordances induce problematic SVA use *via* flow, but also offers insights into effectively managing problematic SVA use through optimizing SVAs.

## Literature review and hypotheses development

### The stimulus-organism-response framework

The stimulus-organism-response (S-O-R) theory is used as the overarching framework of the current study. Developed from behavioral psychology, the S-O-R framework maintains that clues perceived from an environment (S) triggers an individual's internal assessment (O), which subsequently activates this person's behavioral response (R) (Mehrabia and Russell, 1974). In recent years, the S-O-R framework has been widely used to explicate people's digital media use behaviors (Fang et al., 2017, 2021; Tuncer, 2021). For instance, the perceived affordances of online commerce platforms (e.g., visibility, interactivity, selectivity) influenced users' assessment of the brand experience and the relationship quality with the seller, which in turn, regulated their purchase intention and further engagement with the platform (Fang et al., 2021; Tuncer, 2021). Likewise, users' perception of mobile travel applications' design and performance affected their psychological engagement and benefit perception of the applications, which then drove their behavioral engagement with mobile travel applications (Fang et al., 2017). Moreover, the technological features of SVAs—such as immersion, socialization, and control—induce addictive usage by activating users' perceived enjoyment and feeling of withdrawal (Tian et al., 2022).

To sum up, the above-reviewed studies updated the S-O-R framework in the digital environment: affordances of digital media perceived by users (S) affect their assessment of the media and the associated psychological experiences (O), which in turn, influence their digitally mediated behaviors (R). According to this updated S-O-R framework, we try to explain how certain technological affordances of SVAs (S) trigger a user's flow experience (O), and thereby induce the user's problematic SVA use (R).

### Technological affordances and problematic SVA use

The concept of affordance was first coined by Gibson (1979) in the field of ecological psychology. Originally, Gibson defined an affordance as a possibility for action available in the environment, which exists as congenial to the action capabilities of an organism (Gibson, 1979). Such a definition highlights that an affordance manifests a certain relationship between an organism and its surrounding environment. Later, to modify Gibson's model of affordance, Norman (1988) accommodated design interests and introduced a perspective of subjective perception to understand affordance: an affordance

is a perceived property of a thing that determines how the thing could possibly be used by a human being (Norman, 1988, 1990). Norman (1988) developed Gibson (1979) definition in two ways. First, only when an affordance is perceived by an actor, instead of being an objective possibility for action, can the affordance induce a behavior. Second, focusing on affordances perceived by human actors rather than organisms in general helps explicate how to optimize the design of a thing for human beings' better usage. Notably, the increasing digitalization in the past decades has drawn researchers' interest from affordances of things to affordances of technologies. The term technological affordance has thus frequently appeared in recent scholarship (Leonardi, 2011; Majchrzak et al., 2013; Lu et al., 2014; Chatterjee et al., 2015; Abhari et al., 2017). Accordingly, based on Norman (1988, 1990) approach to affordance and draws on research on affordances of information technologies (Leonardi, 2011; Majchrzak et al., 2013; Lu et al., 2014; Chatterjee et al., 2015; Abhari et al., 2017), this study defines technological affordances as the features of a digital technology that may invite certain behaviors recognized by users.

Given that contents, forms, and the mode of human-computer interaction constitute a typical scenario of technology use, we draw upon prior research (Sundar and Limperos, 2013; Zhang et al., 2019; Zhao, 2021) and propose three affordances of SVAs that induce users to consume contents (i.e., recommendation algorithm), utilize various forms to edit (i.e., multimodality), and interact with the interface in specific ways (i.e., low-cost interaction). Recommendation algorithm is widely used in the design of various mobile applications, through which the platforms tailor information and services according to users' preferences, thereby increasing user satisfaction (Moon et al., 2014; Mou et al., 2021). In reference to previous research (Zhang et al., 2019), we consider recommendation algorithm a content-related affordance and define it as the perceived potential of SVA platforms to provide users with customized contents and services based on their preferences. The use of certain modalities—the ways in which information is presented, such as text, audio, and audiovisual—has a great impact on how the information is received and processed (Sundar and Limperos, 2013). Given the design of SVAs, this study sees multimodality as a form-related affordance and defines it as users' perceptions of SVAs' possibility of presenting information in multiple forms through the function of filters, frames, templates, and beautifying. Besides, users have frequently reported that SVAs are quite easy and convenient to use, in that they just need to continuously slide up the screen to view the auto-play videos (Zhao, 2021). This delineates the low-cost interaction affordance (Chen et al., 2017), an affordance that characterizes the human-computer interaction and allows SVA users to watch short-form videos with the least cognitive effort yet obtaining instant gratifications.

Affordances of a given technology tend to invite users to interact with the technology in certain ways to reach

their goals (Norman, 1988, 1990; Withagen et al., 2012). For instance, the technological affordances of TikTok influence users' experience, thereby affecting their intention to use TikTok for health information seeking (Song et al., 2021). Likewise, the technological affordances of social networking sites contribute to users' satisfactory use, thus increasing their stickiness to these sites (Shao et al., 2020). Besides, in the context of organization management, affordances of social media applications facilitate business organizations' communicative practices with stakeholders, thereby improving the organization-stakeholder relationship (Argyris and Monu, 2015). These studies suggest that technological affordances have the potential to elicit a certain mode of behavior among users. Moreover, considering that recommendation algorithm, multimodality, and low-cost interaction represent an affordance that is related to contents, forms, and human-computer interaction modes, respectively, we try to explore whether these affordances of SVAs may induce the problematic use behavior in different ways. Specifically, we ask the following research question:

**RQ1:** Is recommendation algorithm (RQ1.1), multimodality (RQ1.2), and low-cost interaction (RQ1.3) significantly associated with problematic SVA use, respectively? Are there any differences in the associations between three affordances and problematic SVA use?

## Technological affordances and flow

Flow represents an immersive and optimal experience in which an individual gets fully absorbed in an activity and feels heightened enjoyment, curiosity, and little distinction between self and the environment (Csikszentmihalyi, 1990). According to the S-O-R framework in the digital environment (Fang et al., 2017, 2021; Tuncer, 2021), it is the setting and design of a technology that induces users' experience with the technology (Ghazali et al., 2018). Likewise, we assume that the technological affordances of SVAs are the antecedents that trigger users' flow experience.

Recommendation algorithm affords SVA users customized contents and services based on their preferences. For instance, if you viewed several videos about food, the algorithm would push food-related videos when you use SVAs next time. The frequent exposure to the tailored contents makes it easier for users to concentrate and reach the state of cognitive absorption (Huang, 2016). This is because contents tailored to an individual's interest create few cognitive obstacles for this person to get fully involved. Moreover, a plethora of research has demonstrated that one's cognitive absorption in a limited field of stimuli largely facilitates this person to experience flow (Chou and Ting, 2003; Lee et al., 2017). Short-form videos recommended by algorithms represent an array of limited and concentrated stimuli that

are highly likely to trigger viewers' cognitive absorption. Thus, we infer that recommendation algorithm of SVAs may elicit users' flow:

**H1:** Recommendation algorithm is positively associated with flow.

Multimodality of SVAs enables users to receive and process short-form videos in multiple forms with varying special effects. For example, the filters, frames, and templates of SVAs provide different scenarios to present a video, such as scenery spots and movie-like settings. Likewise, the beautifying function of SVAs allows characters to modify or improve their outlook in a video. These various modalities enhance the richness of the experience and arouse users' multiple senses (Coyle and Thorson, 2001; Jung and Sundar, 2018), thereby facilitating them to experience sensory immersion (Shin, 2019), as if they were there in the scenario presented by the short-form video. Moreover, studies have demonstrated that multiple modalities of digital technology create a sense of being there, thus providing users with an uninterrupted and immersive experience of flow (Huang, 2016; Kim and Ko, 2019). In a similar vein, we expect that multimodality of SVAs creates a sensory rich environment and enriches users' senses. When immersed in such an environment, users tend to experience flow. Thus, we posit the following hypothesis:

**H2:** Multimodality is positively associated with flow.

Low-cost interaction of SVAs reduces the effort to watch short-form videos to a minimal level and provides users with instant gratifications (Zhao, 2021). For instance, users just need to slide up the smartphone screen to view the auto-played short-form videos, from which they get relaxed and have fun immediately. In most circumstances, the convenience and ease of using a technology increase users' psychological engagement with this technology, whereas complexity of use may prevent a user from deeply engaging with the technology (Peters et al., 2016). In relation to this study, when users recognize that SVAs are easy to use and require little effort to operate, they tend to be psychologically engaged with these applications. A high level of psychological engagement indicates a state of full involvement, thus inducing an experience of flow. Meanwhile, obtaining short-term and prompt rewards enables users to focus on the essentials of an activity, thereby creating an immersive feeling in using a technology (Przybylski et al., 2010; Suh et al., 2017). Accordingly, instant gratifications acquired during users' interaction with SVAs are highly likely to trigger their flow experience. Given that the low-cost interaction affordance is characterized by convenience, ease of use, and instant gratifications (Chen et al., 2017), we put forward the following hypothesis:

**H3:** Low-cost interaction is positively associated with flow.

## Flow and problematic SVA use

Flow is an important concept developed in positive psychology (Csikszentmihalyi, 2014). It represents an optimal experience that one is fully involved in an activity. Flow is characterized by the feeling of concentration, enjoyment, curiosity, and intrinsic interest (Csikszentmihalyi and LeFevre, 1989). In addition to the field of positive psychology, flow has been widely examined in the context of information technologies and has been used as a powerful conceptual tool to understand problematic use of information technologies (Chou and Ting, 2003; Kim and Davis, 2009; Duke and Montag, 2017).

The brain's reward mechanism helps explain the relationship between flow and problematic SVA use. Problematic and addictive behaviors are rooted in the neurobiological model of the brain's emotional system (Koob and Le Moal, 2008). Specifically, when the brain receives external stimuli such as gambling, playing games, and drugs, the secretion of dopamine increases, which allows an individual to obtain a reward, such as monetary benefits and psychological satisfaction. Meanwhile, the positive feeling of getting a reward further reinforces the individual to perform the same behavior over and over again. Noticeably, this reward mechanism not only compensates for the reward deficit in the short term, but also inhibits the anti-reward system in the long run, which results in problematic and addictive behaviors (Volkow et al., 2002; Gardner, 2011).

In the context of SVA usage, users who experience flow may perceive the state of concentration, enjoyment, and transcendence of self as an intrinsic reward. The continuous reward then facilitates users to spend more time on SVAs and engage deeper in short-form videos, which finally leads to problematic use of SVAs. Indeed, prior research has demonstrated that flow generated from using online applications tends to facilitate users to develop problematic use behaviors (Wu et al., 2013; Wang, 2020). Therefore, we propose

that people who experience flow during SVA usage are more likely to engage in problematic SVA use. Accordingly, we posit the following hypothesis:

**H4:** Flow is positively associated with problematic SVA use.

## The mediating role of flow

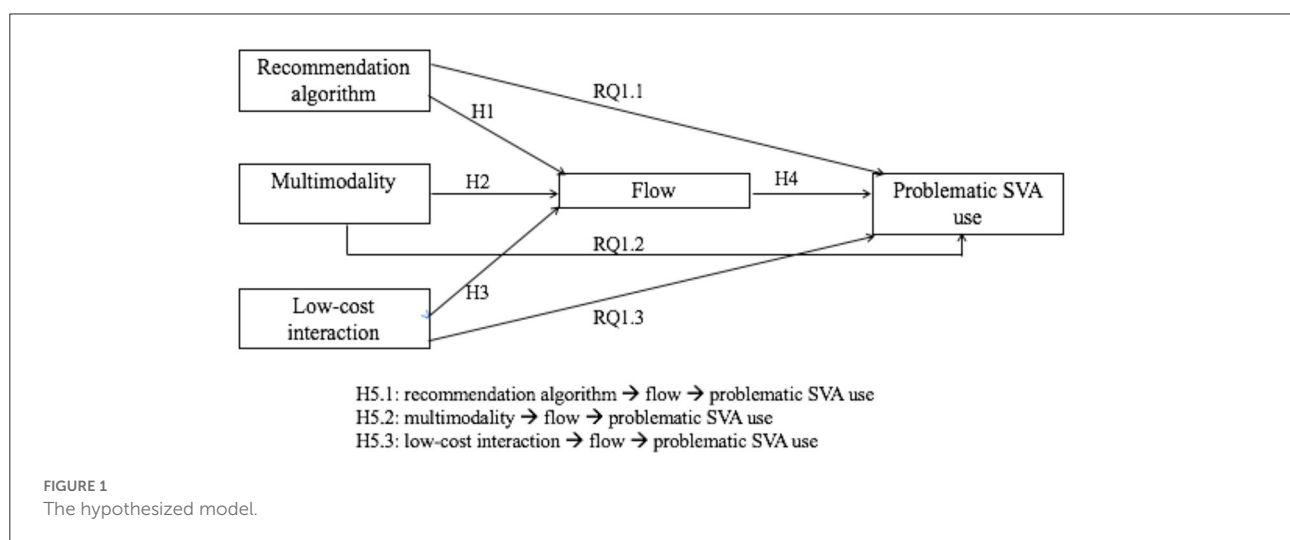
The positive associations between three affordances and flow and the association between flow and problematic SVA use suggest a mediation model, in which flow mediates the relationship between three affordances and problematic SVA use, respectively. The mediating paths are in line with the S-O-R framework (Mehrabia and Russell, 1974; Fang et al., 2021; Tuncer, 2021), which assumes that certain affordances of a digital technology (e.g., recommendation algorithm, multimodality, and low-cost interaction) influence users' experiences in using this technology (e.g., flow), which in turn affects users' subsequent behaviors (e.g., problematic SVA use). Thus, we posit a set of hypotheses to test the mediating role of flow between three affordances and problematic SVA use:

**H5:** Flow mediates the relationship between recommendation algorithm (H5.1), multimodality (H5.2), low-cost interaction (H5.3) and problematic SVA use, respectively.

Moreover, given that recommendation algorithm, multimodality, and low-cost interaction demonstrate the possibilities of using SVAs in different ways, users' flow afforded by each of the three affordances may differ. Hence, we ask the following research question:

**RQ2:** Are there any differences in the indirect effects described in H5?

Figure 1 presents the hypothesized model of this study.





## Materials and methods

### Participants

We collected data using Sojump's sampling service. Sojump is a professional data collection platform in China and provides a sampling pool consisting of around 2.6 million participants nationwide. This sampling strategy has been frequently used in studies that examined users' online behaviors (Cui and Wu, 2021; Huang et al., 2022b; Rui, 2022; Zhang and Fan, 2022). The survey was conducted from 14 March 2022 to 30 March 2022. In terms of sampling procedures, each registered user in the Sojump survey pool has an ID number in the range from 1 to 2,600,000. The company automatically generated random integers between this range, obtaining a sample size as requested by the researchers. The company then sent an email to invite the selected users to participate in the online survey. Questionnaires were accessible *via* mobile phones, tablets, and personal computers. The data collection protocol was approved by the institutional review board of the authors' affiliated university. Voluntary informed consent was obtained from the participants before the online survey.

To be eligible for our study, participants should have the experience of using SVAs. Meanwhile, cases were considered invalid if they met one of the two criteria: (1) submitted the questionnaire multiple times using the same IP address; and (2) failed any of the 4 attention checks (e.g., please select "strongly agree"). Finally, we collected 621 valid questionnaires for data analysis. Table 1 presents the demographic characteristics of our participants.

### Measures

#### Recommendation algorithm

Referring to prior studies on the personalized recommendation algorithm of SVAs (Li et al., 2021; Song et al., 2021), this study compiled a five-item instrument to measure recommendation algorithm. Sample items included: "SVAs can provide me with personalized videos tailored to my everyday life" and "SVAs push contents that suit my interest". Items were measured on a five-point scale (1 = "strongly disagree", 5 = "strongly agree") and averaged to create a composite index ( $M = 4.22$ ,  $SD = 0.47$ , Cronbach's  $\alpha = 0.70$ ).

#### Multimodality

We developed a scale of multimodality based on the special effects afforded by TikTok, such as filters, frames, templates, beautifying, and voice changing (Liu, 2022). Multimodality was measured with three items on a five-point scale (1 = "strongly disagree", 5 = "strongly agree"): (1) SVAs offer

TABLE 1 Demographic characteristics of the participants.

Measure	Item	Frequency	Percentage (%)
Age	18–24	83	13.4
	25–34	379	61.0
	35–44	120	19.3
	45–54	33	5.3
	55–99	6	1.0
Gender	Male	326	52.5
	Female	295	47.5
Monthly income	Less than 1,500 RMB	18	2.9
	1,501–2,000 RMB	14	2.3
	2,001–3,000 RMB	21	3.4
	3,001–5,000 RMB	81	13
	5,001–8,000 RMB	205	33
	8,001–12,000 RMB	150	24.2
	12,001–20,000 RMB	111	17.9
	More than 20,000 RMB	21	3.4
Education level	Never attend to school	0	0
	Primary school	0	0
	Middle school	7	1.1
	High school	17	2.7
	Vocational high school	13	2.1
	Higher vocational school	64	10.3
	Bachelor	478	77
	Master	41	6.6
	PhD	1	0.2
	Beijing, Shanghai, Tianjin, Chongqing, Shenzhen	200	32.2
	Capital city of province	245	39.5
Area	Prefecture-level cities	145	23.3
	Counties and towns	30	4.8
	Administrative villages	1	0.2

various special effects, such as filters, frames, templates, and beautifying, which make video editing interesting, (2) SVAs offer various special effects, which make video watching attractive; and (3) SVAs offer various special effects, which increase my willingness of continuous SVA usage. Items were averaged, with higher scores indicating stronger perceptions of the multimodality affordance ( $M = 3.96$ ,  $SD = 0.75$ , Cronbach's  $\alpha = 0.80$ ).



## Low-cost interaction

According to the prior measurement of low-cost interaction of SVAs and smartphones (Yoon and Kim, 2007; Chen et al., 2017; Zhao, 2021), we created an eleven-item scale with three dimensions, namely, (1) convenience (e.g., “Using SVAs is effortless for me”), (2) ease of use (e.g., “When using SVAs, I just need to continuously slide up to view the videos”) and (3) instant gratifications (e.g., “I use SVAs because they fulfill my needs immediately”). Items were asked on a five-point scale (1 = “strongly disagree”, 5 = “strongly agree”). The internal consistency of the scale was acceptable ( $M = 4.15$ ,  $SD = 0.46$ , Cronbach's  $\alpha = 0.79$ ). To test the construct validity of the scale, we conducted a confirmatory factor analysis. According to the acceptable thresholds of the model fit indices (Bentler, 1992), the factor structure of the newly compiled scale showed a good fit:  $\chi^2/df = 3.06$ , GFI = 0.96, CFI = 0.93, RMSEA = 0.06, SRMR = 0.04. Additionally, the factor loadings of all items on their respective dimensions exceeded the recommended cut-off value of 0.40 (Hassim et al., 2020).

## Flow

Drawing upon previous research (Trevino and Webster, 1992; Agarwal and Karahanna, 2000; Wang et al., 2020), we modified the scale of flow in the context of SVA usage, which included thirteen items with four dimensions: (1) temporal dissociation (e.g., “Sometimes I lose track of time when I am using SVAs.”); (2) focused immersion (e.g., “While using SVAs, I am able to block out most other distractions.”); (3) heightened enjoyment (e.g., “I have fun interacting with SVAs.”); and (4) curiosity (e.g., “Using SVAs excites my curiosity.”). Questions were asked on a five-point scale (1 = “strongly disagree”, 5 = “strongly agree”), with higher scores suggesting high levels of flow experience ( $M = 3.97$ ,  $SD = 0.54$ , Cronbach's  $\alpha = 0.87$ ).

## Problematic SVA use

Problematic SVA use was measured using an established instrument (Huang et al., 2022a). The instrument consisted of thirteen items with four dimensions: (1) loss of control (e.g., “I find myself engaged on SVAs for a longer period of time than intended.”), (2) withdrawal (e.g., “I feel anxious if I have not checked for SVAs updates for some time.”), (3) craving (e.g., “I often think of SVAs when I am doing something else.”), and (4) negative life consequences (e.g., “Feeling pain in the wrists or at the back of the neck while using SVAs.”). The participants answered the questions on a five-point scale (1 = “strongly disagree”, 5 = “strongly agree”). The items were averaged to create a composite index, with a higher value indicating a greater tendency of engaging in problematic SVA use ( $M = 3.09$ ,  $SD = 0.76$ , Cronbach's  $\alpha = 0.91$ ).

## Control variables

We included five control variables in the hypothesized model: duration of SVA use, lack of self-control, gender, education level, and monthly income. We used a single item to measure duration of SVAs use: “On average, how long do you use SVAs every day?” Answers were scored on a ten-point scale, ranging from less than 10 min to more than 5 h ( $Median = 5.00$  or 1–1.5 h,  $SD = 1.76$ ). Adapted from the prior instrument (Tangney et al., 2004; Busch et al., 2021), three items were used to assess lack of self-control, such as “I have a hard time breaking bad habits.” Gender was measured as a dichotomous variable (52.6% males), while monthly income ( $Median = 5.00$ , or 5001–8000 RMB,  $SD = 1.45$ ) and education level ( $Median = 7.00$ , or bachelor's degree,  $SD = 0.80$ ) were measured as ordinal variables.

## Statistical analyses

We first used SPSS version 26.0 to calculate the means and standard deviations of the examined variables and the Pearson correlations between them. Then, we used AMOS version 23.0 to conduct a path analysis to test the research hypotheses. Technological affordances of SVAs (i.e., recommendation algorithm, multimodality, and low-cost interaction) and control variables were treated as exogenous variables. Endogenous variables included flow (i.e., the mediator variable) and problematic SVA use (i.e., the outcome variable). We tested the direct and indirect effects with 5,000 bootstrap samples at 95% confidence intervals (Preacher and Hayes, 2008). Standardized coefficients were reported.

## Result

### Preliminary analysis

Table 2 presents the means, standard deviations, and bivariate correlations between the examined variables. The mean value of problematic SVA use was 3.09 on a five-point scale, indicating a medium level of problematic SVA use among our participants. Recommendation algorithm ( $r = 0.52$ ,  $p < 0.01$ ), multimodality ( $r = 0.57$ ,  $p < 0.01$ ), and low-cost interaction ( $r = 0.68$ ,  $p < 0.01$ ) were all significantly and positively correlated with flow. Meanwhile, a positive correlation between flow and problematic SVA use was found ( $r = 0.57$ ,  $p < 0.01$ ). Additionally, recommendation algorithm ( $r = 0.24$ ,  $p < 0.01$ ), multimodality ( $r = 0.36$ ,  $p < 0.01$ ), and low-cost interaction ( $r = 0.43$ ,  $p < 0.01$ ) were positively linked to problematic SVA use. Among the control variables, lack of self-control ( $r = 0.47$ ,  $p < 0.01$ ) and duration of SVA use ( $r = 0.24$ ,  $p < 0.01$ ) were positively associated with problematic SVA use, suggesting that people with lower levels of self-control and a

TABLE 2 Means, standard deviations, and bivariate correlations between examined variables.

Variables	M	SD	1	2	3	4	5	6	7	8	9	10
1. Recommendation algorithm	4.21	0.47	-									
2. Multimodality	3.96	0.75	0.49**	-								
3. Low-cost interaction	4.15	0.46	0.65**	0.54**	-							
4. Flow	3.97	0.54	0.52**	0.57**	0.68**	-						
5. Problematic SVA use	3.09	0.76	0.24**	0.36**	0.43**	0.57**	-					
6. Lack of self-control	2.90	0.92	-0.02	-0.04	0.10*	0.12**	0.47**	-				
7. Gender	1.48	0.50	0.002	0.003	-0.03	-0.05	0.01	0.08*	-			
8. Education level	6.80	0.80	0.04	0.04	0.08	0.08*	0.07	-0.03	0.01	-		
9. Monthly Income	5.32	1.45	0.10*	0.14**	0.10*	0.13**	0.03	-0.14**	-0.14**	0.31**	-	
10. Duration of SVA use	5.35	1.76	0.25**	0.21**	0.25**	0.26**	0.24**	0.12**	-0.002	0.000	0.06	-

Gender 1 = male, 2 = female; \*  $p < 0.05$ ; \*\*  $p < 0.01$ .

TABLE 3 Path analysis results.

Independent variable		$\beta$	95% CI	$p$
<b>Direct effect</b>				
Problematic SVA use	Recommendation algorithm	-0.11	-0.19, -0.03	<0.01
	Multimodality	0.13	0.04, 0.23	<0.01
	Low-cost interaction	0.09	-0.01, 0.19	0.08
	Flow	0.43	0.34, 0.53	<0.01
Flow	Recommendation algorithm	0.07	-0.09, 0.18	0.42
	Multimodality	0.27	0.20, 0.35	<0.001
	Low-cost interaction	0.47	0.36, 0.56	<0.01
<b>Indirect effect</b>				
Problematic SVA use	Recommendation algorithm	0.03	-0.04, 0.09	0.41
	Multimodality	0.11	0.08, 0.16	<0.01
	Low-cost interaction	0.20	0.14, 0.27	<0.01
<b>Total effect</b>				
Problematic SVA use	Recommendation algorithm	-0.08	-0.18, 0.01	0.07
	Multimodality	0.25	0.16, 0.33	<0.001
	Low-cost interaction	0.29	0.20, 0.38	<0.001

$\beta$ , standardized regression coefficient; CI, confidence interval.

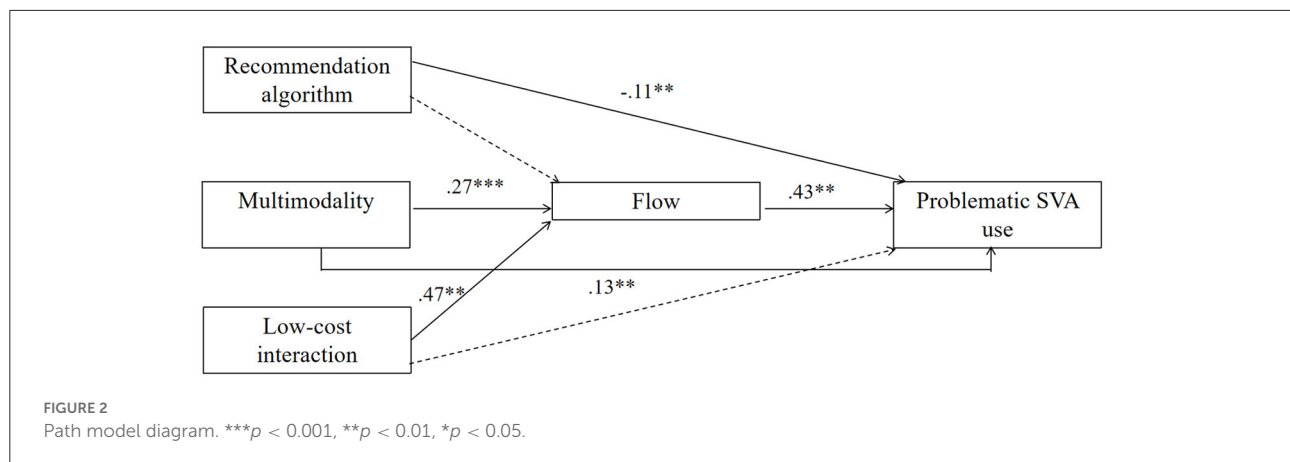
longer duration of SVA usage were more likely to engage in problematic SVA use.

## Path analysis

We tested a model in which recommendation algorithm, multimodality, and low-cost interaction were included as independent variables. Flow was treated as the mediator and problematic SVA use was entered as the dependent variable. Based on the acceptable thresholds of model fit

indices (Hu and Bentler, 1999; Kline, 2005)<sup>1</sup>, our model demonstrated a good fit:  $\chi^2(6) = 7.15$ ,  $p = 0.31$ , CFI = 0.99, TLI = 0.99, GFI = 0.99, RMSEA = 0.02, SRMR = 0.01. Our model explained about half of the variance in problematic SVA use ( $R^2 = 0.51$ ). Table 3 demonstrates the results of path analysis and Figure 2 presents the path model diagram.

<sup>1</sup> Non-significant p-value for Chi-square, CFI > 0.95, TLI > 0.95, GFI > 0.95, RMSEA < 0.06, SRMR < 0.06.



### Direct effects

To answer **RQ1**, recommendation algorithm ( $\beta = -0.11$ ,  $p < 0.01$ ) and multimodality ( $\beta = 0.13$ ,  $p < 0.01$ ) were directly linked to problematic SVA use. However, low-cost interaction was not significantly associated with problematic SVA use ( $\beta = 0.09$ ,  $p = 0.08$ ).

### Indirect effects

Inconsistent with **H1**, the relationship between recommendation algorithm and flow was not significant ( $\beta = 0.07$ ,  $p = 0.42$ ). Supporting **H2**, multimodality was positively correlated with flow ( $\beta = 0.27$ ,  $p < 0.001$ ). Likewise, the association between low-cost interaction and flow was also significant ( $\beta = 0.47$ ,  $p < 0.01$ ), showing support for **H3**. Besides, in line with **H4**, flow was positively associated with problematic SVA use ( $\beta = 0.43$ ,  $p < 0.01$ ).

To test the mediating role of flow, the results showed that the indirect effect of recommendation algorithm on problematic SVA use through flow was not significant ( $\beta = 0.03$ ,  $p = 0.41$ ). Thus, **H5.1** was not supported. In comparison, multimodality was indirectly linked to problematic SVA use via flow ( $\beta = 0.11$ ,  $p < 0.01$ ), showing support for **H5.2**. Additionally, the indirect link between low-cost interaction and problematic SVA use through flow was also significant ( $\beta = 0.20$ ,  $p < 0.01$ ), thereby supporting **H5.3**. To answer **RQ2**, the results demonstrated that the indirect effect of low-cost interaction on problematic SVA use was the strongest, followed by the indirect effect of multimodality, whereas the indirect effect of recommendation algorithm on problematic SVA use was not significant.

## Discussion

Flow plays an important role in developing problematic use of smartphones and online applications (Thatcher et al., 2008; Khang et al., 2013; Mazzoni et al., 2017; Wang et al., 2020; Barberis et al., 2021; Brailovskaia et al., 2021). Although previous

research has identified the motivations of flow or the personality traits that tend to trigger flow (Khang et al., 2013; Mazzoni et al., 2017; Wang et al., 2020; Barberis et al., 2021), few studies have examined the technological antecedents that induce flow. To this end, the current study proposes a techno-psychological approach and uses a mediation model to test the mediating role of flow between affordances of SVAs and problematic SVA use. The results showed that flow positively mediated the association between two affordances—multimodality and low-cost interaction—and problematic SVA use. Nevertheless, due to the non-significant relationship between recommendation algorithm and flow, the mediating role of flow between recommendation algorithm and problematic use of SVAs was not significant. In terms of the direct links, recommendation algorithm was negatively linked to problematic SVA use, multimodality was positively related to problematic SVA use, whereas the direct association between low-cost interaction and problematic SVA use was not significant. Implications for understanding the relationship between each affordance and problematic SVA use are discussed.

## Theoretical implications

First, the non-significant association between recommendation algorithm and flow and the negative association between recommendation algorithm and problematic SVA use might be related to the stage of SVA use. At the early stage, users would be curious and enjoyed about the contents recommended by SVAs that were tailored to their preferences. The curiosity and enjoyment on the one hand facilitated users to experience flow (Agarwal and Karahanna, 2000), while on the other hand stimulated them to watch more videos, which finally led to problematic use. Hence, the hypothesized positive association between recommendation algorithm and flow and that between recommendation algorithm and problematic SVA use apply to explaining the early-stage users. However, at the later stage, users might

get fed up with the homogenous contents recommended by algorithms. The boredom then prevented one from continuously watching videos, thereby lowering the likelihood of developing problematic use. Meanwhile, given that arousal and the desire for challenge are important prerequisites for experiencing flow (Jin, 2012), the boredom resulted from repeated exposure to homogenous contents undermined these prerequisites, thus cutting the link between recommendation algorithm and flow. Notably, on average, our participants had used SVAs for more than 2 years (Mean = 6.10, on a seven-point scale, 1 = “less than a month”, 7 = “more than 3 years”), indicating that the majority of them were at a later stage of usage when this study was conducted. Accordingly, whether recommendation algorithm increases people’s flow and their tendencies of engaging in problematic SVA use may depend on their stage of use.

Second, multimodality was not only indirectly associated with problematic SVA use *via* flow, but was also directly linked to problematic SVA use. The indirect association corroborated the S-O-R framework in the digital environment (Fang et al., 2017, 2021; Tuncer, 2021), in which technological affordances (i.e., multimodality) induced users’ experience (i.e., flow), and thereby influenced the behavior of technology use (i.e., problematic SVA use). Besides, considering that multimodality is a form-related affordance, the direct association between multimodality and problematic SVA use has two implications. On the one hand, form-related affordances could directly affect users’ behavioral patterns of SVA use, such as the problematic use. On the other hand, flow might not be the only mediating mechanism underlying the association between multimodality and problematic SVA use. In addition to flow, certain motivations may mediate the relationship between multimodality and problematic SVA use. For instance, multimodality affords users opportunities to present themselves through video shooting and kill time with the vivid contents. Meanwhile, motivations of passing time and self-presence predict people’s problematic use of online applications (Khang et al., 2013; Wang et al., 2020). These findings suggest potential mediating factors underlying the relationship between multimodality and problematic SVA use.

Third, low-cost interaction did not influence problematic SVA use directly, but exhibited an indirect relationship with problematic SVA use through flow. This finding further supported the appropriateness of the S-O-R framework in explicating problematic SVA use. Low-cost interaction is a behavior-related affordance that highlights the possibility of using SVAs with the least effort (Zhao, 2021). Notably, the perception of the low-cost interaction affordance indicated a cost-benefit evaluation of using SVAs, which suggested that the user was in a state of self-consciousness and was less likely to engage in problematic SVA use. Nevertheless, low-cost interaction largely facilitated users to experience flow, which in turn made users indulged themselves in problematic SVA use. Consequently, affordances related to users’ assessment of usage

behaviors tend not to cause problematic use directly but induce problematic use through triggering users’ positive experiences such as flow.

Fourth, the findings indicate that different types of affordances may play different roles in explaining problematic SVA use. Within the techno-psychological approach, behavior-related affordances such as low-cost interaction serves as the most powerful predictor of problematic SVA use through flow, followed by form-related affordances such as multimodality. In comparison, content-related affordances such as recommendation algorithm may not be a consistent predictor, given its varying impacts on flow and problematic SVA use at different usage stages.

Fifth, although flow is often considered an optimal experience that helps individuals regulate their emotions and improve their wellbeing (Chen et al., 2022b), the role of flow in inducing problematic SVA use suggests its downside, which has been understudied in prior research. This reminds us to revisit flow in relation to mindfulness, a state of paying full attention to the present (Bishop et al., 2004; Regan et al., 2020; Liu et al., 2022a) and keeping a non-judgmental awareness of one’s internal experiences (Baer et al., 2006; Kabat-Zinn, 2015). Overall, there are two approaches to understand flow and mindfulness (Chiou et al., 2022). One approach considers flow a branch of mindfulness because both flow and mindfulness focus on one’s awareness of the present moment. This approach has been supported in studies that examined how mindfulness helped individuals stay focused and maintain awareness of the present in various settings (Chen et al., 2019, 2022a,b; Liu et al., 2022b). In contrast, another approach argues that flow and mindfulness are different from each other: mindfulness emphasizes one’s self-awareness of his or her internal states, whereas an individual’s self-awareness is largely weakened in the state of flow, due to an intense and focused concentration on the present (Reid, 2011). We take the second approach to view flow and mindfulness for two reasons. First, seeing flow as a state of losing reflective self-consciousness helps explain why users who experience flow tend to get addicted to using SVAs. Besides, arousing one’s inner observer as suggested by mindfulness helps prevent users from engaging in flow-induced problematic SVA use (Lan et al., 2018; Regan et al., 2020; Arpacı, 2021; Lakshmi, 2021).

Last but not least, our proposed model not only corroborates the S-O-R framework but also enriches it in the digital environment. Furthermore, compared with prior research that used the S-O-R framework to examine how short-form videos’ technological characteristics might facilitate users to develop SVA addiction (Tian et al., 2022), our study specifies and refines the technological affordances of SVAs and highlights the role of flow between these affordances and problematic SVA use. These findings suggest that the S-O-R framework and the techno-psychological approach are consistent with each other in explicating problematic use of SVAs and other digital applications.

## Practical implications

The findings have several implications for optimizing SVAs' affordances to properly manage problematic SVA use. Although the findings of our study did not support that recommendation algorithm was a technological affordance that caused problematic SVA use, frequent exposure to a narrowing array of contents had few benefits on users' psychological wellbeing. Thus, we first advise SVA platforms to improve the algorithms to recommend more diverse contents to users. For example, algorithms should draw user profiles from multiple dimensions, including users' interest, identity, behaviors, etc. Besides, updating user profiles in real time and randomly dividing users into several small groups both help algorithms push more diversified contents (Zhao, 2021). Meanwhile, alerts that remind users to pause use should be incorporated in the algorithm to prevent users from excessive use.

Second, given that multimodality had a direct and indirect link with problematic SVA use, SVA platforms could keep the commonly used modalities while lower the speed of updating various special effects. This measure has two advantages. On the one hand, keeping the essential modalities may prevent users from spending too much time on watching or creating short-form videos, thereby weakening their flow experience and lowering the tendency of engaging in problematic use. On the other hand, despite a decrease in the updates in special effects, the essential modalities provide users with the pleasure of using SVAs.

Third, the indirect association between low-cost interaction and problematic SVA use *via* flow suggests that SVA platforms should set some interruptive notifications. For instance, a notification reminding users to select certain pictures or characters could be set. Additionally, short quizzes could be another form of notification. These interruptive notifications would pop up if users continuously spent much time on SVAs (e.g., half an hour or longer). Through interruptions, notifications significantly increase the cost of interacting with SVAs and make temporal dissociation—an important element of flow—impossible, thus lowering the likelihood of performing problematic use.

On the part of users, we offer several suggestions to prevent them from developing problematic use behaviors. First of all, although flow is a psychological state that tends to induce problematic SVA use, mindfulness has the potential to intervene with the problematic use (Lan et al., 2018; Regan et al., 2020; Arpaci, 2021; Lakshmi, 2021). Thus, programs that cultivate users' mindfulness are recommended. Besides, users are advised to improve their digital literacy, namely, raising their awareness of the affordances of SVAs and improving their ability to properly use SVAs to fulfill desirable purposes. Lastly, given that duration of use is a predictor of problematic SVA use, users should develop a good habit of smartphone use, such as setting a time limit for using SVAs and other mobile applications.

## Limitations and future research

This study has several limitations. First of all, our survey data was cross-sectional. Therefore, the results demonstrated associations between the examined variables instead of causal relationships. To test the causal relationships depicted in the proposed model, future research is advised to use longitudinal surveys. For instance, researchers could measure participants' perceptions about recommendation algorithm, multimodality, and low-cost interaction in the first-wave survey. In the second-wave survey, flow and problematic SVA use could be measured.

Second, considering the nature of problematic SVA use, social desirability bias could exist in the measurement of this variable. Participants might answer the questions in a manner that will be viewed favorably by others (Krumpal, 2013). To overcome this bias, future research is advised to use objective data to measure problematic SVA use.

Third, we measured three technological affordances of SVAs, but we did not measure participants' psychological traits. Future research could take psychological traits into account and compare the relative impacts of affordances and psychological traits on flow. This links the techno-psychological approach to the more conventional psychopathological approach and may stimulate a conversation between the two.

Fourth, although stages of use might be a possible explanation for the negative association between recommendation algorithm and problematic SVA use, it is an inference with limited empirical evidence. Thus, researchers may interview managers of SVA platforms or invite technicians specialized in algorithms to participate in a focus-group discussion. Through these qualitative methods, the negative association between recommendation algorithm and problematic SVA use can be empirically explained.

Lastly, given that flow and mindfulness are closely related yet different to each other, future research could include mindfulness as a moderator in the mediating model proposed in the current study. Through survey or intervention studies, researchers may test whether mindfulness moderates the paths from technological affordances and flow and the path from flow and problematic SVA use. Findings from such a moderated mediation model could provide useful insights to develop intervention programs of problematic SVA use.

## Conclusion

This study proposes a mediation model to explore how three technological affordances of SVAs induce problematic SVA use through flow. Recommendation algorithm directly and negatively predicts problematic SVA use. Multimodality is directly and positively linked to problematic SVA use, while has an indirect link with the outcome variable *via* flow. Low-cost interaction is found to be indirectly related to problematic



SVA use through flow. The results demonstrate the difference in the associations between each affordance and problematic SVA use. Moreover, our findings suggest a techno-psychological approach to examining problematic use of SVAs and other smartphone applications.

The psychopathological approach assumes that individuals with predisposed psychopathologies are highly vulnerable to problematic use behaviors (Davis, 2001; Elhai and Contractor, 2018; Elhai et al., 2020). To challenge such an assumption, the compensatory use approach proposes that problematic use represents an unintended consequence resulted from people's active use of digital tools to compensate for the undesirable life situations (Kardefelt-Winther, 2014; Elhai et al., 2017; Wegmann and Brand, 2019). Following this line of research, the techno-psychological approach extends the compensatory use approach through introducing technological affordances as antecedents of users' psychological experiences and subsequent behaviors. Against the backdrop of the digital age, the techno-psychological approach offers us insights into understanding how digital technologies afford the development of problematic use behaviors, and provides us with some implications for optimizing digital applications to effectively manage the problematic use of various applications.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

The studies involving human participants were reviewed and approved by the Institutional Review Board of the Faculty of Social Sciences, Zhejiang University. The patients/participants

provided their written informed consent to participate in this study.

## Author contributions

QH acquired the funding, designed the study, analyzed the data, and wrote the main body of the manuscript. MH participated in the study design, cleaned the data, wrote the Method and Result sections, and made the tables and figures. NZ acquired the funding, participated in the study design, and reviewed and revised the manuscript. All authors contributed to the article and approved the submitted version.

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## Conflict of interest

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

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# The effect of trait mindfulness on social media rumination: Upward social comparison as a moderated mediator

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Social media rumination means that social media users are inclined to worry about their posts, relevant situational elements, and ramifications of the posts on a regular basis, and it is one of the main reasons why people's use of social media is linked to unfavorable mental health and interpersonal results. Rumination is antagonistic to mindfulness, which entails paying attention on purpose and without judgment, and mindfulness appears to be useful in reducing rumination. However, in the context of social media, the nature of the relationship between rumination and mindfulness has gained less attention. The current research study indicates that trait mindfulness, upward social comparison (USC), and self-esteem are implicated in social media rumination (SMR). However, no research study has synthesized the findings into one model. Therefore, the current research study aims to explore the relationship between trait mindfulness and SMR, the mediating effect of USC, and the moderating effect of self-esteem. The model was tested using AMOS and the PROCESS macro in SPSS with bootstrapping. According to the findings, SC appears to have a moderated mediator effect on the relationship between trait mindfulness and SMR. Specifically, individuals with high mindfulness trait do not necessarily have less USC. Self-esteem moderated the above mediation. The beneficial effect of trait mindfulness on social media rumination is explained in depth in this study.

## KEYWORDS

mindfulness, social media rumination, upward social comparison, self-esteem, social media

## Introduction

Mobile applications and websites known as “social media” used by individuals to create and share ideas or feelings influence the lifestyle and behavior of each individual to some degree. Recent studies have linked the use of social media with increase in depressive symptoms and suicide rates, calling for a better perception of the elemental process of the effect of social media (Twenge et al., 2019). As rumination is a significant factor in maintaining and even exacerbating psychological distress (Nolen-Hoeksema and Morrow, 1993), social media rumination, which is the tendency to obsessively worry and brood over social media posts, may also be an important indicator of psychological health, but most previous research studies on this topic have relied on broad rumination



measures (Parris et al., 2020). The specificity of social media rumination may help us better explain the negative effect related to social media and provide feasible suggestions to deal with them. Protective factors reducing the risk of rumination in social media context are scarcely studied.

Research on mindfulness is a relatively new topic in psychology, also leading to increase in analyzing mindfulness training in the West from the 1970's (Keng et al., 2011). Mindfulness is also considered a positive personality trait. Dispositional mindfulness, as a personality trait, has been proved to be related to generation of human emotions (Kong, 2015). Growing evidence suggests that rumination can be significantly restrained by dispositional mindfulness, which refers to the awareness of and sustained attentiveness to one's present moment without any judgment (Raes and Williams, 2010; Heeren and Philippot, 2011). It should be emphasized that this study focuses on mindfulness as a personality trait rather than mindfulness training. Consequently, we infer that there would be a similar relationship between trait mindfulness and social media rumination. However, few studies have empirically investigated the mechanism of the influence of mindfulness on rumination in social media context. In addition, with the aim of better understanding the relationship between mindfulness and social media rumination, this study introduces the upward social comparison, which has been found to be associated with negative psycho-emotional wellbeing (Jang et al., 2016), rumination (Yang et al., 2021), and mindfulness (Langer et al., 2010), as the mediation variable. As the effect of mindfulness on social comparison is moderated by other variables (Langer et al., 2010), such as self-esteem, an attitude that each individual has toward himself (Coopersmith, 1967) and is regarded as an important moderation variable (Apaolaza et al., 2019). Previous research has shown that mindfulness is more effective in reducing harmful reactions to events in individuals with different levels of self-esteem, with mindfulness tending to be more effective in individuals with low self-esteem (Ford, 2017). Therefore, we incorporated self-esteem into our conceptual model.

Previous research studies have suggested that mindfulness is related to social media rumination, whereas if and how upward social comparison and self-esteem play a role demands further research and discussion. The present study would make contribution in theory in two ways. First, as some outcome factors are rarely explored in social media context, this study focuses on them, among which and in particular, social media rumination is selected as the main outcome variable. As the use of social media could easily lead to a mental problem for individuals, this research is aimed at exploring whether trait mindfulness could be an approach to reduce this negative effect. Second, this study contributes to the extant research by investigating how trait mindfulness influences upward comparison and rumination in the social media context. The findings of present research study can help us have a better understanding of how trait mindfulness can help individuals to

avoid or reduce social media rumination through the process of upward social comparison's mediating effect and moderation of self-esteem, consequently leading to a better online experience.

## Theoretical framework

### Mindfulness

The concept of mindfulness arises from the meditation training in Buddhism and refers to the intensity of attention (Jacobs and Blustein, 2008). It can be viewed as a stable psychological state and requires people to consciously focus on a fixed object and be attentive to the present. Jon Kabat Zinn applied it to clinical therapy and psychotherapy. Due to its remarkable treatment effect and universal applicability, the application of mindfulness intervention has developed rapidly and attracted more and more attention. In addition to "awareness," "attention," and "remembering," researchers add "nonjudgment" and "acceptance" to the concept of mindfulness (Kabat-Zinn, 2003). In short, it could be referred to as awareness of the situation combined with the attitude of no judging of any thoughts or feelings (Keng et al., 2011). In research, mindfulness is generally divided into state mindfulness and trait mindfulness (Randal et al., 2015). Trait mindfulness refers to one's ability to focus on what is happening at the present moment, and it can be seen as a stable state of mind that requires one to consciously focus on a fixed object and pay attention to the present moment. In brief, it can be referred to as awareness of the situation and a non-judgmental attitude toward any thought or feeling (Keng et al., 2011). To explore sustained rather than transient behavioral effects, the present study focused on trait mindfulness.

Over the past few years, the benefits of mindfulness have received more attention in research. It has been found that mindfulness can bring benefits to individuals such as: maintaining mental health (Brown and Ryan, 2003), increasing subjective well-being (Liu et al., 2020a), enhancing intensity of attention and mental lucidity (Hanley and Garland, 2017), increasing productivity (Liu et al., 2020b), reducing stress (Huberty et al., 2019) and depression (Jones et al., 2022), improving patient safety competence levels (Liu et al., 2022a), and becoming a viable treatment option for anxiety disorders (Boettcher et al., 2014). Aside from these advantages, mindfulness began to play a greater role with high social value as scholars began to explore its application in other fields, and it has become a subject of interdisciplinary research (e.g., sociology, family studies, education, anthropology, philosophy, economics, and organizational science). However, the application of mindfulness in the field of communication is scarce. Social media is a popular topic in communication research, and it suggests new approaches to communicate across temporal and spatial boundaries (Whelan et al., 2020). Due to accessibility,



recreation, and information approach, social media has prevailed all around the world (Chai and Kim, 2012). Nevertheless, social media is a double-edged sword, as studies have suggested that disproportionable and obsessive use of social media could result in users' psychological problems, such as fatigue (Ravindran et al., 2014), social anxiety (Yen et al., 2012), and depression (Twenge et al., 2019). As mindfulness may be a significant factor that could lead to diminishing of negative psychological emotions (Liu et al., 2020b), it is significant and necessary to explore its application in social media context.

## Effect of mindfulness on social media rumination

Rumination is the opposite of mindfulness (Heeren and Philippot, 2011). Rumination refers to the tendency to think repetitively about causes, situational factors, and consequences related to a stressful or distressing event (Nolen-Hoeksema and Morrow, 1993). Rumination has been recognized as a way of thinking negatively and is often related to low spirits, poor wellbeing, despair, and inefficiency (Broderick, 2005; Strizhakova et al., 2012; Javed et al., 2019). Despite the fact that researchers have connected rumination with depression, stress, and other psychological problems, researchers have rarely studied rumination in the context of social media, which is important due to the fact that use of social media is connected with mental distress as well as rumination about social media content in the same trend (Parris et al., 2020). Social media rumination refers to the situation under which one tends to think repetitively about his social media posts, other relevant situational factors, and consequences (Parris et al., 2020). Social media rumination has been linked to behavioral problems and negative psychological emotions in studies. As an example, a study found that social media rumination is strongly related to problematic smartphone use (Elhai et al., 2018), and that it may also aggravate symptoms of depression (Espelage et al., 2018). Therefore, it is important to explore factors that reduce social media rumination for social media users' mental health.

The drawback of rumination is clear, but research studies focusing on the leading ameliorating factor of social media rumination are still scant. As more and more people become engrossed in digital spaces, it is necessary to explore the factors affecting social media rumination to improve the situation. Social media users may feel social pressure when displaying themselves, leading to cautiously curating their posts; concerning about these, online self-presentation may draw out social media rumination (Feinstein et al., 2014; Yang et al., 2018). On the contrary, this study suggests that people who pay less attention to others and rarely rethink about their social media posts are less likely to elicit social media rumination. As a type of an individual's characteristic, mindfulness allows people to

concentrate their cognitive attention to the present moment (Keng et al., 2011), thus making them less likely to rethink what they have posted online in the past and more likely to de-emphasize negative thoughts (Frewen et al., 2008). Mindfulness may help reduce rumination by balancing a wandering mind, where "wandering" can be repetitive thinking (Tingaz and Cakmak, 2021). The mitigating effect of mindfulness on rumination has been confirmed by numerous studies, and the current study suspects that a similar mechanism will also exist in the context of social media (Selby et al., 2016). Therefore, this article proposed the following hypothesis.

H1: mindfulness is negatively related to social media rumination.

## Upward social comparison as a mediator

Social comparison theory suggests that people have a tendency to compare their beliefs and talents to those of others. According to the tendency to choose what kind of people to compare, social comparisons are classified into three types: downward comparisons (comparing with people inferior to themselves), parallel comparisons (comparing with people similar to themselves), and upward comparisons (comparing with people superior to themselves) (Festinger, 1954). Considering that looking at others' profiles on social media platforms has already been a normal activity, social network sites seem to be a platform through which individuals could make social comparison (Pempek et al., 2009). A previous research study has found that users of social media platforms like Facebook, Twitter, and Instagram are more likely to believe that other users have higher social status than they do, leading to upward social comparisons (Latif et al., 2021). Upward social comparison on social media could also result in depression and social anxiety (Shaw et al., 2015), which are thought to be related to rumination (Strizhakova et al., 2012). Therefore, it is very important for social media users to make the negative effects brought about by upward social comparison diminish to keep their mental health in a good state.

The current study hypothesizes that upward social comparison is an important factor in causing ruminative thoughts on social media platforms, and that mindfulness mitigates rumination by reducing upward social comparison. In social media, upward social comparison has been shown to lead to some negative emotions, as users looking at others' photos and posts may enhance their self-perception of deficiencies that may lead to a negative feeling about themselves (Kim and Park, 2016). There is also evidence proving that upward social comparison is related to rumination. Considering the motivation for self-image management, users tend to present an idealized personal image on social media platforms in a positive way, which also means that they tend to spend a lot of

time rethinking and decorating their social media posts (Jordan et al., 2011; Lee-Won et al., 2014). Rumination is a form of self-attention characterized by neurotic brooding and fixation on one's negative experiences (Nolen-Hoeksema et al., 2008). It is driven by perceived threats, losses, and injustices to the self, and social comparisons on social media can trigger these perceptions, which can easily lead to ruminative thoughts (Yang, 2022). Specifically, increased social media use could expose users to frequent upward social comparison, which leads to higher level of rumination (Vogel et al., 2014). Therefore, reducing upward social comparisons may be an effective path to reduce rumination. A previous study has shown that mindfulness is effective in reducing social comparison and its negative effects (Langer et al., 2010). Specifically, mindfulness suggests an approach to adopt a mindset of taking without judgments and to consider situations only with contemporary information. An experiment showed that mindfulness can help individuals better accept themselves without caring what others evaluate them to be, which leads to less upward comparison and the distress it brings (Wolsko, 2012). Previous research studies have discussed the relationship between upward social comparison and rumination, mindfulness and upward social comparison, and mindfulness and rumination; however, few studies have examined all three variables in one model (treating upward social comparison as a pathway for the influence of mindfulness on rumination). Based on the previous logic, mindfulness alleviates social media upward social comparison, and upward social comparison causes rumination, this article proposed the following hypothesis.

H2: upward social comparison mediates the relationship between mindfulness and social media rumination.

## Self-esteem as a moderator

Although mindfulness would negatively affect upward social comparison and rumination, the effects may be different for all individuals. A number of factors, particularly personal traits, may moderate the association between mindfulness and its results (Ford, 2017). Therefore, the effect of mindfulness on rumination may also be moderated by personal traits, and it is important to further identify these personal traits. Existing studies have explored the relationship between mindfulness and self-esteem. Many of them have confirmed a positive correlation between mindfulness and self-esteem (Gregoire et al., 2021; Rehman et al., 2021). However, few studies have considered self-esteem as a moderator between mindfulness and its influencing variables. Some researchers have noted this and have considered the moderating role of self-esteem while exploring the effects of mindfulness. A study on the impact of mindfulness on harmful responses to rejection noted that mindfulness only significantly helped individuals with low self-esteem and that those with

high self-esteem did not benefit from mindfulness meditation (Ford, 2017). We therefore wondered whether self-esteem plays a similar role in the influence of mindfulness on upward social comparisons. Specifically, an individual's self-esteem level may moderate the effect of trait mindfulness on the individuals' negative psychology.

Self-esteem reflects a person's overall evaluation of her/his self-worth (Rosenberg et al., 1989); it is defined as the degree to which individuals evaluate themselves positively or negatively. Self-esteem is thought to be a fairly stable personality trait that differs between individuals (Waterman, 1992). It has been linked to a variety of behaviors in studies. Negative emotions and depression are less common in people who have a high self-esteem level than in people with a low level of self-esteem (Bandura, 1977). Self-esteem, as an important part of the self concept, is both an individual's temporary attitude and evaluation of self and a relatively stable personality trait that is gradually formed in the process of social interaction. It has an important impact on psychosocial adaptation for individuals (Leary, 2003). The sociometric theory of self-esteem suggests that self-esteem moderates individuals' perceptions and evaluation processes of others and external things (Leary, 2005). Social media is a convenient and efficient platform for social interaction and helps individuals with low self-esteem to cross interaction barriers, interact with others, and establish or maintain good interpersonal relationships (Lee et al., 2012). As a result, individuals with low self-esteem often treat social media as a substitute for offline social interaction, leading to more psychological problems and problematic online behaviors (Kuss and Griffiths, 2011). Nowadays, self-esteem has been catching the attention of social media researchers as it is deeply entangled with the social comparison process, playing the role as one of the key psychological phenomena related to social media use (Bayer et al., 2020).

Although the association between self-esteem and upward social comparison is well understood in social media contexts, we know little to determine factors that might be more effective in helping individuals with low self-esteem reduce upward social comparison. Preliminary evidence suggests that mindfulness can reduce an individual's upward social comparison (Langer et al., 2010). Trait mindfulness aims to focus attention and processing on the present moment in an accepting and nonjudgmental way. Individuals with a high level of mindfulness are better able to relate private events at the present moment in a positive light, manage complex emotions more effectively, and facilitate greater wellbeing in their daily lives (Apaolaza et al., 2019). As a result of not judging and avoiding criticism, mindfulness assists people in accepting themselves and improving their perceptions of who they are and their worth, which is very beneficial for individuals with low self-esteem (Pepping et al., 2013). With regard to individuals with low self-esteem, mindfulness may allow them to be less focused on social upward comparisons on social media. Conversely, individuals with high self-esteem

are inherently less interested in upward social comparisons and therefore may benefit less from mindfulness (Ford, 2017). While much of the previous research has focused on direct effects of self-esteem, the current study aims to explore the moderating effects of self-esteem. The sociometer theory states that self-esteem is an indicator for individuals to evaluate their social relationship status, and that the higher the level of self-esteem, the better the individual's social relationship performance is likely to be. Social beliefs, social motivations, and social styles differ greatly among individuals with different levels of self-esteem (Anthony et al., 2007). It has been revealed that there are differences in attentional bias among individuals with different levels of self-esteem. Individuals with high self-esteem levels are more inclined to external attributions, and they tend to adopt positive defensive strategies to maintain high self-esteem; so when faced with upward social comparisons, they direct their attention to their own strengths and show positive coping styles, such as self-confidence and optimism. In contrast, individuals with low self-esteem prefer internal attributions, attribute their unfavorable social status to their own problems, and show negative emotions (Brown and Dutton, 1995). Many studies have confirmed the moderating effect of positive thinking on the outcome of other psychological trait influences (Wang et al., 2021). Based on this logic, we focus on differences in the performance of trait mindfulness across different self-esteem groups, although there may be a significant correlation between self-esteem and trait mindfulness. Since the effects of self-esteem and trait mindfulness are similar, we consider trait mindfulness to be more effective for individuals with low self-esteem. Specifically, the present study suggests that self-esteem plays a moderating role in the effect of trait mindfulness on upward social comparison. Despite previous studies on the relationship among mindfulness, self-esteem, and upward social comparison, few studies have attempted to test the interaction effect of self-esteem and mindfulness on upward social comparison. Self-esteem has been used as a moderator in several studies (Kraemer et al., 2001). Based on the above logic, we hypothesized that the level of self-esteem could moderate the effect of mindfulness on upward social comparison. Specifically, individuals who possess high self-esteem show less interest in upward social comparison. Therefore, these individuals may have less need for mindfulness to help reduce upward comparison on social media. Conversely, for social media users with low self-esteem, the mindfulness trait can effectively inhibit their willingness to make upward comparisons on social media. Based on the relationship among the three, this study proposed the following hypothesis:

H3: self-esteem moderates the relationship between mindfulness and upward social comparison.

The moderating effect of self-esteem may also appear simultaneously in the influence of upward social comparison on rumination. The behavioral plasticity theory suggests that

individuals with low self-esteem are more susceptible to stress and therefore more reactive to stress because of upward social comparison sensitivity (Brockner, 1988). If upward social comparison is considered a stressor, high self-esteem is a protective factor that can help buffer the negative effects of stressor and thus reduce the risk of negative thinking (Hui et al., 2022). Moreover, self-esteem serves as a buffering factor that convinces individuals that differences in input standards are remediable (Wu and Pooler, 2014). Therefore, individuals with high-esteem are less likely to be threatened by upward social comparison and are less likely to suffer from rumination. Based on the above logic, this article proposes the following research hypothesis:

H4: self-esteem moderates the relationship between upward social comparison and social media rumination.

## Conceptual model

Based on the information above, our research developed a moderated mediation model (refer to Figure 1). The purpose of the model is to show how (the mediator role of upward social comparison) and when (the moderator role of self-esteem) a high level of mindfulness leads to a lower level of social media rumination.

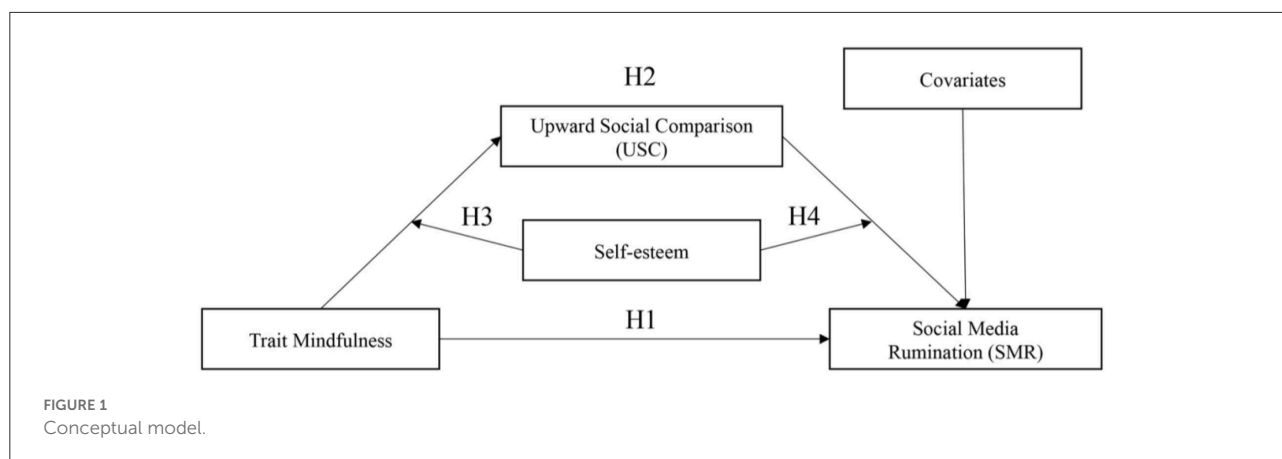
## Materials and methods

### Study design

In order to ensure that our samples have an experience in using social media, we recruit participants through social media platforms. At the same time, we had to confirm that the participants are over 18 years old. Our study was a cross-sectional one to test the relationship between their mindfulness traits, self-esteem, upward social comparison, and social media rumination.

### Participants and procedures

"Questionnaire Star" ([www.wjx.cn](http://www.wjx.cn)), a professional survey distribution platform, is chosen to be the approach for this study to collect questionnaires. We limited the IP address of the answering device so that every participant could not fill in the questionnaire twice. Meanwhile, our criteria for selecting the samples are participants over 18 years old who have an experience in using social media (if a respondent answers no in the two questions, the survey will be ended). In addition, we also set up identification questions, and questionnaires that



failed to pass the identification questions were invalidated. With the aim of ensuring that the questions were clearly worded, the questionnaire was pretested in a small group of participants. The participants were informed of their right to withdraw, confidentiality, and anonymity prior to taking the survey. Computers, tablets, and mobile phones were all used to complete the cross-sectional survey. After consent was given, the participants began to answer our formal questionnaires. We collected a total of 380 questionnaires; after screening out invalid questionnaires (failed to answer the screening questions correctly and the answer time was <100 s), the final sample consisted of 317 current social media users.

A total of 380 questionnaires were collected. With an 83.4 % qualification rate, 63 questionnaires with unqualified answers, less time spent, and inconsistencies were eliminated. Men account for 48.6% of the sample, while women account for 51.4%. The sample's age ranged from 27 to 40 years old, with 65% falling into this category. In terms of education, the sample is concentrated on bachelor's degree holders, with a proportionate of 58.7%. In terms of daily social media usage, 96.2 % of the sample uses it for more than an hour. In Table 1, the basic demographic variables are tabulated.

## Measurements

The instrument of this study included measures of mindfulness, upward social comparison, social media rumination, and self-esteem. The questionnaire of this study is developed following the pre-validated scales. Sub-items within each scale were averaged, resulting in composite scales. In consideration of the overall data analysis, the questionnaire adopts the Likert 7-point for all the scales. We also noticed that some of the original scales used even numbers; this may cause participants with neutral attitudes to choose options that are not appropriate for them, while odd numbered scales can solve this problem.

TABLE 1 Statistical table of basic information on effective samples.

Statistical items	Specific content	Statistical value	Percentage
Gender	Male	154	48.6%
	Female	163	51.4%
Age	18–26	88	27.8%
	27–40	206	65.0%
	41–55	15	4.7%
	Over 55	8	2.5%
Educational background	High School	14	4.4%
	Undergraduate	186	58.7%
	Master and Doctor	117	36.9%
Social media usage duration	<1 h/ day	12	3.8%
	1–3 h/ day	116	36.6%
	3~5 h/ day	107	33.8%
	5 h/ day	82	25.9%

## Trait mindfulness

The Trait Mindfulness Questionnaire is a 5-item self-reported scale, and items are adapted from the “act with awareness” dimension of the Five-Facet Mindfulness Questionnaire (Baer et al., 2006) (e.g., “I tend to be absent-minded and easily distracted when I do things”). It should be noted that, Turel adapted five items stemming from the act with awareness dimension of the Five-Facet Mindfulness Questionnaire to the context of social media use (Turel and Osatuyi, 2017). The validity of the five-item scale has also been verified in a previous study (Apaolaza et al., 2019). The participants were given a 7-point scale ranging from 1 (not at all true of me) to 7 (extremely true of me), with higher scores indicating higher levels of mindfulness. Cronbach's  $\alpha$  was 0.838 in our study.

## Upward social comparison

The Upward Social Media Comparison Questionnaire for this study is based on Gibbons et al.'s upward social comparison scale adapted in a social media context (Gibbons and Buunk, 1999). It is a 6-item questionnaire that assesses the level of upward social comparison among social media users (i.e., "I like to compare with those who live better than me on social media platforms"). A Likert scale of 1 (not at all true of me) to 7 (extremely true of me) was used to grade all the responses, with higher scores indicating more upward social comparisons. Cronbach's  $\alpha$  was 0.928 in this study.

## Social media rumination

The Social Media Rumination Questionnaire was used to assess social media rumination, and the original scale included 12 items (Parris et al., 2020). We first excluded items for symptom rumination because of its high overlap with depressive symptoms (Treyner et al., 2003). In our pre-test, we merged the items that the participants perceived to be similar, because many of the participants commented that our overall questionnaire was too long, and that this made them feel fatigued. Therefore, we finally selected five items with a factor loading index higher than 0.6. It is a five-item self-reported survey (i.e., "do I worry about how people will react to my social media posts"). The responses were graded on a seven-point scale ranging from 1 (not at all true of me) to 7 (extremely true of me), with higher scores indicating more social media ruminations. Cronbach's  $\alpha$  was 0.867 in our study.

## Self-esteem

Our self-esteem scale is derived from the six-item version of the Rosenberg Self-Esteem Scale (Rosenberg et al., 1989; Apaolaza et al., 2019). After translating the scale into Chinese, we merged some similar expressions and eventually retained three of them (including three perspectives: state, cognition, and attitude), and all the factor loading indexes are higher than 0.6. In addition, it is a self-reported survey (e.g., "I have a positive attitude toward myself"). The responses were graded on a seven-point scale ranging from 1 (strongly disagree) to 7 (strongly agree), with higher scores indicating higher levels of self-esteem. Cronbach's  $\alpha$  was 0.916 in this study.

## Data analysis

The validity and reliability of our questionnaire were tested using AMOS 26.0. The PROCESS macro of SPSS was used to evaluate the moderated mediation model with bootstrapping (95 % CI, 5,000 samples). Gender (0 = female, 1 = male), highest degree attained, age, and daily social media usage length are among the covariates examined in this model.

## Results

Before the data analysis, we checked for missing values and found none in the dataset.

## Measurement of the model

Table 2 shows that the Cronbach's  $\alpha$  and composite reliability of the scales are higher than the acceptable value ( $>0.8$ ). This means that the reliability is satisfactory. The CR values of all the variables ranged from 0.841 to 0.929 and were higher than the standard value ( $>0.7$ ), indicating that the reliability of the combination of variables met the requirements (Hair et al., 2019). To assess for convergent validity, the AVE of the variables is calculated, with all the values above the allowed value ( $>0.5$ ), showing positive convergent validity (Hair, 2010). Discriminant validity was tested by comparing the square root of AVE with the correlations of the researched variables. The square root of the AVE was greater than the correlations, indicating good discriminant validity (Fornell and Larcker, 1981).

The goodness of fit metrics was then evaluated. The confirmatory factor analysis (CFA) of our questionnaire produced satisfactory fit values for the one-dimensional factor structure after including the error covariances in the model ( $\chi^2/df = 2.528 < 3$ , RMSEA = 0.07 < 0.15, SRMR = 0.058 < 0.05, GFI = 0.915 > 0.9, CFI = 0.945 > 0.9, NFI = 0.912 > 0.9, and IFI = 0.945 > 0.9).

## Statistics

Table 3 shows the descriptive statistics and correlation analysis results. Mindfulness was negatively associated with upward social comparison (USC) and social media rumination (SMR). Upward social comparison (USC) was positively correlated with social media rumination (SMR).

## Relationship between mindfulness and social media rumination

We conducted a polynomial regression analysis using the PROCESS macro of SPSS, and the results are shown in Table 4. After controlling for highest degree obtained, gender, age, and daily social media usage duration, mindfulness significantly negatively affected the levels of upward social comparison ( $\beta = -1.287$ ,  $SE = 0.375$ ,  $t = -3.435$ ,  $p = 0$ ). Upward social comparison positively predicted social media rumination ( $\beta = 0.374$ ,  $SE = 0.168$ ,  $t = 2.23$ ,  $p = 0.026$ ) significantly. Although mindfulness and social media rumination were significantly negatively correlated in our survey ( $\beta = -1.292$ ,  $p = 0.006$ ), mindfulness had no significant direct effect on social



TABLE 2 Results of validity and reliability.

	1	2	3	4	AVE	CR	Cronbach's $\alpha$
1.USC	<b>0.851</b>				0.724	0.929	0.928
2.SMR	0.494	<b>0.771</b>			0.594	0.875	0.867
3.Self-esteem	−0.050	0.082	<b>0.885</b>		0.784	0.916	0.916
4.Mindfulness	−0.256	−0.153	0.062	<b>0.720</b>	0.518	0.841	0.838

The bold numbers on the diagonal represent the square root of AVE, AVE = Average Variance Extracted, CR = Construct Reliability.

TABLE 3 M, SD, and correlations among the variables.

Research variables	M	SD	1	2	3	4	5	6	7
1. Gender (male = 1 female = 2)									
2. Age			−0.096						
3. Highest Degree			0.091	−0.013					
4. Social Media Usage Duration			0.152**	−0.162**	0.112*				
5. Mindfulness	5.601	0.758	−0.086	0.230**	−0.126*	−0.034			
6. Self-esteem	4.849	1.361	0.113*	0.074	0.221**	0.019	0.062		
7. USC	3.121	1.542	0.067	−0.302**	0.041	0.181**	−0.256**	−0.050	
8. SMR	3.611	1.509	0.047	−0.286**	0.198**	0.282**	−0.153**	0.082	0.494**

\* $p < 0.05$ ; \*\* $p < 0.01$ .

media rumination ( $\beta = -0.011$ ,  $SE = 0.1$ ,  $t = -0.107$ ,  $p = 0.915$ ) in this model, H1 partly held. However, this will not affect the following analysis of moderated mediation, because whether mindfulness has an effect on social media rumination is not a prerequisite for moderated mediation. The SPSS PROCESS Model 4 Bootstrap test revealed that upward social comparison had a completely mediating effect of mindfulness on social media rumination [95% boot CI = (−0.139, −0.03)]. H2 held.

The Bootstrap test was performed using Model 58 in the SPSS PROCESS macro to assess the self-esteem moderation effect. Before creating the interaction term, mindfulness, upward social comparison, and self-esteem were concentrated. The analysis indicated that self-esteem significantly moderated the effect of mindfulness on upward social comparison ( $p = 0.013$ ), implying that the moderated mediation model was established and that H3 was supported. Furthermore, the mediating impact was significant at low (−1 SD; 95 percent boot CI = (−0.415, −0.096)) and medium levels (95 percent boot CI = (−0.264, −0.049)) of self-esteem but not significant at high levels (+1 SD; 95 percent boot CI = (−0.209, 0.11)) of self-esteem. However, self-esteem cannot significantly moderate the effect of upward social comparison on social media rumination ( $p = 0.816$ ). Therefore, H4 is not valid.

Meanwhile, the mindfulness  $\times$  self-esteem interaction significantly predicted upward social comparison ( $\beta = 0.142$ ,  $SE = 0.076$ ,  $t = 2.503$ ,  $p = 0.013 < 0.05$ ; refer to Figure 2). Mindfulness had no significant effect on upward social comparison when the level of self-esteem was high ( $\beta =$

−0.104,  $SE = 0.161$ ,  $t = -0.644$ ,  $p = 0.52$ ) and was significant when self-esteem is at medium ( $\beta = -0.364$ ,  $SE = 0.111$ ,  $t = -3.285$ ,  $p = 0.001$ ) and low ( $\beta = -0.624$ ,  $SE = 0.143$ ,  $t = -4.374$ ,  $p = 0$ ) levels.

## Discussion

The aim of the present study was to explore the relationship among mindfulness, social media rumination, upward social comparison and self-esteem. It is exhibited that upward social comparison plays a mediating role, whereas self-esteem plays a moderating role (as shown in Figure 3). This help to clarify the process of how and under which situation the mindfulness of social media users affect their social media ruminations so as to provide a mechanism for dealing with individuals' psychological problems caused by social media.

## Mediation of upward social comparison

This study found that mindfulness has a significantly negative effect on upward social comparison, indicating that the higher level of mindfulness an individual possesses, the less likely he would perform upward comparison on social media, which is consistent with previous research results (Park et al., 2021). Meanwhile, upward social comparison can significantly

TABLE 4 Moderated mediation model's multiple regression results.

Independent variable	$\beta$	SE	t	p	R <sup>2</sup>	F
Dependent variable: Social media rumination (SMR)						
Gender	−0.019	0.143	−0.131	0.896	0.576	19.152***
Age	−0.330	0.121	−2.723	0.007**		
Highest degree	0.409	0.129	3.178	0.002**		
Social media usage duration	0.308	0.084	3.691	0.003**		
Mindfulness	−0.011	0.100	0.107	0.915		
USC	0.374	0.168	2.230	0.026*		
USC × Self-esteem	0.008	0.033	0.233	0.816		
Dependent variable: Upward social comparison (USC)						
Gender	−0.013	0.163	−0.079	0.937	0.406	8.693***
Age	−0.608	0.134	−4.526	0.000***		
Highest degree	0.046	0.147	0.313	0.754		
Social media usage duration	0.265	0.094	2.812	0.005**		
Mindfulness	−1.287	0.375	−3.435	0.000***		
Self-esteem	−1.155	0.457	−2.530	0.012*		
Mindfulness × Self-esteem	0.191	0.077	2.489	0.013*		

\*\*\*  $p < 0.001$ , \*\*  $p < 0.01$ , and \*  $p < 0.05$ .

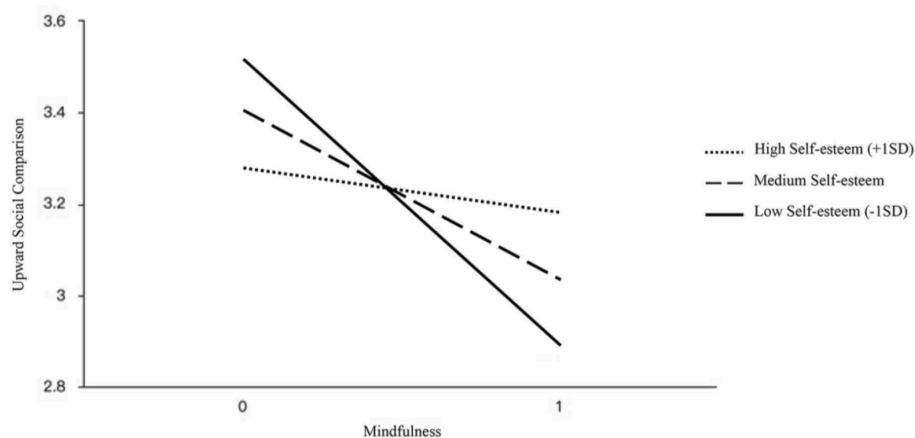


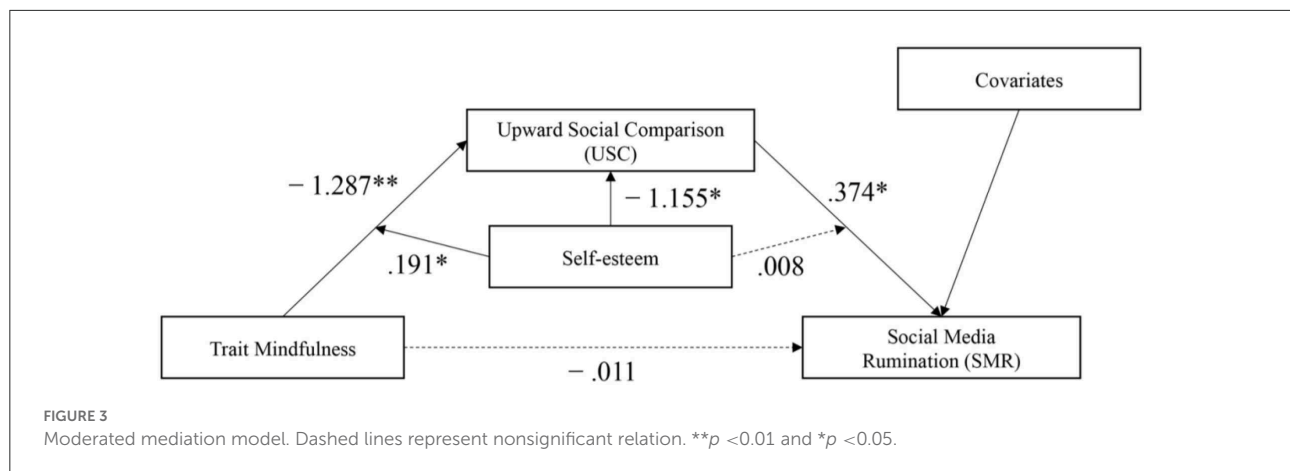
FIGURE 2

Interaction between mindfulness and self-esteem on the USC is tested by a simple slope test.

predict social media rumination. The higher intensity an individual possesses toward upward social comparison, the higher risk of social media rumination he would possess, in line with previous research studies (Yang et al., 2018). In addition, the results of this study showed that upward social comparison completely mediated the effect of mindfulness on social media rumination. Specifically, in the correlation test, mindfulness was negatively correlated with social media rumination, but when we included upward social comparison as a mediating variable, the correlation between mindfulness and social media rumination was no longer significant. In social media context, the mitigating effect of mindfulness on

social media rumination is mainly achieved by reducing upward social comparisons.

The use of social media enables users to learn about others' lives easily but also leads to upward social comparison (Wang et al., 2020). This research suggests that upward social comparison is strongly mediated by the relationship between mindfulness and social media rumination; that is, mindfulness affects the social media rumination of social media users indirectly through upward social comparison, which is considered as a bridge between mindfulness and social media rumination.



## Moderation of self-esteem

Self-esteem moderates the relationship between mindfulness and upward social comparison but does not moderate the relationship between mindfulness and social media rumination, and that between upward social comparison and social media rumination. Enhancement of mindfulness does not make the upward social comparison of social media users with high self-esteem diminish significantly. It does, however, safeguard those with low and medium levels of self-esteem. That is to say, with enhancement of mindfulness, individuals with low and medium self-esteem make upward social comparison diminish significantly. This also clearly shows that self-esteem plays a buffering impact (which reduces low mindfulness individuals' upward comparing inclination), which is consistent with earlier findings (Pepping et al., 2013; Ford, 2017). The results of this study exhibit that individuals with low mindfulness is likely to tend to make an upward social comparison if their self-esteem level is not high. Therefore, for this group, raising the level of mindfulness could be effective in curbing upward social comparisons.

Meanwhile, the moderating role of self-esteem in the mediating process of “mindfulness–upward social comparison–social media rumination” has been demonstrated in this study. The results show that with decline in self-esteem, mindfulness influences the level of social media rumination through upward social comparison's mediating effect. Thus, social media users with low and medium self-esteem can avoid social media rumination by the similar approach as intervention of upward social media comparison (e.g., mindfulness training). However, this approach is not applied to individuals with high self-esteem, so other interventions should be sought.

## Effect of age and highest degree

As shown in Tables 3, 4, we found that age was correlated with mindfulness, USC, and SMR, and that highest degree was correlated with mindfulness, self-esteem, and SMR. First of all, in terms of age, although different scholars have different statements on the concept of generation, the consensus among them is that a generation will be influenced by the culture, society, and politics of the time period; thus, groups born in a similar time period will have similar perceptions and behaviors, while there are some stable differences among groups in different times. A number of studies have empirically demonstrated differences in the values and behaviors of different age groups in different research fields (Smola and Sutton, 2002). We therefore first tested the model using age as a moderator:

Mindfulness\*Age  $\rightarrow$  USC:  $\beta = -0.259$ ,  $t = -1.578$ ,  $p = 0.116$  [95% boot CI = (-0.582, 0.64)]; USC\*Age  $\rightarrow$  SMR:  $\beta = 0.084$ ,  $t = 1.072$ ,  $p = 0.284$  [95% boot CI = (-0.698, 0.237)]. It was found that age did not play a moderating role in this model; however, age directly affected mindfulness, USC, and SMR. Specifically, age was positively associated with mindfulness, implying that older social media users had higher levels of trait mindfulness. In addition, age also negatively affected USC ( $\beta = -0.33$ ,  $p = 0.007$ ) and SMR ( $\beta = -0.608$ ,  $p = 0$ ), suggesting that older groups were less likely to prefer upward social comparison and have a lower level of rumination. This also means that the younger group may have more serious online mental health problems than the older group. Second, in terms of highest degree, we also conducted a test with highest degree as a moderator: Mindfulness\*HD  $\rightarrow$  USC:  $\beta = -0.11$ ,  $t = -0.605$ ,  $p = 0.545$  [95% boot CI = (-0.468, 0.248)]; USC\*HD  $\rightarrow$  SMR:  $\beta = 0.019$ ,  $t = 0.229$ ,  $p = 0.545$  [95% boot CI = (-0.149, 0.188)]. It was found that highest degree also did not play a moderating role in our model. In addition, we found

that mindfulness was negatively correlated with highest degree, meaning that groups with higher education had lower levels of mindfulness instead. Moreover, as highest degree increased, individuals had more severe ruminations and higher self-esteem level. This finding is very revealing, as although some literature has confirmed the influence of academic qualifications on individuals' psychological traits (Karatas, 2015), few studies have explored the relationship between academic qualifications and rumination and upward social comparison, so future research could dig on this deeper.

## Implication

From a theoretical perspective, the present study suggests that people with low mindfulness and low self-esteem might have a risk of making upward social comparisons, which in turn may cause social media rumination, which may be harmful to their mental health. Moreover, self-esteem exhibits no increasing effect; but as a buffer, it makes social media users with low mindfulness less likely to make upward comparisons. Then, the degree of mediating effect of upward social comparison is different because of different levels of self-esteem. The mediating effect was not significant on social media users who have a high level self-esteem but significant in those with medium and low levels of self-esteem. These provide more comprehensive knowledge of understanding the social media rumination symptoms of social media users.

Considering the practical way, the current study reveals insights into under what conditions and how mindfulness can lead to lower social media rumination level, enabling feasible implications to reduce the risk of rumination of social media users with potential mental health problems: (a) upward social comparison is the risk factor of social media rumination for social media users. Therefore, mindfulness training is necessary for social media users to reduce upward social comparisons, especially for individuals with low and medium self-esteem. (b) More clarified suggestions can be provided considering the differences in personality characteristics and self-esteem of social media users. On one hand, improving their self-esteem according to the moderating effect can lower the possibility of making upward social media comparisons of individuals with low mindfulness. On the other hand, individuals with low self-esteem and mindfulness need to focus on contemporary to avoid judgments and being influenced by situational factors.

## Limitations and future directions

Although research on the topic of mindfulness and rumination is popular, especially in communication field, a large amount of research questions still remains unanswered. The present study, although it explores some valuable findings, has some deficiencies. To begin with, in our study, mindfulness

refers to a wide term that is not divided into separate elements. It has been suggested that mindfulness is constructed by many facets or dimensions (Bishop et al., 2004; Coffey et al., 2010). The current study only focuses on the "act with awareness" dimension of mindfulness, so more dimensions of mindfulness can be taken into account in future studies. A two-component model has been proposed by Bishop including self-regulation of attention and orientation toward one's experience in the present. Future research could subdivide mindfulness to analyze whether different aspects would set a different impact on the relationship between social media rumination and upward social comparison. Second, in this study, mindfulness was measured *via* self-report; as a result, it recorded people's perceptions of their own trait mindfulness, which may have flaws, such as bias stemming from their acquaintance with mindfulness-related ideas (Grossman and Van Dam, 2011). However, when compared to other research using self-report measures, this study is not limited by them. Third, due to the limitation of translation, we modified some measurement items of their original scales, and although the modified scales have been tested for reliability and validity, this may challenge the external validity of our scale. Fourth, the data used in this study are cross-sectional and do not permit the testing of causal relationships. Fifth, this study only explored upward social comparison as a mediator; however, there are other influences on rumination [e.g., FOMO (Elhai et al., 2020), social media fatigue (Ye et al., 2020), and cyberbullying (Liu et al., 2020c)] that could be included in future studies. Sixth, the correlation analysis (Figure 3) shows that self-esteem is neither significantly correlated with trait mindfulness nor with upward social comparison in our study, which is inconsistent with previous research (Dion et al., 2021), probably because we measured only trait mindfulness. Future research could explore more the correlation between other dimensions of mindfulness and self-esteem. Finally, although the current research study included a diverse sample, we did not examine the influence of gender, generation, and social media usage as key study variables. Investigating gender and generational disparities could help develop more effective therapies for reducing social media rumination. They should be considered in future investigations.

## Conclusion

This research focuses on the rumination of social media users and aims to provide insights into how (the role of upward social comparison as a mediator) and under what situations (the role of self-esteem as a moderator) mindfulness can reduce the level of social media rumination. Study finds that those social media users with low mindfulness and low or medium self-esteem may have an upward social comparison tendency. However, self-esteem reduces the danger of upward social comparison in individuals with low mindfulness, and upward

social comparison only has a mediating influence on people with medium or low self-esteem. The insights from this study may help to have a better understanding of the rumination of social media users and provide more feasible intervention suggestions to improve the situation.

## Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

## Ethics statement

This study was reviewed and approved by the academic committee of the school of Journalism and communication of Xiamen University. Written informed consent from the patients/participants was not required to participate in this study in accordance with the national legislation and the institutional requirements.

## Author contributions

CG is responsible for the overall research design, thesis writing, collation of the questionnaires, and data analysis. SC is responsible for the guidance. SL is responsible for the proofreading and article touch up. All the authors in the research team have contributed to the thesis. All authors contributed to the article and approved the submitted version.

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## Conflict of interest

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

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## Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsyg.2022.931572/full#supplementary-material>



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# The effect of employee mindfulness in the new media industry on innovative behavior: The chain mediating role of positive emotion and work engagement

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Mindfulness has long been concerned and emphasized by scholars in the field of psychology, but there is still a lack of research on mindfulness in management in China. In this study, a questionnaire survey was conducted among 483 employees in the new media industry in Beijing, Shanghai, Guangzhou, Shenzhen, and Hangzhou, China. After modeling and analysis, it was found that employee mindfulness has a positive influence on innovative behavior. Employee mindfulness and innovative behavior are mediated by positive emotions. Employee mindfulness and innovative behavior are mediated by work engagement. Employee mindfulness and innovative behavior are mediated by a chain of positive emotions and work engagement. Enterprise managers should improve the level of mindfulness of employees in the new media industry through mindfulness training and courses for mindfulness training, create an organizational environment that can arouse positive emotions and improve the positive emotions of employees, pay attention to arousing the enthusiasm of the staff, and promote the innovative behavior of staff while enhancing work engagement.

## KEYWORDS

employee mindfulness, positive emotion, work engagement, innovative behavior, new media industry

## Introduction

In the 21st century, global information technology represented by the Internet is changing with each passing day, promoting the rapid development of emerging media, and media communication soon enters the era of new media (Chen and He, 2022). As an important industry for China's future development, new media industry is constantly integrating into various fields of China's social economy and people's livelihood. As of December 2021, the number of Internet users in China reached 1.032 billion, and the

Internet penetration rate was as high as 73%, providing basic impetus for the sustainable development of China's new media industry (Hu et al., 2022).

With the rapid development of China's new media industry, people's choice of new media products is showing a diversified trend. In order to meet the needs of the public, new media practitioners not only need to have various professional skills, but also need to have the ability to innovate. Employees in the new media industry inevitably encounter various high demands in their daily work (Dediu et al., 2018), which greatly reduce their innovative behavior and willingness while affecting their mood as well as their work status (Martín-Hernández et al., 2020). The innovative behavior of employees is essential for the sustainability of the organization (De Jong and den Hartog, 2010; Martín-Hernández et al., 2020). How to cultivate, develop, stimulate, and utilize the innovative ability of employees in the new media industry is an issue that managers should pay attention to.

Mindfulness is a relatively new concept in psychological research (Keng et al., 2011), which refers to "awareness and observation of the present moment without responsiveness or judgment" (Glomb et al., 2011). As the study progressed, researchers found that mindfulness also plays a huge role in the field of management (Good et al., 2016), especially in enhancing employees' innovative behavior. When mindfulness helps employees to slow down and concentrate (Hensley, 2020), it enables people to retain useful and relevant information, which, in turn, increases the ability of individuals to generate new ideas (Montani et al., 2018) and innovative behavior (Khan and Abbas, 2022). In addition, studies have found that positive emotions (Wang Z. et al., 2021) and work engagement (Montani et al., 2020) also play an important role in enhancing employees' innovative behavior. On the one hand, employees with positive emotions have a wide range of ideas (Isen, 1993) and are not afraid of the risks and challenges brought by innovation (Schwarz and Bohner, 1996), so they are more likely to carry out innovative activities. On the other hand, employees with high work engagement are more focused on their work (Amabile, 1997), and will stimulate their initiative and put more ideas into action (Pieterse et al., 2010), thus stimulating their innovative behavior. Mindfulness as a trait has a significant positive impact on regulating employees' emotions (McLaughlin et al., 2019) and enhancing employees' work engagement (Leroy et al., 2013). According to resource conservation theory, mindfulness is found to be beneficial in helping employees store, perceive, and utilize individual resources, and when employees' own resources are increased, it stimulates and enhances positive emotions (Du et al., 2019; Alhawattme et al., 2022) as well as work engagement (Brown and Ryan, 2003; Leroy et al., 2013), thus promoting the occurrence of innovative behaviors of employees.

Currently, the literature researching the role between employee mindfulness and innovative behavior is scarce. The existing literature mostly starts the analysis from the aspects of creative process engagement (Khan and Abbas, 2022) and

subjective well-being (Liu et al., 2020a,b). Positive emotions and work engagement are important internal factors to stimulate employee innovative behavior (Amabile et al., 2005; Kim and Park, 2017; Jung and Yoon, 2018), but almost no scholars have analyzed the mechanism of the interaction between mindfulness and innovative behavior, and no one has taken employees in the new media industry as the research object. The vigorous development of the new media industry is inseparable from innovation. Therefore, this study explores the relationship among employee mindfulness, positive emotion, work engagement, and innovative behavior through empirical research, which is of great significance to stimulate the innovation ability of employees in the new media industry and the innovation level of enterprises.

## Literature review and hypotheses

### Employee mindfulness and innovative behavior

Mindfulness, originally derived from the meditation training of Buddhism, mainly refers to the intensity of individual attention (Jacobs and Blustein, 2008). Research on mindfulness is generally divided into trait mindfulness and state mindfulness (Randal et al., 2015). State mindfulness can be changed due to internal and external environmental stimuli and lasts for a short time (Liu et al., 2022a), and this state is not fixed (Said and Tanova, 2021). Trait mindfulness is a tendency to remain stable over time, that is, individuals actively and consciously pay attention to the surrounding environment and remember relevant useful information, so that the mind can focus more on the objects related to the goal and be more determined (Wang X. et al., 2021). The improvement of innovative behavior of employees is exactly the stimulation of trait mindfulness. This study mainly analyzes and studies long-term and sustained behavioral effects, and therefore investigates mindfulness as a trait.

Innovation refers to the new integration of the knowledge owned by individuals and the new knowledge acquired, which can enable enterprises to obtain new opportunities more effectively and rationally utilize existing opportunities (Matzler et al., 2013). Innovative behavior often occurs at the individual level (Nonaka and Takeuchi, 1995). When individuals are creative, they can not only complete their work better, but also help enterprises gain competitive advantages in an uncertain environment (Wang et al., 2017). As a trait, employee mindfulness is an important factor affecting their innovative behavior (Mulligan et al., 2021). On the one hand, mindfulness can improve individual alertness and cognitive flexibility (Good et al., 2016; Van gelderen et al., 2019). The flexible cognition generated by mindfulness supports adaptation by generating novel ideas and responses (Good et al., 2016), while alertness helps individuals maintain extensive external attention and capture important information, thereby reducing error rate and enhancing their ability to generate new



ideas (Dane and Brummel, 2014). On the other hand, mindfulness reduces automatic responses and enhances attentional breadth (Dane and Rockmann, 2020). When mindfulness helps individuals to focus (Hensley, 2020), it will make them retain useful and relevant information, so as to have a deeper understanding of the problem, and then generate more flexible new ideas (Montani et al., 2018; Khan and Abbas, 2022).

According to social cognitive theory, individual psychological traits can influence individual behavior (Bandura, 1986). Mindfulness is an individual's internal perception of inner changes or inner emotional changes caused by external stimuli (Brown and Ryan, 2003). Innovation behavior is a phased process, including not only the generation of new ideas, seeking support for individual innovation ideas, but also the implementation of new ideas (Scott and Bruce, 1994). Previous studies have confirmed that mindfulness positively affects innovative behavior (Jobbehdar Nourafkan et al., 2022; Khan and Abbas, 2022). In conclusion, we make the hypotheses:

*H1: Employee mindfulness has a significant positive impact on innovative behavior.*

## Employee mindfulness, positive emotion, and innovative behavior

Emotion is a physiological arousal state and a cognitive state corresponding to this arousal state (Schachter and Singer, 1962). People's emotions in the face of various things in life reflect people's evaluation of these things (Diener et al., 1999). Emotions include both positive and negative emotions (Watson and Tellegen, 1985). At present, negative emotions have been studied by many psychologists, and some scholars say that studying positive emotions is also very important (Seligman and Csikszentmihalyi, 2014). Positive emotion is often a transient emotional experience, which is an individual's response to meaningful events in life (Fredrickson, 2001). Individuals with high levels of positive emotions show more flexible thinking, faster conversion speed, and accept a wider range of behavioral choices (Kahn and Isen, 1993). In essence, negative and positive emotions are incompatible, but experiments have shown that positive emotions can reduce or eliminate reactions caused by negative emotions (Fredrickson, 1998; Fredrickson, 2001). At the same time, people can improve their mental resilience and mental health by cultivating positive emotions at appropriate times, thus promoting their physical health (Fredrickson, 2000). Mindfulness is not only a way of emotion regulation, but also a kind of emotion regulation ability. Previous studies have shown that mindfulness is closely related to emotion regulation (Lutz et al., 2014; McLaughlin et al., 2019; Liu et al., 2022b), in which there is a spiraling process between mindfulness and positive emotions, that is, by improving individual mindfulness, people with positive emotions will generate more positive emotions in the future, and the increase of positive emotions predicts more mindfulness (Du et al., 2019).

Numerous studies have shown that positive emotions positively predict employees' innovative behavior (Madrid et al., 2014; Zhou et al., 2014; Wang Z. et al., 2021; Caniels et al., 2022; Zhou et al., 2022). The broaden-and-build theory of positive emotions suggests that positive emotions can expand the scope of an individual's immediate thinking actions by constructing more enduring personal resources such as psychological, social, physical, and intellectual resources to provide more sustainable adaptive benefits for the development provided by the individual (Fredrickson, 2001). On the one hand, individuals under the influence of positive emotions can flexibly adjust their cognitive state and improve the level of thinking activity (Madrid, 2020), thus generating extensive and diverse ideas, which is often the source of individual innovative behaviors (Isen, 1993). On the other hand, positive emotions, as a comfortable state, can make individuals not afraid of risks and challenges in the process of innovation, show amazing expansion of thinking in urgent problems (Zhou et al., 2022), and enhance the exploration of new procedures, so as to carry out innovative activities (Schwarz, 1990; Schwarz and Bohner, 1996). In addition, positive emotions also expand the attention range of individuals (Fredrickson and Branigan, 2005), which enables individuals to guide their behavioral responses more effectively. When individuals are in a state of positive emotion, they are more likely to choose more challenging goals (Cardon et al., 2009) and motivate them to act in an innovative way and make more efforts (Caniels et al., 2022).

According to the broaden-and-build theory of positive emotions (Fredrickson, 2001), mindfulness promotes the generation of positive emotions and further improves the cognitive flexibility and attention of individuals, thus expanding the scope of instant thinking and action of individuals and generating innovative behaviors. Previous studies have confirmed the mediating effect of positive emotions between mindfulness and creativity (Chen et al., 2022). Based on this, we propose the following three hypotheses:

*H2: Positive emotions play a mediating role in the relationship between employee mindfulness and innovative behavior.*

*H2a: Employee mindfulness positively affects positive emotions.*

*H2b: Positive emotions positively affect innovative behavior.*

## Employee mindfulness, work engagement, and innovative behavior

Work engagement is an active state of work, characterized by concentration, energy, and dedication (Schaufeli et al., 2002). As a good working attitude (Rahman and Karim, 2022), work engagement not only affects organizational commitment (Ahmad and Gao, 2018), employee job satisfaction (Van Tuin



et al., 2021), and turnover intention (Cao and Chen, 2021), but also has an important influence on organizational citizenship behavior (Ismael et al., 2022) and innovative behavior (Bakker et al., 2014), which is one of the basic factors influencing the results and attitudes of various behaviors in the workplace (Han et al., 2021).

Innovation is a dynamic and complex process, and the stimulation of innovative behavior requires individuals not only to possess certain professional knowledge, ability, and motivation, but also to invest a lot of energy and time in continuous trial and error and improvement (Amabile, 1997). It has been found that the employee's work engagement can promote innovative behavior (Hakanen et al., 2008; Zhang and Bartol, 2010). On the one hand, employees with high work engagement are more focused on their work, and they will continue to finish their work when faced with difficulties or bottlenecks, such concentration and persistence are the sources of promoting their creativity (Amabile, 1997). On the other hand, high work engagement will reduce employees' stress (Britt et al., 2001) and promote an increase in positive emotions (Hakanen et al., 2008), which will further stimulate their initiative and put more ideas into action. Thus, more innovative behaviors are generated (Pieterse et al., 2010). Mindfulness can enhance engagement in activities or work by increasing the vividness and clarity of an individual's experience (Brown and Ryan, 2003), helping employees to "accept" what is known and change their perspective (Shapiro et al., 2006; Carmody et al., 2009), and making employees more focused on their work and maintain interest in it, thus stimulating employees' innovative behavior (Sonnentag, 2003).

Conservation of Resource Theory holds that individuals are motivated to use and invest resources (Hobfoll, 1989). When initial resources are abundant, individuals will make full use of existing resources and put them into subsequent activities or work (Hobfoll, 2011; Halbesleben et al., 2014). However, when initial resources are relatively scarce, individuals are vulnerable to the risk of resource loss, which leads to more cautious use of resources. Mindfulness is an internal resource possessed by individuals (Grover et al., 2017; Montani et al., 2018; Fisher et al., 2019). It can help individuals store energy and enhance their awareness of other resources so that individuals can perceive more alternative resources (Kroon et al., 2015) and make good use of resources in subsequent activities (Shapiro et al., 2006; Good et al., 2016). Therefore, when employees experience high mindfulness, they will devote more resources to their work, making them more focused, and the resulting high level of work engagement will further promote the occurrence of innovative behavior. Previous studies have confirmed that mindfulness can enhance individual concentration and immersion and has a positive correlation with work engagement (Brown and Ryan, 2003; Leroy et al., 2013). Meanwhile, work engagement has a promoting influence on increasing employee innovative behavior (Rich et al., 2010; Aryee et al., 2012; Kim and Park, 2017; Jung and Yoon, 2018), but fewer studies have used work engagement as a mediator to

study employee mindfulness and innovative behavior. Thus, we propose the following three hypotheses:

*H3: Work engagement plays a mediating role in the relationship between employee mindfulness and innovative behavior.*

*H3a: Employee mindfulness positively affects work engagement.*

*H3b: Work engagement positively affects innovative behavior.*

## Positive emotion and work engagement

Work engagement is a pleasant state of mind associated with one's job (Schaufeli and Bakker, 2004), which essentially contains a series of positive emotions (Ouweneel et al., 2012b). The broaden-and-build theory for positive emotions holds that positive emotions can not only bring instantaneous expansion of individual thinking activities, but also help individuals build long-term and abundant individual resources (Fredrickson, 2001), and the increase in individual resources is usually caused by positive emotional experience. This side effect will increase the motivation, initiative, and enterprising spirit of the individual (Schaufeli et al., 2002). When employees are in a positive emotional state, they will positively evaluate and experience their work and surrounding environment, thus stimulating the behavior of absorbing new information, experience, and exploration, and in this process, expand themselves and become more engaged in their work to achieve their goals (Forgas, 1995). Therefore, individuals with positive emotions are more inclined to increase their personal and job resources and devote them to work (Ouweneel et al., 2012a). Scholars have confirmed that positive emotions have an important positive influence on employees' work engagement (Leavitt et al., 2019; Wu and Wu, 2019; Ameer and Zubair, 2020; Yuan et al., 2020).

In addition, according to the conservation of resource theory, mindfulness is conducive to the storage, perception, and utilization of individual resources, and when employees' own resources are increased, it will stimulate and enhance employees' positive emotions (Du et al., 2019; Alhawtmeh et al., 2022) and work engagement (Brown and Ryan, 2003; Leroy et al., 2013), which will promote the occurrence of employee innovative behavior.

Hence, we propose the following hypothesis:

*H4: Positive emotions positively affect work engagement.*

*H5: Positive emotion and work engagement play a chain mediating role between employee mindfulness and innovative behavior.*

To summarize, Figure 1 shows the research model and hypothesis established in this study.

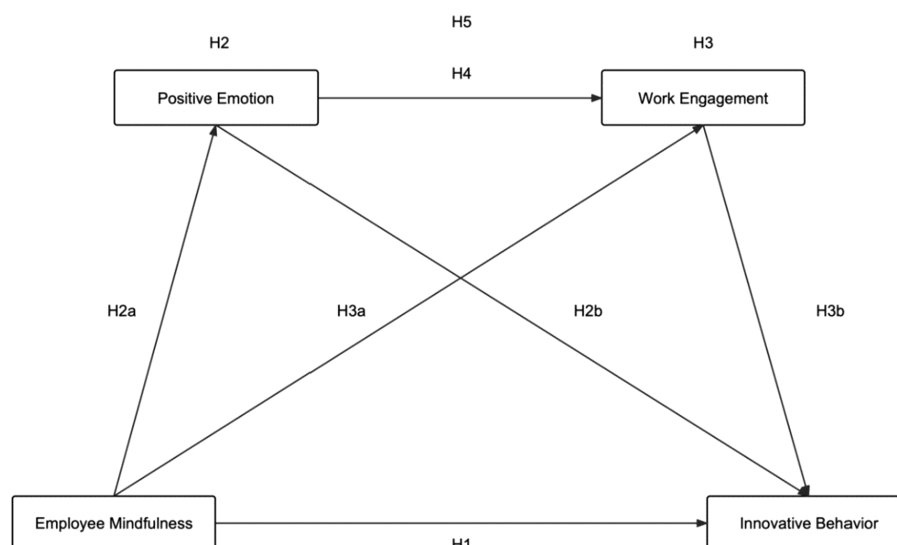


FIGURE 1  
Research model and hypotheses.

## Methodology

### Participants and collection

New media industry refers to related industries that rely on emerging technologies (digital technology, mobile communication technology, etc.) and take emerging media such as mobile phone, Internet, interactive TV media, and new media such as mobile TV and building TV as carriers (Gong and Weng, 2010). In this study, employees in the new media industry are defined as employees engaged in relevant enterprises (such as Weibo, WeChat, webcast, short video, etc.) that use Internet technology as the media of information dissemination. According to China Statistical Report on Internet Development, Beijing, Shanghai, Guangzhou, Shenzhen, and Hangzhou are the five cities with good economic development and the most listed Internet companies (China Internet Network Information Center, 2021). Research has found that economic development and Internet penetration rate are both important driving forces to promote the development of new media industry (Guo and Fang, 2022). Therefore, Beijing, Shanghai, Guangzhou, Shenzhen, and Hangzhou were selected as sample collection sites in this study.

Questionnaire Star,<sup>1</sup> one of the largest questionnaire collection platforms in China, is a professional survey distribution platform. In the collection of questionnaires, in order to ensure the authenticity of the questionnaire recovery, the questionnaire must be filled by a real-name user (the questionnaire fillers are informed in advance that it is only for academic research and will not involve any privacy), and each user can only fill in the questionnaire once. The participants of the questionnaire

responded more positively to the collection of the online questionnaire (Huang et al., 2016), and the online questionnaire can not only expand the sample size, but also improve the reliability and validity of the sample (Cao et al., 2021). Therefore, this study adopts online questionnaire to conduct convenient sampling of employees in the new media industry in these five cities. Convenient sampling is easy to implement and has the advantage of saving time and cost. Previous studies have also confirmed the effectiveness of convenient sampling based on online questionnaire (Zhu et al., 2022).

The questionnaire consists of two parts. The first part contains four scales of employee mindfulness, positive emotion, work engagement, and innovative behavior, and the second part contains relevant information of the questionnaire fillers. A total of 550 questionnaires were collected in this study, of which 483 were valid, with an effective rate of 87.82%. There were 310 females (64.2%) and 173 males (35.8%). In terms of age, the number of people aged 26–35 was the largest (36.2%). In terms of marital status, 52.8% of employees were married. In terms of education, the largest number of people had a bachelor's degree (48%). The number of people who had worked for more than 10 years was the highest in terms of working years (34.2%). In terms of jobs, the proportion of ordinary employees (Ordinary employees are employees in non-management positions) was up to 60.7% (see Table 1 for details).

## Measures

### Mindfulness attention awareness scale

In this study, the single-dimension scale of mindful attention awareness developed by Brown and Ryan (2003) was adopted, which has 15 items in total. Through confirmatory factor analysis,

<sup>1</sup> <https://www.wjx.cn>

TABLE 1 Demographic characteristics (N =483).

Variables		Frequency	%
Gender	Female	310	64.20%
	Male	173	35.80%
Age	18–25	130	26.90%
	26–35	175	36.20%
	36–45	132	27.30%
	46–55	37	7.70%
	Older than 55	9	1.90%
Marital status	Married	255	52.80%
	Unmarried	222	46.0%
	Others	6	1.20%
Educational background	Graduates of high school or technical secondary school or below	26	5.40%
	Junior college graduates	94	19.50%
	Bachelor	232	48.00%
	Master or above	131	27.10%
Years of working	<1	94	19.50%
	1–3	92	19.00%
	4–5	48	9.90%
	6–10	84	17.40%
	>10	165	34.20%
Job title	Ordinary employee	293	60.70%
	Grass-roots manager	78	16.10%
	Middle manager	79	16.40%
	Senior manager	33	6.80%

6 items with factor loading coefficients lower than 0.6 were deleted, and there remained 9 items, making the scale more suitable for this study (for example, items include “I find it difficult to stay focused on what’s happening in the present.”). This scale was self-rated by employees, and the Likert 5-point scale was used to score the questionnaire (1 = completely inconsistent, 5 = completely consistent). All the questions are reverse scored. Therefore, conversion was conducted in the empirical analysis of this study.

### Positive emotion scale

Watson et al. (1988) created an emotion scale that encompasses both positive and negative emotions. In this study, 10 words of positive emotion were selected, including Enthusiastic, Excited, and Determined. A 5-point Likert scale was used to score the questionnaire (1 = almost none, 5 = very much).

### Work engagement scale

The work engagement scale prepared by Schaufeli et al. (2006) was adopted in this study, which included three dimensions of vitality, dedication, and concentration, with three questions in each dimension and nine items in total. Words such as “I am enthusiastic about my job, I am immersed in my work” were

scored using a five-point Likert scale (1 = strongly disagree, 5 = strongly agree).

### Innovative behavior scale

Scott and Bruce (1994) developed the Innovation Behavior Scale, which has 6 items (for example, “Promotes and Champions ideas to others.”). The questionnaire adopted A 5-point Likert scale scoring (1 = strongly disagree, 5 = strongly agree).

### Data analysis

In this study, SPSS 23.0, PROCESS 3.3, and Amos 23 were used to analyze the data. AMOS was mainly used in model testing, while SPSS was mainly used in descriptive statistical analysis and regression analysis. PROCESS was used to test the mediating effect of the model.

### Control variables

We controlled for gender, age, marital status, educational background, working years, and job title because demographic variables will influence employees’ innovative behavior (Tang et al., 2017).

## Results

### Test of common method bias

To reduce the common method bias, we first introduced the purpose of this study to the questionnaire participants. Secondly, to reduce the concern of the participants, we explained to the questionnaire participants that there is no right or wrong and ensured that all the answers were anonymous. Finally, Harman single-factor test was used to test the collected data to avoid the common method bias. The results show that the eigenvalues of five factors are greater than 1, and the maximum factor variance explanation rate is 39.241% and <40% (Podsakoff et al., 2003), which indicates that there is no serious common method bias in this study.

### Descriptive statistical analysis

In this study, the control variables (gender, age, marital status, educational background, working years, and job title) had no effect on the current research hypothesis. The correlation coefficient, mean value, and standard deviation of each variable are shown in Table 2. The results show that employee mindfulness (EM) is positively correlated with positive emotions (PE;  $r = 0.368, p < 0.01$ ), work engagement (WE;  $r = 0.330, p < 0.01$ ), and innovative behavior (IB;  $r = 0.369, p < 0.01$ ). PE are positively correlated with

**TABLE 2** Correlation coefficient, mean value, and standard deviation among variables.

	M	SD	1	2	3	4
1. Employee mindfulness	3.76	0.80	<b>0.902</b>			
2. Positive emotion	3.54	0.68	0.368**	<b>0.934</b>		
3. Work engagement	3.49	0.75	0.330**	0.651**	<b>0.934</b>	
4. Innovative behavior	3.70	0.65	0.369**	0.541**	0.569**	<b>0.893</b>

N = 483; The Cronbach's  $\alpha$  coefficient is in bold. \*\* $p < 0.01$ .

WE ( $r = 0.651$ ,  $p < 0.01$ ) and IB ( $r = 0.541$ ,  $p < 0.01$ ). There is a positive correlation between WE and IB ( $r = 0.569$ ,  $p < 0.01$ ).

## Model inspection

CFA was carried out using Amos 23. Table 3 shows the results. The model fitting indexes are  $\chi^2 = 1497.838$ ,  $df = 519$ ,  $\chi^2/df = 2.886$ , CFI = 0.914, TLI = 0.907, RMSEA = 0.063. All the indicators are within the acceptable limits, so the four-factor model is the most appropriate (Table 3).

## Direct effect test

SPSS 23.0 was used for regression analysis based on good model fitting, and the results are reported in Table 4. EM positively affects IB ( $\beta = 0.300$ ,  $p < 0.001$ ), H1 is supported; EM positively affects PE ( $\beta = 0.311$ ,  $p < 0.001$ ), H2a is supported; PE positively affects IB ( $\beta = 0.521$ ,  $p < 0.001$ ), H2b is supported; EM positively affects WE ( $\beta = 0.309$ ,  $p < 0.001$ ), H3a is supported. WE positively affects IB ( $\beta = 0.495$ ,  $p < 0.001$ ), H3b is supported. PE positively affects WE ( $\beta = 0.721$ ,  $p < 0.001$ ), H4 is supported.

## Indirect effect test

The indirect effect was tested using the PROCESS 3.3 plug-in (Table 5). The indirect effect of EM on IB through PE is 0.0759, and the confidence interval of 95% is [0.0337, 0.1276] (excluding 0), showing that PE has a significant mediating effect, and H2 is supported. EM has a 0.0299 indirect effect on IB through WE, and the confidence interval of 95% is [0.0068, 0.0601] (excluding 0), showing that WE has a significant mediating effect, and H3 is supported. EM has a 0.0644 indirect influence on IB through PE and WE, and the confidence interval 95% is [0.0373, 0.0965] (excluding 0), showing that PE and WE are significant in the chain mediation of EM and IB, and H5 is supported.

## Discussion

### Theoretical significance

First, most previous studies on workplace employees have focused on state mindfulness (e.g., Olafsen, 2017; Said and

Tanova, 2021), which focuses on the antecedents of state mindfulness. However, there are few studies on employee trait mindfulness. Trait mindfulness is a personal trait that focuses more on how it affects work outcomes as a predictor (Wang X. et al., 2021). This study confirmed that trait mindfulness is initiated by a top-down mechanism (Wang Z. et al., 2021), in which employees are conducive to the occurrence of innovative behavior. This study has helped spark researchers' interest in the effects of trait mindfulness on employee behavior and attitudes.

Secondly, previous antecedent studies on employees' innovative behavior have focused on external factors, such as external environment, leadership influence, leadership style, and the exchange relationship between leaders and subordinates (Dhar, 2016; Leitch and Volery, 2017; Hoang et al., 2022). However, these studies ignore the vulnerability of external factors to other factors (such as the closeness of the relationship between enterprise managers and employees; Kim et al., 2021) and the importance of internal factors. Studies show that positive emotions and work engagement, as positive mental states of individuals, play an important role in improving their innovative behavior. This study helps us to understand the influencing factors and influencing mechanism of employee innovation behavior from the perspective of internal factors of employees, and further enriches the theoretical development of innovative behavior.

Finally, although previous studies have explained the importance of mindfulness in improving innovative behavior among employees (Jobbehdar Nourafkan et al., 2022; Khan and Abbas, 2022), but very little is known about how it works. This study uses a research model to clarify how mindfulness improves the operating mechanism of employees' innovative behavior, thus helping enterprises gain competitive advantages. This study supports the theory of resource conservation, in which individuals are motivated to use and invest resources. Studies have shown that mindfulness, as an individual trait, can help employees store resources and enhance the perception, discovery, and utilization of other resources (Good et al., 2016), by stimulating employees' positive emotions, more resources will be put into work, which will greatly enhance employees' focus and cognitive flexibility, so as to promote the occurrence of innovative behavior. Few scholars have studied the chain mediating effect of positive emotions and work engagement on the relationship between mindfulness and employees' innovative behavior, let alone employees in the new media industry. This study not only broadens the research scope of employee mindfulness, but also deeply analyzes the mechanism of employee mindfulness in the new media industry on innovative behavior, which has important theoretical contributions.

### Practical significance

The results of this study have important practical significance for improving the innovative behavior of employees in the new media industry and can provide some constructive suggestions for human resource management practices in the new media industry. First, employee mindfulness has a positive effect on improving

TABLE 3 CFA.

Model	$\chi^2$	df	$\chi^2/df$	CFI	TLI	RMSEA
Four-factor model (EM, PE, WE, IB)	1497.838	519	2.886	0.914	0.907	0.063
Three-factor model (EM, PE and WE, IB)	2861.117	524	5.460	0.794	0.779	0.096
Two-factor model (EM and PE, WE and IB)	4158.209	526	7.905	0.679	0.658	0.120
Single-factor model (EM and PE and WE and IB)	5229.820	527	9.924	0.585	0.558	0.136

*N* = 483. EM, Employee mindfulness; PE, Positive emotion; WE, Work engagement; IB, Innovative behavior.

TABLE 4 Studies the direct impact of pathways.

Path	$\beta$	SE	P-value
H1: EM $\rightarrow$ IB	0.300	0.035	0.000
H2a: EM $\rightarrow$ PE	0.311	0.036	0.000
H2b: PE $\rightarrow$ IB	0.521	0.037	0.000
H3a: EM $\rightarrow$ WE	0.309	0.040	0.000
H3b: WE $\rightarrow$ IB	0.495	0.033	0.000
H4: PE $\rightarrow$ WE	0.721	0.038	0.000

EM, Employee mindfulness; PE, Positive emotion; WE, Work engagement; IB, Innovative behavior.

TABLE 5 Indirect effects of research pathways.

	Effect	BootSE	BootLLCI	BootULCI
TOTAL	0.1702	0.0305	0.1138	0.2320
EM $\rightarrow$ PE $\rightarrow$ IB	0.0759	0.0240	0.0337	0.1276
EM $\rightarrow$ WE $\rightarrow$ IB	0.0299	0.0137	0.0068	0.0601
EM $\rightarrow$ PE $\rightarrow$ WE $\rightarrow$ IB	0.0644	0.0151	0.0373	0.0965

EM, Employee mindfulness; PE, Positive emotion; WE, Work engagement; IB, Innovative behavior.

employees' innovative behavior, which is one of the major findings of this study. Scholars have pointed out that specific forms of practice, training, and experience can help employees skillfully focus their attention on specific work environments (Hulsheger et al., 2013). At the same time, some scholars have proposed that mindfulness training for employees can help them focus on the present (Dane and Brummel, 2014), improve performance, and reduce employee pressure (Allen et al., 2015), etc. Employees in the new media industry will inevitably meet various high requirements in their work (Dediu et al., 2018). The huge work pressure will have a direct impact on employees' emotions and work status, and then affect employees' innovative behavior. Therefore, the management department of the new media industry can improve the mindfulness level of employees in the new media industry through mindfulness training and mindfulness training courses. At the same time, enterprise managers can also incorporate mindfulness into employee training programs and conduct regular training so as to regulate employees' emotions and work status and lay the foundation for stimulating employees' innovative behavior.

Secondly, current research results show that positive emotions have a positive effect on improving employees' innovative behavior. Therefore, enterprise managers can improve employees' positive

emotions by creating an organizational environment that can evoke positive emotions. In the organizational environment, both work and non-work factors may trigger emotional reactions of employees. Therefore, managers in the new media industry can stimulate employees' positive emotions by creating a relaxed and free working atmosphere, giving positive feedback and encouragement to employees' work achievements or phased progress, and improving family welfare, and leaders' care and encouragement. At the same time, they strengthen emotion management ability training, so that new media industry employees can form a stable positive mood, so as to stimulate employees' innovative behavior.

Finally, work engagement has a positive effect on employees' innovative behavior, which is another important finding of this study. This finding indicates that managers in the new media industry should attach importance to arousing the enthusiasm of employees. On the one hand, managers can improve the autonomy and enthusiasm of employees by optimizing the work process and content and paying attention to the design of work, enable employees to gain a sense of accomplishment and excitement in the process of work, enhance their enthusiasm and investment in work, and promote their innovative behavior. On the other hand, managers should recognize and encourage employees' innovative behavior and achievements and provide certain material rewards in addition to spiritual incentives, so as to guide work engagement to produce more innovative achievements.

## Limitations and future research directions

This paper discusses the relationship between mindfulness and innovative behavior among employees in China's new media industry. Although some valuable research conclusions and practical implications have been obtained, there are still some deficiencies and limitations.

Firstly, the research object of this paper is employees in the new media industry, but employees in different industries have different individual characteristics. Therefore, future research can target employees in different industries to conduct research on mindfulness and innovative behavior. Secondly, convenience sampling was adopted to sample five cities in this study, which was deficient in sample size and sample scope, and the data obtained were all cross-sectional data. In future studies, more effective methods (such as systematic sampling) can be adopted to expand the sample size and sample scope of data collection, and longitudinal



studies can also be considered to test the model. Third, although this study verified that positive emotion and work engagement play a chain mediating role in employee mindfulness and innovation behavior, it did not consider whether work engagement also positively affects positive emotion, which can be further verified in future research. Finally, mindfulness has become one of the current research hotspots in human resource management. This study found that employee mindfulness can stimulate or enhance innovative behavior, and future research can start from the leadership level (such as mindful leadership) to explore the mechanism of its interaction with employee innovative behavior.

## Conclusion

The purpose of this study was to investigate the effect of employee mindfulness in the new media industry on innovative behavior. The results indicate that employee mindfulness has a positive impact on innovative behavior. Employee mindfulness positively impacts innovative behavior not only through positive emotion, but also through work engagement. At the same time, this study found that positive emotion and work engagement play a chain mediating role between employee mindfulness and innovative behavior in the new media industry. Therefore, we hope that this study can help enrich the research on mindfulness and innovative behavior of employees in the new media industry and make more contributions to the management of employees in the new media industry.

## Data availability statement

The original contributions presented in the study are included in the article/[Supplementary material](#), further inquiries can be directed to the corresponding authors.

## Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and

institutional requirements. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

## Author contributions

TYK proposed research ideas and data collection. YH proposed research framework and data analysis. YL drafted and revised the manuscript. All authors contributed to the article and approved the submitted version.

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## Conflict of interest

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

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## Supplementary material

The Supplementary material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsyg.2022.976504/full#supplementary-material>

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# Parental intervention strategies and operating mechanism on adolescent social media use—The concept of literacy improvement based on interaction

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This study focuses on a realistic picture of parental intervention in the use of social media among teenagers in the post-pandemic era. First, based on a questionnaire survey and in-depth interviews, and under the guidance of the concept of interactive literacy improvement, we propose a conceptual model and a verifiable measurement dimension of parental-mediated intervention. Second, based on the comparison of parent–child samples, it was found that parental-mediated intervention strategies are often used in families, and parents and children have roughly the same cognition and preference for the four intervention strategies. However, parents reported that they use intervention strategies much more frequently than perceived by their children. Third, we constructed and verified the prediction model of “individual technical characteristics-online family environment-parental-mediated intervention,” namely, the hierarchical progressive logic of parental-mediated intervention, and realized the systematization of influencing factors. The study confirmed that the effectiveness of parental-mediated intervention is improved by parent–children “cohesion.” In the follow-up, we will focus on the new perspective of theoretical research on parental intervention and intra-generational digital inequality among adolescents.

## KEYWORDS

usage behavior knowledge, literacy improvement, social media, parent-mediated intervention, online friends

## Introduction

The Covid-19-induced need for “social distancing” and emergency adoption of “online courses” has contributed to people’s, especially teenagers’, obsession with online social interaction. Forty percent of teenagers (CNNIC, 2020) have either been exposed to undesirable online content, such as pornography, violence, and bloodshed, or have



experienced psychological and behavioral disorders, such as cyber bullying, cyber violence, irrational consumption, privacy disclosure, and addiction to online games and short videos. The newly revised 2021 law for the protection of minors in the People's Republic of China has added a chapter on “network protection,” requiring Internet platforms to launch or upgrade the “youth model.” “Youth model” is a system that regulates adolescent online behavior in terms of use period, duration, functions and browsing content, which applied to short video platform, social platform, game platform and other network platforms. However, technological settings alone cannot ensure that the youth use the Internet in a civilized, productive, and healthy manner.

Parents are the “first line of defence” for children against undesirable content (Liu et al., 2022a). The guidance, restriction, and regulation of children's media use behavior constitutes their digital parenting responsibilities and obligations (Jones et al., 2013). With the progress of communication technology and changes in the media environment, teenagers have identified ways to evade parental monitoring (Liu et al., 2022b), such as erasing browsing history, deleting instant messages, and installing location masking software. To deal with a series of new situations and problems emerging in this context, this study focuses on the realistic picture of parental intervention in the post-pandemic era by adopting the individual–environment–behavior theory as the analytical framework. We innovatively consider the technological characteristics of parents and the online family environment jointly constructed by parents and children as antecedents to explain parental intervention behavior from both logical and empirical perspectives. We also clarify the mechanisms of parental intervention.

## Theoretical background and hypothesis building

### Guiding philosophy and strategies of parental intervention

It is not clear whether the influence of media on teenagers is largely positive or negative. The final influence, it seems, depends on how parents intervene and guide their children's media use behavior (Clark, 2011). According to Desmond et al. (2010), who first defined this phenomenon as “parental intervention” in 1985, parents explain the complexity of the social environment presented by television media in a manner that is intelligible to their children, so as to promote their cognitive development. Chinese scholars have generally recognized the important role of parents in shaping the media use behavior of their children as can be seen in related research on topics, such as “parent intervention” (Chen, 2019), “parent control” (Liu, 2017), “parental intervention” to protect their children from undesirable media content (Zeng and Zhan, 2022; Zheng, 2022); “new media education for parents” focusing on media education and education action (Liu and Huang, 2018). Research has also been done on the premise that parents know about the media use behavior of their offspring

(Ding et al., 2019) on topics such as “parental monitoring” and “parental network supervision” (Su et al., 2016; Zhang et al., 2020).

A review of studies on the Internet, social media, online games, and other interactive technologies shows that research on parental intervention is rooted in the research tradition of the media effect theory. Accordingly, parental intervention is interpreted as parents' conscious management and regulation of media and content accessible to their children (Lee and Chae, 2012), to regulate and weaken the adverse effects of media use on teenagers (Shin and Huh, 2011). Thus, the guiding concept of parental intervention is the protection of children from “undesirable influence,” with parents playing the role of protector (Waizenhofer et al., 2004).

Parents are the gatekeepers for their children's media use. However, given the popularity of mobile Internet, widespread use of digital devices, and loss of adults' absolute control over information, an increasing number of families are exhibiting a trend of “de-autocracy” in children's media use. However, research on parent-mediated intervention still adheres to the guiding concept of ensuring children's “safety of use,” which needs to be urgently developed into the concept of interactive literacy improvement. Therefore, in this study, parent-mediated intervention—in which parents integrate into children's online activities as co-participants—is a dual interaction of emotion and behavior aimed at improving children's digital literacy. Positive, restricted, and joint viewings were the three dominant strategies of parent-mediated intervention in the era of TV media (Austin, 1993); they are still widely adopted in the follow-up intervention of interactive technologies, such as in online games—albeit less effectively than television intervention. Additionally, the cognition and favor of parent–child samples on parent-mediated intervention strategies in the use of TV media are roughly the same (Nathanson, 2001). Consequently, we raised our first research question.

*RQ1:* In the post-epidemic era, how do parents interfere with children's social media use and what strategies do they use? What are the cognitions and preferences of parents and children regarding different intervention strategies?

### Predictive model of parental-mediated intervention strategies

Kurt Lewin, a German psychologist, proposed that predicting individual behavior requires attention to the individual, the environment, and the interaction between the two. This viewpoint provides a theoretical framework for predicting parents' intervention in children's social media use. Additionally, established studies on the factors influencing parental intervention provide explanatory variables. How parents intervene in their children's media use is rooted in their attitudes toward media (Warren, 2001). Established research confirms that when parents focus more on the negative effects of



television or games, they implement a mix of intervention strategies (Shin and Huh, 2011), especially when they compulsively restrict their children's use behavior (Carl et al., 1981). Parents are more inclined to use co-viewing or co-using interventions when they believe that watching or using media will expand their children's knowledge and enhance their cognitive abilities (Nathanson, 2001). Accordingly, we propose the following hypothesis:

*H1: Parental attitudes toward social media can predict their interference with children's social media use.*

Parents' ability to use media is a prerequisite for effective performance of parental intervention duties (Austin, 1993); parents with poor media use skills are more likely to employ permissive or coercive interventions, such as outright confiscation of cell phones and disconnection from the Internet (Lee, 2013). The frequency of parents' Internet use also significantly predicts their choice of intervention (Livingstone and Helsper, 2007). Parents who are obsessive or active users of television or online games are more likely to formulate rules to restrict their children's media use in a targeted manner, because they are better informed (Padilla-walker et al., 2011; Liu et al., 2022c). Accordingly, we propose the following hypotheses:

*H2–H3: Parental proficiency in skills (H2) and frequency of online activity participation (H3) can predict their intervention in children's social media use.*

It is noteworthy that individuals' attitude toward media impact their usage behavior. Individuals with more positive attitudes tend to participate in a wider range of online activities. If individuals have more positive attitudes, their online activities tend to be extensive (Perazzo et al., 2020). For example, older people who hold a negative perception of online financial applications, such as online banking, will tend to refuse to use them; this will inevitably affect their corresponding usage skills. Accordingly, we propose the following hypotheses:

*H4–H5: Parents' attitudes toward social media influence their frequency of online activity participation (H4) and proficiency in skills (H5).*

Previous studies have identified that the extent of participation in online activities is not only closely related to age, gender, socioeconomic status, etc. but also the skills used (Liu et al., 2021; Livingstone and Helsper, 2007). Additionally, the richer the online activities performed by an individual, the relatively higher the corresponding level of online skills (Livingstone and Helsper, 2008; Lin et al., 2020; Chen et al., 2021). Accordingly, we propose the following hypothesis:

*H6: There is a correlation between proficiency in skills and the frequency of online activity participation.*

Unlike the traditional media era that relied on the technological environment, the social media era relies on the online family environment jointly constructed by parents and children. The environmental factors influencing parent-mediated interventions were assessed based on this online family environment. In this study, "whether parents and children are online friends" and "parental knowledge of adolescent usage behavior" constituted the bases for assessing the harmony of online family environment. The fact that parent–child subjects are online mutual friends indicates that children are willing to disclose their online lives to their parents to a certain extent (Padilla-walker et al., 2011). Simultaneously, parents' gradual involvement and integration into their children's Internet life can enhance their level of knowledge about their children's online behavior (Wang et al., 2005). In turn, parental information is embedded in parent–child communication, and a few studies have considered parental information as a broad dimension of parent–child relationship quality (Anderson and Branstetter, 2012). Thus, we hypothesized that parents being online friends with their children and their level of knowledge of adolescent usage behavior may influence their preferences for different intervention strategies. Accordingly, we propose the following hypotheses:

*H7: There is a correlation between parent-child subjects being mutual online friends on social media platforms and parental knowledge of adolescent usage behavior.*

*H8, H9: Parents being their children's social media friends (H8) and their level of knowledge about their children's social media use behavior (H9) influence their intervention in their children's social media use.*

In our previous interviews, when asked whether their parents were aware of their social media use, 82.2% of respondents said "yes," 5.8% said "no," and 12% were "not sure." The comparison suggested that parents who were better informed about their children's online behavior tended to have a more positive attitude toward social media and a relatively practiced skill set. When asked whether their parents were their social media friends, 30% of children responded that their parents were their online friends on all social apps; such parents participate in a relatively wide range of online activities. A total of 38.7% said that their parents were their online friends on a few social platforms, partly because they did not use them and partly because they deliberately hid them from their parents. As can be seen, the interview data partially confirm a correlation between parents' technological characteristics—attitudes toward social media, frequency of online activity participation, and proficiency in skills—and the construction of an online family environment—online mutual friends, informed use behaviors, etc. However, inadequacy of empirical data is a major challenge for the current study. Accordingly, we propose the following hypotheses:

*H10–H12*: Parents' attitudes toward social media (H10), frequency of online activity participation (H11), and proficiency in skills (H12) influence parents' intervention in children's social media use by facilitating online mutual friendship.

*H13–H15*: Parents' attitudes toward social media (H13), frequency of online activity participation (H14), and proficiency in skills (H15), in turn, influence their intervention in children's social media use by promoting parental awareness about children's media use behaviors.

Based on the 15 research hypotheses mentioned above, an attribution model was proposed to explain the adoption of parental intervention strategies (Figure 1).

## Methodology

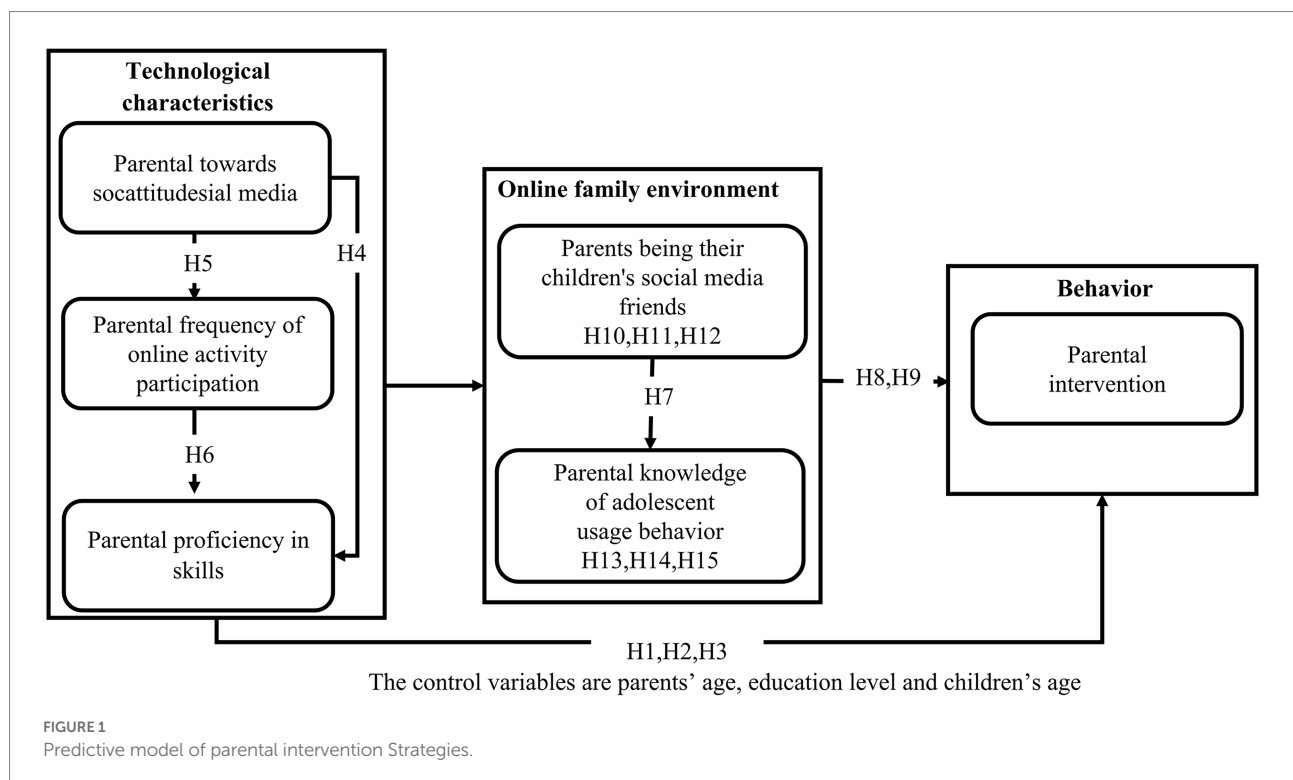
### Data collection and analysis

Our study examined parents' intervention in adolescents' social media use in the post-pandemic era and explored the mechanisms influencing their adoption of specific intervention strategies. Middle school, high school, junior college, and technical school students aged 12–17 were specified as youth. According to Van den Bulck and Van den Bergh (2000), social responsibility norms induce parents to intentionally exaggerate

their media intervention in questionnaires. In contrast, children may intentionally weaken their parents' intervention for peer admiration (Warren, 2001). Consequently, this study incorporated semi-structured online interviews with 40 parent–child paired samples, in addition to the parent sample questionnaire, to present a clear and complete picture of parental interventions from the dual perspective of parent–child subjects.

The data collection of the parental sample was selected from Nanchang, Shangrao and Ganzhou, Jiangxi Province, in Mainland China. Using PPS sampling, 24 sampling units were obtained based on the principle of equal spacing by ranking economic indicators, and one community was selected from each sampling unit, and 20–25 households were randomly selected in each community. Parents were surveyed if there were adolescents aged 12–17 in the sampled households; if not, scroll down and try to ensure a 50/50 split of male and female respondents. The survey was conducted in face-to-face interviews between December 1 and 30, 2021, the newly revised 2021 law has just been issued. The questionnaires were manually reviewed after collection. The questionnaires with too many “not sure” and “cannot say” options were eliminated. 500 questionnaires were distributed, 469 were collected, 447 were valid, and a valid return rate was 89.40%.

In terms of parental sample composition, 47.1 and 52.9% of the respondents were male and female, respectively; 44.7% were aged 41–45, 36.3% were aged 36–40, and the remaining three age-groups accounted for 19.0% in total. A total of 21.7% were in junior high school and below, 26.2% were in technical secondary school / senior school / technical school, 28.9% were in college, 16.2% were university undergraduates, and 7% were postgraduates



and above. The participants included professional and technical personnel (28.9%), employees of enterprises and companies (25.4%), staff of party and government organs (18.2%), freelancers (14.0%), and agricultural, forestry, and fishery production workers (13.5%). A total of 54.8% of the participants self-assessed their family economic level as middle, 21.5% as middle and low, 14.7% as middle and high, while 9% were not sure about their family income level. If there are several children fit the age range, the first child was selected to fill in the questionnaire. The children of the respondents were as follows: 33.5% were 12–13 years old, 35.6% were 14–15 years old, and 30.9% were 16–17 years old.

## Measurements

### Parents' attitudes toward social media

Referring to the scale of [Yi and Lin \(2015\)](#), five items were measured; for example, "Social media is very interesting," "My work and life would be very different without social media," etc. Responses ranged from "strongly disagree" = 1 to "completely agree" = 5 ( $M = 2.43$ ,  $SD = 1.04$ ,  $\alpha = 0.90$ ).

### Frequency of online activity participation

The use of eight service functions was measured; for example, "search (people, groups, official accounts)," "give a like, comment, dynamic publishing," etc. ([Wei et al., 2011](#); [Zhou, 2014](#); [Liu et al., 2022d](#)). The responses ranged from "not at all" = 1 to "often" = 5 ( $M = 3.35$ ,  $SD = 1.03$ ,  $\alpha = 0.89$ ).

### Proficiency in skills

Referring to Jianhua, van Deursen, and van Dijk's scale, we focused on users' mastery of six skills, such as "creating content" and "security settings;" responses ranged from "unfamiliar" = 1 to "very familiar" = 5 ( $M = 3.76$ ,  $SD = 1.35$ ,  $\alpha = 0.87$ ; [van Deursen and van Dijk, 2010](#)).

### Parents being online friends of their children

The responses of the proactive invitee and the invitee were examined with the help of three questions based on the study by [Katherine and Joy \(2011\)](#), such as "How did you react when your child invited you to become an online friend?"; responses were scored on a 5-point Likert scale, ranging from "very unhappy" = 1 to "very happy" = 5 ( $M = 3.18$ ,  $SD = 1.14$ ,  $\alpha = 0.94$ ).

### Parental knowledge of adolescent usage behavior

Referring to the Parental Information Scale ([Spath et al., 1998](#)), five items, including "which social media the child uses" and "with whom the child communicates online" were examined; scores ranged from "not at all" = 1 to "very clear" = 5 ( $M = 2.89$ ,  $SD = 0.89$ ,  $\alpha = 0.83$ ).

Cronbach's alpha values of the above variables were in the range of 0.87–0.94, the KMO of all variables was  $>0.83$ , Bartlett's sphericity test reached a significant level, and the factor loadings

of all items on the corresponding latent variables were greater than 0.50. This indicates that the scale has good structural and functional validities.

## Parental intervention strategies

A pool of entries for the parental intervention scale was developed after preliminary in-depth interviews and an open-ended questionnaire survey. After two rounds of expert consultation, a 40-item parental intervention scale was finalized, including "Talking to your child about your experiences with using" and "Talking to your child about how to deal with online harassment." In the survey, parents were asked to respond using a 5-point Likert scale, where 1–5 represented "almost never," "once or twice a month," "once or twice a week," "three or five times a week," and "almost every day," respectively ( $M = 3.34$ ,  $SD = 0.89$ ,  $\alpha = 0.87$ ).

After three rounds of exploratory factor analysis of the sample data—and after removing question items 13, 39, and 40—four common factors were extracted. The factor loading values of similar topics constituting each factor were greater than 0.5 (0.54–0.98) and cumulatively explained 69.29% of the variance in the parental intervention scale. Validated factor analysis showed that all 4 s-order factors fit the data well, and the exogenous observed variables fell within the corresponding four common factors, indicating good convergent validity for all four dimensions of parental intervention. By summarizing the commonalities of the 4 s-order factors, conceptual dimensions of rule-based technical enhancement, active guidance enhancement, informed participation enhancement, and two-way empowerment enhancement were proposed. Rule-based technical enhancement means that the parent and offspring jointly develop rules or the parent control, manage and regulate of the social media use behavior of the offspring by technology. Active guidance enhancement refers to promote effective use of social media through guidelines such as "how to distinguish between virtual and real" or "how to achieve safe sharing of content." Informed participation enhancement refers to achieve parental knowledge of the offspring's online behavior through integration with the offspring in the online world of social media, then enhancing digital literacy. Two-way empowerment enhancement can be understood as the parent and child encouraging each other to explore and learn new things together on social media, forming family discussion groups to accomplish specific tasks together, sharing problems and interesting things, exchanging insights and judgments about social media use in collaboration. Based on related theories and the dimensional structure of existing measurement scales, the structural dimensions of the three hypothetical unidimensional, three-dimensional, and four-dimensional models were compared. This comparison confirmed that the four-dimensional model had a better fit for the main indicators ( $X^2 = 391.475$ ,  $df = 241$ ,  $X^2/df = 1.625$ ;  $GFI = 0.972$ ,  $AGFI = 0.941$ ;  $RMSEA = 0.041$ ;  $NFI = 0.913$ ,  $CFI = 0.923$ ,  $IFI = 0.976$ ).

## Control variables

Studies related to television, the Internet, and game interventions have found that gender has less influence on the adoption of parental interventions compared to the age of the child (Livingstone and Helsper, 2008). Additionally, parents who are younger and have a relatively high level of education are more likely to adopt relatively positive interventions such as shared use with their children (Roe, 2000). Thus, the age of parents and children, as well as the education level of parents, were used as control variables.

## Result

### Parent vs. offspring: Recognition and preferences on parental intervention strategies

The in-depth interviews revealed that the younger their children are, the more likely are the parents to choose two intervention strategies: actively guided promotion and rule-based technical promotion, to prevent young children from becoming addicted to social media. Parents will give younger children specific instructions on “what” to use and “how” to use social media, discuss and enforce rules with elder children together, or agree to use technologies such as electronic nannies and teenage models to restrict the use of specific functions and permissions. “I limit the amount of time my younger son (age 12) uses social media. But to his elder brother (age 16), I prefer to advice rather than restrict (PR1, male, age 37, master’s degree, interview log P21).”

Parents will also adjust specific intervention methods according to their children’s characteristics; for example, to weaken the recalcitrance of adolescence, they often send motivational “tweets” to guide their children to moderate their use of media (PC1, male, age 37, junior college, interview log P13). For younger children, they arrange diverse family activities to divert their attention (PW2, female, age 38, bachelor’s degree, interview log P74). A few parents also mentioned setting a good example for their children by themselves using the Internet in a reasonable manner (PD3, male, age 44, master’s degree, interview log P105). Most respondents indicated that children’s time limits were the most popular rule-based technology use restriction strategy. Children also reported that “My parents allow me to use social media only on weekends and holidays” (CD1, male, age 13, middle school, interview log P28).

The two-way empowering media intervention strategies require a certain threshold. When parent–child subjects have comparable skills and interact well, and the concept of “members are resources” takes the lead, the “conscious-active-self-sufficient-shared” activity mechanism is followed. With resource sharing and co-construction of active mutual assistance among subjects, instead of one-way passive “metaphor” and “acceptance,” the enthusiasm of parent–child subjects is fully mobilized to improve

their digital literacy. “Since I worked with my child on a WeChat car rental, my child (age 16) has stopped calling me ‘technologically illiterate’ and discusses with me all that is new online (PL1, female, age 40, bachelor’s degree, interview log P54).” However, when parents do not have the ability to try new things together with their children, and do not have an inclusive and open mind toward new things, the two-way empowering parental intervention will be hindered. “Mom’s skills are so poor that she is not at the same level as me. Just me teaching her is not a two-way improvement” (CZ2, male, age 12, junior high school, interview log P12).

Informed engagement enhancement strategies are more often a “deviant intervention” after being “selectively informed.” A few parents use online media to stay informed. Parents use Weibo, or re-use QQ, to hope to participate in the daily online life of their teenagers through online parent–children interaction to improve communication and understanding between them. “My mother knows my WeChat and QQ accounts. She added me as a friend and checks my status” (CD3, male, age 17, high school, interview log P104). A total of 73% interviewed parents mentioned that being informed about their children’s online behavior alleviated their anxiety about their children’s online safety and facilitated targeted parental interventions. A total of 53% of the parents felt fully informed about their children’s only use behavior, but 69% of them were only “selectively informed” by their children. “Now I do not talk much on Moments because my mother added me as (her) friend. I prefer to update my status on Weibo or elsewhere” (CW2, female, age 14, junior high school, interview log P78).

Interview data showed that parent–child subjects were relatively consistent in their preference for rule-based technical enhancement, active guidance enhancement, and two-way empowerment enhancement. A few children disagreed with the informed participation enhancement strategy, although most confronted it silently without their parents’ knowledge. For example, “Mom installed location and blocking software on my phone, saying it was for my security. I cracked it off a long time ago, but mom does not know” (CZ2, male, age 17, high school, interview log P12). Parents consider access to their children’s private information with permission as a gatekeeping behavior for online safety, but a few adolescents view it as invasion of privacy. The privacy management theory suggests that adolescents have the right to manage and control access to personal information; however, there is no consensus between parents and children regarding the definition of privacy. In particular, parents do not appropriately relinquish control over their children’s private information as they enter adolescence, as expected by the children (Smetana et al., 2006).

In general, the “four modes” of parental intervention are not singularly presented, but are more often intertwined. A comparison of parent–children samples revealed that parent–children subjects’ perceptions and preferences regarding the types of parental interventions were largely consistent. However, parents reported using their intervention strategies much more frequently than perceived by their children. Thus, our first research question was answered.



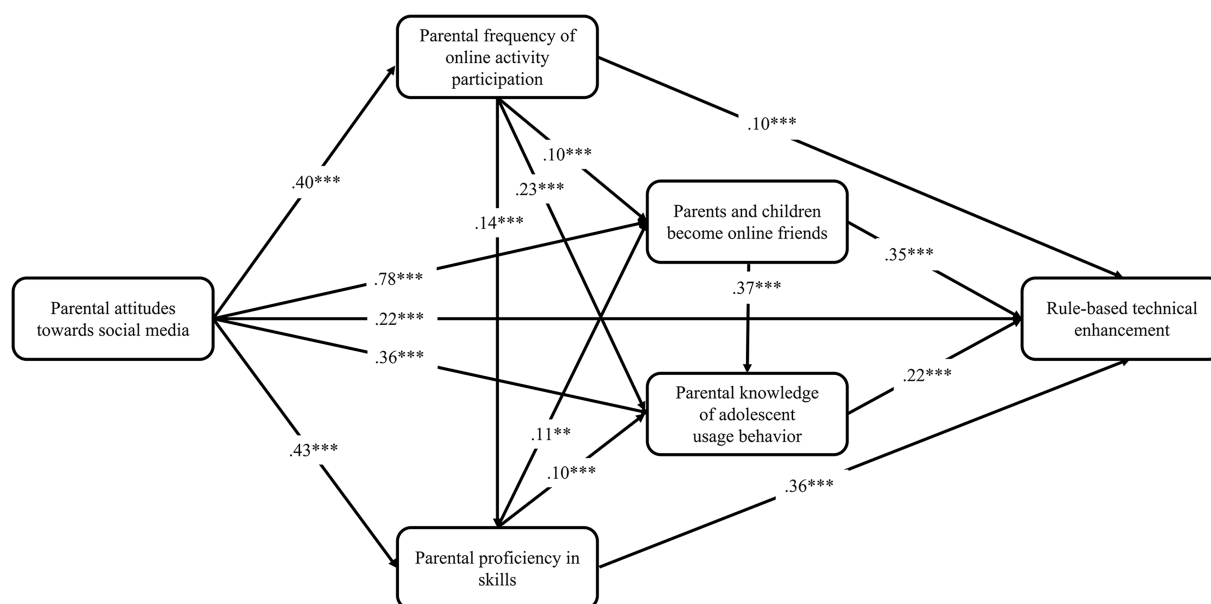


FIGURE 2

Predictive path coefficients of rule-based technical enhancement. \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

## Structural model: Empirical analysis of a predictive model of parental intervention strategies

The structural equation modeling from an empirical perspective reveals the dynamics of the adoption of different parental interventions, and presents the relationships among different possible factors. The aforementioned study proposed four dimensions of parental intervention based on which supplementary research hypotheses were proposed and tested. The fixed-load and maximum likelihood methods were adopted to estimate the previously constructed theoretical model of parental intervention; the standardized path coefficients are shown in Figures 2–5.

The results show that all the fit indices of the four prediction models were extremely good (Table 1), and all the indicators of the models satisfied the fit requirements of the structural equation model, indicating that the hypothetical model could be accepted.

From the perspective of explanatory power, parents' attitudes toward social media, frequency of online activity participation, proficiency in skills, and other factors jointly play a role in the dependent variables. Parents' attitude toward social media not only had a direct effect on the dependent variable, but also indirectly influenced the dependent variable through the mediating variables "frequency of online activity participation," "proficiency in skills," "parents' knowledge of their children's use behavior," and "becoming online friends." The estimation results from the prediction models show that our previous predictions—15 research hypotheses—were supported to varying degrees by the empirical data in all four models. And digital family environment constitutes the intermediary chain

between individual technical characteristics and parental intervention. A comparison of the four models shows that the explanatory power of the individual's technical characteristics and digital home environment for the dependent variables together differed more significantly between the rule-based technical enhancement ( $R^2 = 0.35$ ), active guidance enhancement ( $R^2 = 0.38$ ), informed participation enhancement ( $R^2 = 0.56$ ) and two-way empowerment enhancement models ( $R^2 = 0.83$ ).

Comparatively, the two-way empowerment enhancement model fits better with the current reality of parental intervention on children's media use in digital families. It has higher explanatory power, which can be regarded as an ideal family digital literacy enhancement strategy. Since the harmony of the online family environment is a prerequisite for the parental knowledge of the offspring's use behavior, the introduction of the online family environment variable is more explanatory for the informed participation model. Rule-based technical enhancement and active guidance enhancement, which were born out of restrictive and active interventions in the traditional media era, are far less effective than the two aforementioned models in explaining digital literacy enhancement.

## Discussion

### Conclusion and implications

The Covid-19 pandemic has induced adolescents' increased engagement on social media for multiple activities: work (Liu et al., 2022e), education (Hsu et al., 2021), socialization (Liu et al., 2021), entertainment (Chen et al., 2022a,b), etc., which



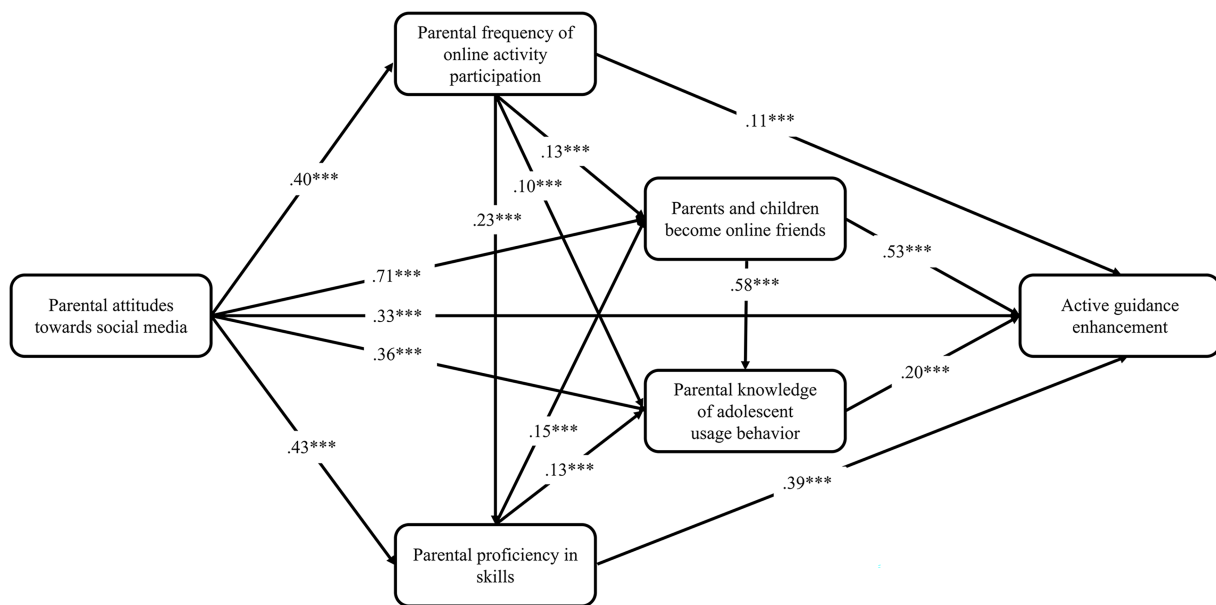


FIGURE 3

Predictive path coefficients of active guidance enhancement. \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

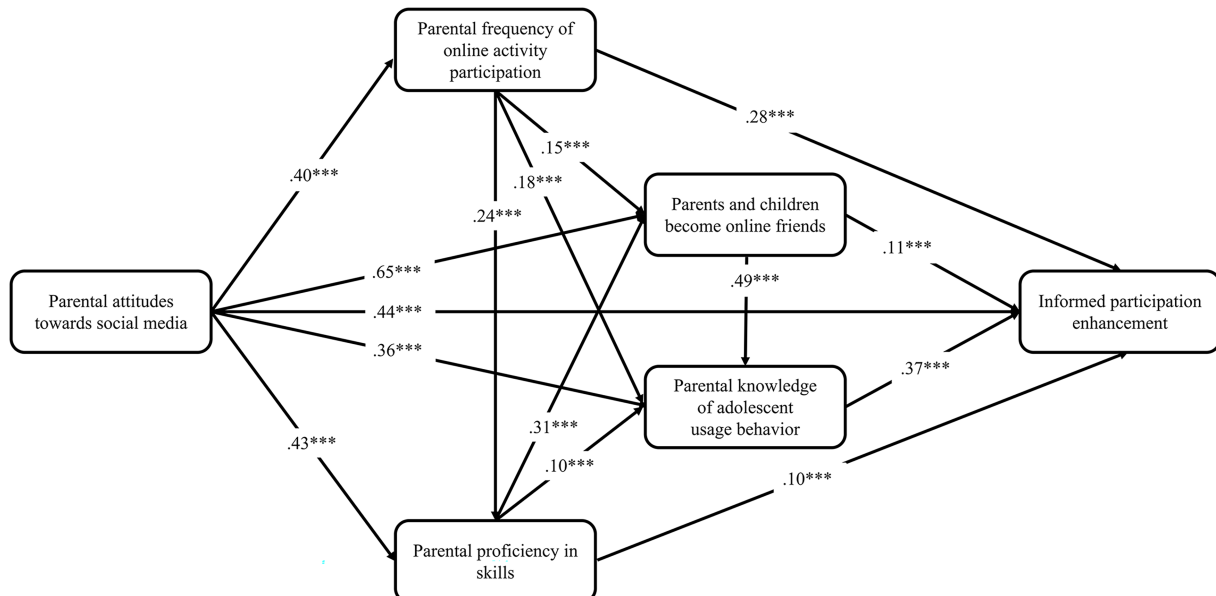


FIGURE 4

Predictive path coefficients of informed participation enhancement. \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

may influence parental intervention strategies. Our study focused on parental intervention in the post-pandemic era. First, the concept of literacy improvement based on interaction extends beyond the interpretation of parental intervention and provides a comprehensive conceptual model with verifiable measurement dimensions. Second, the comparison based on the

parent-child sample reconfirmed that the frequent occurrence of the four intervention strategies in the family and parent-child subjects has a certain degree of consensus. Third, the prediction model of “individual technical characteristics-online family environment-parent-mediated intervention” was constructed and verified, and the influencing factors were systematized. In

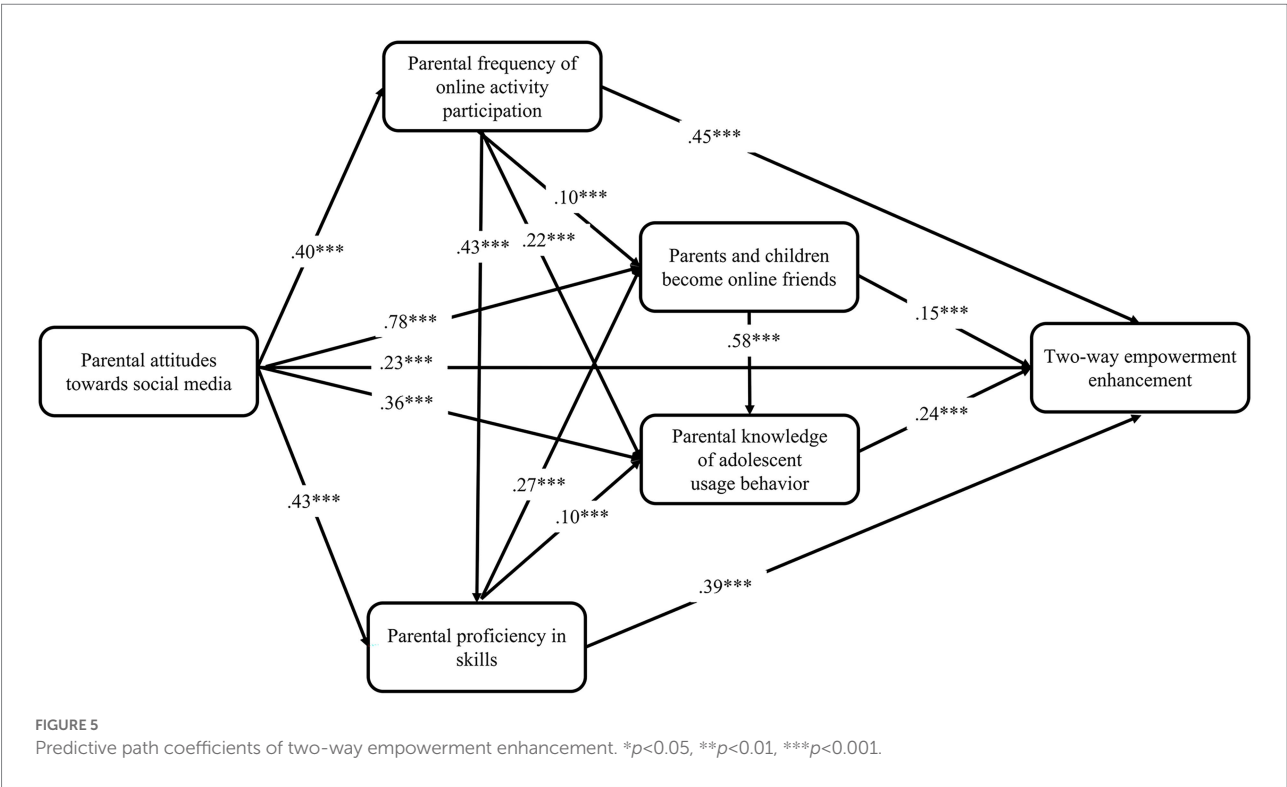


TABLE 1 Fitting results of the prediction model of parental-mediated intervention strategies.

Model	X <sup>2</sup> /df	RMSEA	PNFI	PGFI	GFI	AGFI	CFI	NFI	IFI	TLI
Rule-based technical enhancement	2.56	0.07	0.79	0.88	0.97	0.90	0.97	0.97	0.97	0.94
Active guidance enhancement	2.31	0.05	0.76	0.84	0.98	0.90	0.98	0.98	0.98	0.92
Informed participation enhancement	2.78	0.07	0.74	0.82	0.96	0.91	0.97	0.96	0.96	0.91
Two-way empowerment enhancement	2.06	0.07	0.73	0.83	0.98	0.92	0.98	0.98	0.98	0.90

contrast to previous explorations of hardware technology adoption and parent–child relationship quality as causal factors influencing parental intervention environments, an online family environment (“whether they are friends online” and “parents’ knowledge of their children’s use”) was introduced based on a parent–child interaction perspective to fit the new scenario of social media use.

Theoretical implications

The theoretical implications of this study include moving beyond “protectionism” to “interactive literacy enhancement,” innovating the concept and practice of parental intervention in the post-epidemic era. Parental interventions in social media use should be to “guide” rather than “prohibit.” Parents should focus on “safe use” instead of “better use,” effectively integrate “parent–child online interaction,” and implement interactive and guided parental interventions with a more inclusive and open mind. For example, parents should spend more time to find good “digital projects” for

the family and share their digital technology skills with their children to promote the digital literacy of both parents and children and build a new communication pattern for a digital family.

Practical implications

Summing up the hierarchical progressive logic of parental intervention, family cohesion is the “anchor point” of media intervention. This study not only provides an empirical description of parental interventions, but also reveals that parents’ technological characteristics and online family environment jointly influence the occurrence of parental interventions. The online family environment constitutes a mediating chain between individual technological characteristics and the occurrence of parental interventions. Parents’ technological characteristics are also antecedent variables in the construction of the online family environment. In summary, parents guide their children’s social media use with the concept of literacy improvement, and they are not only observers but also active participants in their children’s

online activities. The effectiveness of the intervention is more because of the “cohesion” between parent–child subjects.

## Limitations and directions for future

From a theoretical perspective, future research should focus on the following: First, parents’ intervention in their children’s social media use varies, depending on the type of media; our study focused on a broad category of social media and did not distinguish between specific types. Subsequent refinement of the study is required. Second, although adolescents are considered digital natives, a few individuals may lack the ability to use social media effectively; this intra-generational disparity can be partly attributed to the lack of effective parental intervention. Thus, it is necessary to focus on the relationship between parental intervention and intra-generational inequality among adolescents. Third, our study confirmed the influence of individuals’ technological characteristics and online family environment on parental interventions; however, it did not involve the social and emotional decision-making process when parents adopted specific intervention methods. Subsequent attempts could be made to incorporate integrative behavioral models into the study of parental interventions.

## Data availability statement

The data analyzed in this study is subject to the following restrictions: some adolescent respondents asked for personal privacy protection. Requests to access these datasets should be directed to the corresponding author JC, [chenjiali0907@163.com](mailto:chenjiali0907@163.com).

## Ethics statement

Written informed consent was obtained from the individual(s), and minor(s)’ legal guardian/next of kin, for the

publication of any potentially identifiable images or data included in this article.

## Author contributions

BW: research design, conceptualization, data collection and analysis, manuscript writing, and supervising. JC: theory construction, data collection and analysis, manuscript writing, and supervising. All authors contributed to the article and approved the submitted version.

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## Conflict of interest

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

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# The effect of mindfulness on online self-presentation, pressure, and addiction on social media

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As social media has become more imperative in daily life, people pay more attention to self-presentation and impression management on social media, and some have even become psychologically dependent. There is a large group of socially addicted users who continuously strive to improve their online self-presentation. Due to stress and burnout arising from social media addiction, people change their social media behavior. The influence of mindfulness on social behavior cannot be ignored. This study aims to explore coping behaviors and the role of mindfulness for people under social media pressure and social media addiction in China's special political environment. We found significant differences in self-presentation, social media pressure, and social media addiction among different circles in the Chinese context. Experiments have shown that people's socially addictive behaviors and abilities to withstand social media pressure are affected by their mindfulness. In addition, the more social media pressure people perceive on social media, the more likely they are to stop using social media and shift to offline interpersonal interactions. However, when there are more offline interpersonal interactions, people's willingness to return to social media platforms increases.

## KEYWORDS

**mindfulness, social network relations, self-presentation, social media pressure, social media addiction**

## Introduction

Social media emerges to be the primary platform for people to communicate with each other. An increasing number of people use social media for social interaction, and an online network society has emerged (Castells, 2001). People use social media to shape and promote an idealized self-image. The interactive behavior of liking, sharing, and commenting replaces offline, face-to-face communication. Compared to offline communication, online social behavior is more performative. Many users share creative performances to present themselves and their talents. The content posted by users on social media gradually becomes the primary channel for others to know them and even serves as a reference for others whether they want to communicate further.



The appearance on social media might also determine whether a user can join a community (e.g., work, leisure, politics). Such communities are referred to as circles in China. The cultural, social, and political development of China differs significantly from Western countries. Therefore, the qualifications for entering a community differ. Entering a circle in China is, among other factors, driven by political affiliation and personal relations (Jiade, 2017). Political affiliation refers to membership in or close association with a political party or organization and indicates one's political orientation and views. In comparison, personal relations are less specific than political affiliation when judging whether a person can enter a circle. Political affiliation is an objective judgment and relatively stable over time, while personal relations are affected by subjective, dynamic factors.

As social media becomes increasingly prevalent in life, many people become psychologically dependent and sometimes even addicted. They continuously strive to present themselves positively and shape an idealized self-image. Intensified social media addiction can also greatly impact offline life, because it causes stress and potentially burnout. Consequently, people develop different coping behaviors, one of which is to relieve pressure by reducing or stopping the usage of social media (Lazarus and Folkman, 1984). Some users purposively reduce the frequency of their posts or even close some of their social media accounts. Another coping behavior is to return to social media after a brief period of deactivation (Ravindran et al., 2014; Zhao, 2019).

Mindfulness describes a practice of meditation in which a person is fully aware of his or her activities and feelings in the present moment, without any subjective interpretations and judgments (Bishop et al., 2004). Recently, it becomes one of the most-researched areas in psychotherapy (Germer et al., 2013). Existing research shows that mindfulness is linked to people's mental health (Liu et al., 2022a). According to some studies, mindfulness is associated with people's mental health. Rasmussen and Pidgeon (2011) report that "mindfulness significantly predicts high levels of self-esteem and low levels of social anxiety." Another study confirms that improving individual mindfulness can effectively foster subjective well-being (Liu et al., 2022b). And spirituality mediates the relationship between mindfulness and subjective well-being (Liu et al., 2020). The many benefits of mindfulness have led scholars to explore how to improve mindfulness. Research shows that mindfulness meditation can significantly increase mindfulness and boost creativity (Chen et al., 2022). In addition, studies started to explore the interplay between mindfulness and social media use. For example, research by Poon and Jiang (2020) proves that mindfulness can effectively mitigate the negative effects of social media. Previous research on mindfulness shows that mindfulness has a considerable influence on people's social life. This study attempts to explore the interrelation between mindfulness and social media use.

Even though some studies point out the interaction between mindfulness and social media addiction (Sriwilai and Charoensukmongkol, 2016), other studies reveal a correlation between mindfulness and self-control (Bowlin and Baer, 2012).

However, how mindfulness relates to the two coping behaviors described above is an open field. Previous studies have summarized the main factors that reduce people's performative behavior on social media. For instance, the rising cost of maintaining a self-image (Hong and Duan, 2020), the increasing complexity of social relationships on social media, the hindrance of self-expression (Chen and Hu, 2015), and the complex use and operation of social media technology (Maier et al., 2015).

This study aims to discuss the following questions: 1. Are there differences in social media stress and social addiction behaviors faced by people from different political backgrounds in China's unique political and cultural context? 2. Does individual mindfulness lead to differences in how people shape their self-image on social media? 3. How does mindfulness affect people when facing social media pressure? 4. Finally, when people become socially addicted and are thus tired of self-image construction or perceived social pressure, what behaviors do they adopt to cope with it?

## Literature review and research hypothesis

In this section, we review the related literature. We first review literature that investigates Chinese social network relations in Section 2.1 before we summarize literature on mindfulness in Section 2.2. In Section 2.3, we present literature that discusses self-presentation on social media, and Section 2.4 summarizes literature regarding social media pressure and social media addiction. Finally, we present an integrated model in Section 2.5.

### Chinese social relations

Individuals cannot live without social relationships. In China, a commonly used expression is 'make use of guanxi', which means people expect to establish and maintain relationships in anticipation that assistance can be obtained when the need arises. Hwang (1987) emphasizes that a large proportion of Chinese relationships is a combination of 'instrumental' relationships (with parties with whom one deals in order to achieve practical goals) and 'affective' relationships (with family members and close friends). Yu (1987) suggests that Chinese individuals strive to build relationships and share specific rules with others. The development of relationships can convert a person who was merely an acquaintance into a type of in-group member, and then exchanges of favors are used to maintain the relationship. Fei (1998) suggests that Chinese social relationships take the form of a differential pattern. In this pattern, each person forms his or her set of relationships and is simultaneously in the circle of other people's relationships. Blood lineage, geography, economic level, political status, as well as intellectual and cultural level are the five major factors affecting the formation of the differential pattern. Among them, political status is the most influential.

China implements a system of multi-party cooperation and political consultation, which includes the Communist Party of China (CPC) and eight democratic parties, as well as people without party affiliation. The Communist Party of China is the founding and sole governing political party in China, and it is also the party with the largest number of members. A Chinese citizen who wants to join the Communist Party of China needs to go through a series of complicated processes. First, he needs to join the Chinese Communist Youth League and become a member of the Communist Youth League. Then, outstanding members of the Communist Youth League can be recommended to become active members. Active members have the opportunity to become probationary party members after inspection. Finally, prepare Party members can become full-fledged party members only after a one-year probation period. In China's unique political system, political status is primarily related to people's political affiliation. With the rapid development of social media, a series of activities and learning courses in the process of political profile conversion in China have gradually moved online and integrated with social media, and local party branches have started to actively use online learning applications to carry out political education activities, set quantitative assessment criteria such as learning points for applicants, and measure applicants' political attitude through the information presented on social media platforms such as WeChat. If the number of hours of online learning or the number of learning points is not up to par, it may affect the individual's evaluation results. The public's political stance also affects social media expression and political participation behavior (Cao Yue, 2020). Given the many benefits of increased mindfulness, mindfulness has found its way into all spheres of society and even politics. In the United Kingdom, for example, mindfulness practice is widely spread among politicians, who see mindfulness as a good tool to help the entire polity and society (Bristow, 2019). In China, mindfulness has not yet been applied in the political field on a large scale, and there is also a lack of research on the correlation between mindfulness and political factions in academia.

## Mindfulness

Mindfulness, originally derived from the Buddhist tradition, is a meditation practice (Baer, 2003). It is generally defined as focusing attention in a non-judgmental and receptive way on the activities being in the moment and the inner thoughts and feelings of the individual (Bishop et al., 2004). The nature of mindfulness to be in the midst of things but to keep it at arm's length in a non-judgmental manner gives mindfulness a number of benefits. For example, regular and continuous mindfulness practice is showed to reduce automatic responses in the emotional, physiological, and behavioral domains (Bartlett et al., 2021). Mindfulness can significantly reduce postpartum depression symptoms in mothers (Liu et al., 2022c). At the same time, mindfulness can help improve people's subjective well-being

(Liu et al., 2019). Many studies have demonstrated the positive effects of mindfulness on people in many fields, and this study wants to explore the specific effects of mindfulness on people in the social media environment.

To date, many tools for assessing mindfulness have been developed, such as the Mindfulness Attention Awareness Scale (MAAS; Brown and Ryan, 2003), the Toronto Mindfulness Scale (TMS; Lau et al., 2006), the Philadelphia Mindfulness Scale (PHLMS; Cardaciotto et al., 2008), the Kentucky Inventory of Mindfulness Skills (KIMS) developed by Baer et al. (2004), and their revised Five-Faced Mindfulness Questionnaire (FFMQ) based on KIMS (Baer et al., 2006). These scales differ mainly in the dimensions they measure, the population they are used for, and how and in which context they measure mindfulness. Among the many tools for assessing mindfulness, the MAAS has been considered by most scholars. The MAAS was initially validated with white college students and adults living in the United States. In addition, Deng et al. (2012) conducts a research test of the Chinese translation of the MAAS, demonstrating its effectiveness in assessing mindfulness in a population of Chinese college students. However, few scholars have explored the association between mindfulness and social media use in China, as well as the relationship between mindfulness and political context.

## Self-presentation on social media

The emergence of social media has led to the migration of offline social circles going online, with users finding a sense of identity and belonging to circles through more diverse and rich self-presentation. People tend to present an idealized self-image to others and make others form a specific impression of themselves through strategic self-presentation (Goffman, 1978). In real life, people rely on verbal communication, gestures, expressions, and dressing for face-to-face impression presentation and adjust their self-image through immediate observed audience reactions. The emergence of social media has turned this self-presentation into a strategic display characterized by reinforcing strengths and hiding weaknesses (Chenyu Dong, 2018).

WeChat is currently the most widely used social media platform in China. Displaying and sharing information through WeChat Moments has become a common method of social interaction. The WeChat Moments feature removes the time and space limitations of traditional interpersonal communication, which allows users to display themselves to a bigger audience without any in-person presence (Shan, 2019). In terms of communication content, dynamic visual displays such as short videos and GIFs make image building more vivid and comprehensive, adding more realism. Additionally, the contextual reproduction ability of the video can also better cope with contextual dissolution. In most contexts, individuals' interpersonal relationships rely nowadays more on the online sphere than the offline sphere. Young people, who rely heavily on the internet, are the primary users of WeChat. They are sensitive to their self-image

and the evaluation of others (Wang, 2017), and they are adept at purposeful and strategic self-presentation and impression management through this medium.

Extensive research over the years also demonstrates the many psychological benefits of mindfulness (Keng et al., 2011). Mindfulness is considered a potential regulator of self-presentation. Studies show that there is a negative correlation between mindfulness and loss of self-awareness dimensions, that is, high levels of mindfulness can help people better maintain self-awareness (Chen et al., 2019). Yang et al. (2017) explore how four dimensions of social media self-presentation affect college freshmen's self-esteem and identity clarity by using a multi-faceted model of online self-presentation. Their research shows that mindful adults may be more effective in monitoring and regulating their online self-presentations. In particular, their research shows that those who are under pressure to be perfect and over-engage in extreme self-presentation can benefit greatly from increased mindfulness, which helps them shape better self-presentation (Flett et al., 2021). In addition, mindfulness plays an important role in improving negative outcomes associated with being left out on social media. Poon and Jiang (2020) research report states that when people do not get enough likes on social media, their negative emotions increase significantly, and mindfulness can moderate this effect.

Social media has become a social arena where self-expression and image construction are synchronized. Advanced technologies and mobile devices have created an instantly updated and closely connected online social world for users, increasing the accessibility of interpersonal communication and becoming the basis for modern people to build interpersonal relationships. Some people worry that socialization on social media platforms will gradually replace traditional face-to-face interpersonal communication, and people will use the symbolic system of new media to communicate, interact, and shape themselves.

## Social media pressure and social media addiction

Social networking platforms play an indispensable role in people's daily life as a digital tool to execute social interactions (Pontes et al., 2018). With the popularity of social media, negative consequences such as social media addiction have attracted the attention of scholars. Social media addiction is a state in which an individual cannot control his or her social media use despite adverse effects on his or her life. The American Psychiatric Association defines social media addiction as a disorder requiring further research (American Psychiatric Association and Association, 2013). Specific symptoms of social media addiction include individuals spending more time than average on social media, having difficulty controlling their behavior, and a severe lack of offline socialization (Kraut et al., 1998; Iskender and Akin, 2010). In other words, for social addicts, social media becomes a compulsive activity

(Kardefelt-Winther, 2014). This paper's definition of social media addiction is based on behavioral addiction and considers it as a universal behavior.

Empirical studies show that users may discontinue to use platforms due to stress of social media use (Luqman et al., 2017). In recent years, there has been an increasing number of retreaters in WeChat Moments, and many people have gradually reduced the frequency of posting online and even blocked WeChat Moments. According to statistical reports on internet development in China, as of June 2020, the use of WeChat Moments has decreased by 2.3% compared to the end of 2017. It has also been found that social media users are likely to temporarily or permanently reduce their online social activities due to emotional torment (Oghuma et al., 2016; Swar et al., 2017). Previous research show that social media users are prone to tiredness after experiencing various technological, information, and social overloads (Bright et al., 2015). When users attempt to disengage from the adverse effects of social media, they often resort to switching online platforms or abandoning online social media in favor of offline activities, such as face-to-face interpersonal social behaviors, to distract themselves from the exhaustion and stress associated with social media use.

Mindfulness has shown to promote self-control (Holas and Jankowski, 2013). The research of Du et al. (2021) indicates that (1) individuals' mindfulness intensity is positively correlated with social media self-control, (2) low mindfulness leads to social media self-control failure and further social addictive behavior, while (3) individuals with high mindfulness have better social media self-control. Compulsive use of social media creates greater pressure, and higher mindfulness can boost self-esteem, thereby reducing pressure-induced anxiety (Apaolaza et al., 2019). In addition, a study finds that mindfulness is negatively correlated with emotion-focused coping styles, that is, individuals with lower mindfulness tend to avoid problems rather than solve them (Sriwilai and Charoensukmongkol, 2016). Current research on avoidance behavior on social media is still insufficient. For example, Xiao and Mou (2019) study stops at users' emotional changes. Therefore, this study sought to explore how mindfulness is related to social media pressure and social media addiction faced by people China's unique political system. Meanwhile, based on the 'stress-response-outcome' framework, this study investigates how people adjust their social behavior online and offline after perceiving stress. According to the above literature, this study suggests the following hypotheses:

*H1:* In China's unique political and cultural context, there are differences in social media pressure faced by people with different political affiliations.

*H2:* In China's unique political and cultural context, there are differences in the level of social media addiction among people with different political affiliations.

*H3:* In China's unique political and cultural context, there are differences in mindfulness among people with different political affiliations.

*H4:* In the Chinese social environment, people's use of WeChat Moments can affect their online self-presentation behavior.

*H5:* In the Chinese social environment, people's level of mindfulness is linked to the use of WeChat Moments.

*H6:* In the Chinese social environment, people's level of mindfulness has an impact on their self-presentation.

*H7:* In the Chinese social environment, differences in people's mindfulness can cause differences in their social media addiction behaviors.

*H8:* In the Chinese social environment, differences in people's mindfulness can cause differences in perceived social media pressure.

*H9:* In the Chinese social environment, after people perceive stress, individuals with different mindfulness tend to choose different social behaviors to mitigate stress.

*H10:* In the Chinese social environment, after people experience social media addiction, people with different mindfulness tend to choose different social behaviors to deal with the addiction.

## An integrated model

Social psychology is known to be an important paradigm in communication research. With the evolution of social psychology, scholars have challenged the traditional stimulus–response (S–R) approach, which assumes only direct and automatic effects of media stimuli on people's responses and have started acknowledging the important role of indirect effects or mediations. Likewise, communication researchers are increasingly interested in understanding the mechanisms through which people attend and respond to messages from various social media outlets. To investigate these mechanisms, our research explores how the orientation of individuals toward social networking sites (SNS) affects the way they process messages and, further, how this

orientation affects cognitive and behavioral outcomes. In psychology, the S–R model has long been used to study changes in people's attitudes. Woodworth and Schlosberg (1965) propose the S–O–R model based on the S–R model, which is the most widely used model.

The S–O–R model postulates that stimulation and human behavior (reaction, action) are linked by an organismic component. The model differs from the traditional S–R model mainly in two aspects: (1) It emphasizes that stimulation (S) does not directly respond to the behavior of individuals (R), (2) the behavior of individuals is based on consciousness as a mediator. The S–O–R model assume that the attitude of individuals is triggered by external sources of stimulation that directly or indirectly affect its physical and psychological states. When faced with various stimulations, individuals generate specific motivations and behaviors.

The factors influencing people's perception of social media pressure and social media addiction are diverse and complex. Moreover, recent studies have shown that the relevant variables do not affect behavior in only one way, and different variables affect behavior in direct and indirect ways.

Our study refers to the S–O–R model: S is the social media use; O is self-presentation on social media, mindfulness, and social media pressure. That is how the attitudes and behavior of individuals (R) are formed, the variables are listed in Table 1.

## Methodology

### Sampling and data collection

Despite studies on mindfulness, social media pressure, and social media addiction being conducted on various social media sites, there has been little investigation of WeChat, the most popular social networking site in China. WeChat has approximately 1.26 billion users worldwide (Statista, 2022) and is regarded as a typical instant messaging tool, similar to Facebook and WhatsApp. High levels of social media addiction may exist among WeChat users (Montag et al., 2018b).

For this paper, we conduct a survey among WeChat users. To investigate people's SNS usage behavior, mindfulness, social media pressure, and social media addiction, we use a non-probability sampling method based on an online questionnaire. We collected our data in the period from 3 to 20 May 2022 through the online

TABLE 1 An S–O–R model.

Stimulus (S)	Orientation (O)	Response (R)
Social media use	Self-presentation	Social media addiction
	Mindfulness	Distraction within SNS
	Social media pressure	and distraction outside SNS



TABLE 2 Demographic statistics of the respondents ( $n=624$ ).

	Variable	Number	Percentage (%)
Gender	Male	345	35.3
	Female	632	64.7
Age	Less than 18	24	2.5
	18–30	703	72.0
	31–40	163	16.7
	41–50	60	6.1
	Over 51	27	2.7
Education	High school and below	160	16.4
	Bachelor's degree	642	65.7
	Master's degree	154	15.8
	PhD	21	2.1

survey design and dissemination platform Wenjuanwang.<sup>1</sup> This platform is used by many companies and universities in China to conduct online surveys (Mei and Brown, 2018). It provides a sampling pool of more than 260 million registered users in China, representing a diverse demographic background. Wenjuanwang randomly contacts users with brief information about the research and then records their responses to the survey (Vinnikova et al., 2020). We additionally incorporate a mixed-mode approach (e.g., using QQ and WeChat apps) to gather a broader sample of the relevant population. The first part of our questionnaire briefly introduces the research purpose and thanks the respondents for their participation. The second part comprises questions on the demographic characteristics of the respondents. The final part includes scale questions on the research constructs. Only the respondents who indicate to use a WeChat app on their smartphones at the time of filling out the questionnaire are included in our analysis. A total of 977 responses are included in our analysis. The sample proportions are male ( $n=345$ ) and female ( $n=632$ ). The majority of the participants are aged between 18 and 30 (72%,  $n=703$ ). As for education, most of the participants hold a bachelor's degree (65.7%,  $n=642$ ; Table 2). The survey sample mainly focuses on college students, who are in a crucial period of political affiliation change.

## Measures

The conceptualization and operationalization of the specific variables are defined as follows:

### Media use

The study refers to the scale of PAN Shuya (2018) which measures the three aspects of habituation, information acquired, and entertainment. Participants respond on a five-level Likert scale (1 for strongly disagree and 5 for strongly agree) with the

following questions: "I habitually visit my WeChat Moments every day"; "When I want to know what my friends and family are up to, I first look at their WeChat Moments"; "When I want to kill time or have fun, I browse my WeChat Moments." The alpha coefficient of internal reliability is 0.763.

### Mindfulness

We use the MAAS scale to measure the individual trait of mindfulness. Among the many instruments for measuring the trait of mindfulness, MAAS is the most widely used (Chen et al., 2021). The MAAS scale uses a structure of 15 items. Participants respond on a five-level Likert scale (1 for almost never and 5 for almost always). Lower scores represent greater mindfulness (Brown and Ryan, 2003). The alpha coefficient of internal reliability is 0.93 (see Table 3).

### Self-presentation

In the WeChat Moments, self-presentation mainly refers to the naming of the user's online identity, the choice of avatar, and emoji images. In this study, we measure self-presentation strategies according to the scale of Jiang (2013). The proactive strategy refers to the user's initiative to show his or her good side and pay much attention to the comments of others. For example, "I often browse and update the status of WeChat Moments"; "I value my friends' likes and comments in my WeChat moments"; "I pay attention to the personal image I present in my WeChat Moments"; "The photos I upload to my WeChat Moments are carefully selected"; "I actively interact with others on WeChat (Example: give somebody a like or reply to messages)"; "When I post a message on my WeChat moments, I choose my words very carefully." The alpha coefficient of internal reliability is 0.843.

### Social media pressure

Social media pressure refer to factors that make users stressed. Perceived social overload is often considered as one of the stressors (Zhang et al., 2016). Based on the studies of Karr-Wisniewski and Lu as well as Zhang, perceived social overload is measured in two dimensions: information overload and functional overload (Karr-Wisniewski and Lu, 2010; Zhang et al., 2019).

Information overload refers to users' exposure to excessive information on social media that they are unable to process. This study refers to the scale of Lin and Lu (2011) which considers two perspectives. The alpha coefficient of internal reliability is 0.829. Participants respond on a five-level Likert scale with questions such as: "I cannot browse through all the information in my WeChat Moments"; "Every time I open my WeChat Moments, there are too many updates in it"; "There is much information in my WeChat Moments, so it is hard for me to focus on the important information."

Functional overload refers to the fact that the platform provides more features than users need. To be more specific: "It takes me a long time to understand and use the new features of WeChat (e.g., group payment, posting videos)"; "I do not have enough time to understand the new features of WeChat. (e.g.,

<sup>1</sup> <https://www.wenjuan.com/>



TABLE 3 MAAS.

Items	<i>M</i>	<i>SD</i>
I could be experiencing some emotion and not be conscious of it until sometime later.	3.34	1.143
I break or spill things because of carelessness, not paying attention, or thinking of something else.	2.99	1.242
I find it difficult to stay focused on what's happening in the present.	3.44	1.157
I tend to walk quickly to get where I'm going without paying attention to what I experience along the way.	3.37	1.189
I tend not to notice feelings of physical tension or discomfort until they really grab my attention.	3.43	1.191
I forget a person's name almost as soon as I've been told it for the first time.	3.37	1.215
It seems I am "running on automatic," without much awareness of what I'm doing.	3.39	1.239
I rush through activities without being really attentive to them.	3.48	1.221
I get so focused on the goal I want to achieve that I lose touch with what I'm doing right now to get there.	3.43	1.081
I do jobs or tasks automatically, without being aware of what I'm doing.	3.17	1.180
I find myself listening to someone with one ear, doing something else at the same time.	3.30	1.173
I drive places on 'automatic pilot' and then wonder why I went there.	3.53	1.042
I find myself preoccupied with the future or the past.	3.67	1.033
I find myself doing things without paying attention.	3.45	1.096
I snack without being aware that I'm eating.	3.03	1.225

WeChat keyword search, hover window setting"); "I feel that I do not know enough about all the features of WeChat to use it well"; "I often find WeChat features very complicated and troublesome to use." The alpha coefficient of internal reliability is 0.886.

### Social media addiction

Social media addiction refers to individuals who spend more time than average on social media and have difficulty controlling their behavior. Participants respond on a five-level Likert scale to the following questions: "When browsing my WeChat Moments, I often neglect important things"; "Spending much time browsing WeChat Moments has a positive effect on my real-life social behavior"; "When I am studying or working, I often get distracted by browsing my WeChat Moments"; "When I do not browse my WeChat Moments, I feel uneasy"; "I have tried to reduce the frequency of browsing WeChat Moments, but I failed"; "Browsing my WeChat Moments affects my offline private life." (Turel and Serenko, 2012). The alpha coefficient of internal reliability is 0.904.

### Distraction within SNS and distraction outside SNS

Individuals tend to cope with stress through adaptive behaviors (Lazarus and Folkman, 1984). Attentional distraction

behavior is one of these adaptive behaviors. Research shows that people tend to be distracted both inside and outside of social media platforms when they are social media fatigued. In-platform distraction refers to when people get bored with one social media, they tend to switch to another social media, while off-platform distraction refers to when people get bored with one social media, they tend to switch to another social media. Switching to other platforms than social media platforms (e.g., offline social platforms). This study refers to the scale of Salisbury et al. (2002), which measures both in-platform and out-of-platform aspects. We ask participants to recall their coping practices and thoughts when they were unhappy about viewing information from their WeChat Moments in the past. Participants respond on a five-level Likert scale to the following questions: "I stopped browsing my WeChat Moments and went to the content of the official WeChat accounts that I follow"; "I stopped browsing my WeChat Moments and chatted with my family or friends instead"; "I stopped browsing my WeChat Moments and did other things (e.g., walking, reading books, watching TV)"; "I stopped browsing my WeChat Moments and used other social media platforms (e.g., Sina Weibo, QQ)"; "I stopped browsing my WeChat Moments and used video and audio applications other than WeChat (e.g., TikTok, video sites such as IQIYI and Tencent)." The alpha coefficient of internal reliability is 0.833.

## Data analysis and results

### Differences in mindfulness, social media pressure, and social media addiction across different political affiliations

Based on individual demographics, there are significant differences in social media use, social media pressure, and social media addiction. This study considers the unique political and cultural situation in China.

The mean and standard deviation of all scales are listed in Table 4. A univariate ANOVA reveals significant differences in mindfulness, social media pressure, and social media addiction depending on political affiliation (see Table 5 below), supporting H1, H2, and H3. First, the mindfulness of members of the CPC, probationary CPC members, and members of the Communist Youth League of China (CYLC) is higher than that of members of the democratic party. Moreover, a comparison reveals that the mindfulness of probationary CPC members is higher than that of the masses ( $F = 5.93, p < 0.001$ ). Second, the social media addiction status of members of the democratic party and the masses is higher than that of probationary CPC members and members of the CYLC ( $F = 8.1, p < 0.001$ ). Finally, our study finds that members of the democratic party and the masses perceive more social pressure on social media than probationary CPC members and members of the CYLC ( $F = 9.04, p < 0.001$ ).

TABLE 4 Descriptive of the sample.

Scale	Question	<i>M</i>	<i>SD</i>
Media use	I habitually visit my WeChat Moments every day	3.95	1.19
	When I want to know what my friends and family are up to, I first look at their WeChat Moments	3.8	1.16
	When I want to kill time or have fun, I browse my WeChat Moments	3.7	1.18
Self-presentation	I often browse and update the status of WeChat Moments	2.72	1.37
	I value my friends' likes and comments in my WeChat moments	3.45	1.25
	I pay attention to the personal image I present in my WeChat Moments	3.73	1.14
	The photos I upload to my WeChat Moments are carefully selected	3.9	1.14
Social media pressure	I actively interact with others on WeChat (Example: give somebody a like or reply to messages)	3.45	1.2
	When I post a message on my WeChat moments, I choose my words very carefully	3.58	1.16
	I cannot browse through all the information in my WeChat Moments	3.23	1.33
	Every time I open my WeChat Moments, there are too many updates in it	3.18	1.28
	There is much information in my WeChat Moments, so it is hard for me to focus on the important information	3.05	1.31
	It takes me a long time to understand and use the new features of WeChat (e.g., group payment, posting videos)	2.73	1.34
	I do not have enough time to understand the new features of WeChat. (e.g., WeChat keyword search, hover window setting)	3	1.32
	I feel that I do not know enough about all the features of WeChat to use it well	2.91	1.28
Social media Addiction	I often find WeChat features very complicated and troublesome to use	3.22	1.22
	When browsing my WeChat Moments, I often neglect important things	2.73	1.33
	Spending much time browsing WeChat Moments has a positive effect on my real-life social behavior	2.96	1.21
	When I am studying or working, I often get distracted by browsing my WeChat Moments	2.97	1.33
	When I do not browse my WeChat Moments, I feel uneasy	2.6	1.35
	I have tried to reduce the frequency of browsing WeChat Moments, but I failed	2.84	1.35
	Browsing my WeChat Moments affects my offline private life	2.78	1.32
Distraction within SNS and Distraction outside SNS	I stopped browsing my WeChat Moments and went to the content of the official WeChat accounts that I follow	2.92	1.31
	I stopped browsing my WeChat Moments and chatted with my family or friends instead	3.33	1.26
	I stopped browsing my WeChat Moments and did other things (e.g., walking, reading books, watching TV)	3.81	1.12
	I stopped browsing my WeChat Moments and used other social media platforms (e.g., Sina Weibo, QQ)	3.6	1.22
	I stopped browsing my WeChat Moments and used video and audio applications other than WeChat (e.g., TikTok, video sites such as IQIYI and Tencent)	3.64	1.22

## Data model testing and analysis of results

Due to the multifaceted nature of the factors affecting social media pressure and social media addiction, this study uses structural equation modelling (SEM) for examination. The SEM in this study consists of two parts: (1) the measurement model describes the relationship between latent variables and indicators, and (2) the structural model describes the path relationships between different latent variables (Wu, 2009).

After performing SEM in AMOS 21, an important issue is the criterion for accepting or rejecting a model. Wu states that a model should satisfy the following conditions: (1) the chi-square value divided by the model degrees of freedom ( $\chi^2/df$ ) should be below 5 and preferably below 3; (2) root mean square error of approximation (RMSEA) values should be lower than 0.08 and preferably below 0.06; (3) standardized root mean squared residual (SRMR) values below 0.10 are considered to be favorable; and (4) Tacker–Lewis index (TLI) and comparative fit index (CFI) values above 0.90 and preferably above 0.95 indicate a good model fit (Wu, 2009).

TABLE 5 Univariate ANOVA results.

Variable	Groups	Mean	S.D.	F-test	
Mindfulness	Members of the CPC	3.14	1.18	5.93***	Members of the CPC, Probationary CPC members, Members of the CYLC>Members of the Democratic Party; Probationary CPC members> The masses
	Probationary CPC members	2.83	0.90		
	Members of the CYLC	3.17	0.78		
	Members of the Democratic Party	4.01	0.97		
	Persons without party affiliation	3.22	0.82		
	The masses	3.57	1.02		
Social media addiction	Members of the CPC	3.05	1.20	8.10***	Members of the Democratic Party, The masses>Probationary CPC members, Members of the CYLC
	Probationary CPC members	2.49	0.94		
	Members of the CYLC	2.84	1.06		
	Members of the Democratic Party	3.99	0.95		
	Persons without party affiliation	2.58	1.18		
	The masses	3.47	1.11		
Social media pressure	Members of the CPC	3.03	1.24	9.04***	Members of the Democratic Party, The masses>Probationary CPC members, Members of the CYLC
	Probationary CPC members	2.32	0.92		
	Members of the CYLC	2.79	1.03		
	Members of the Democratic Party	3.96	0.90		
	Persons without party affiliation	3.01	0.96		
	The masses	3.44	1.13		

\*\* $p < 0.01$  and \*\*\* $p < 0.001$ .

This study's latent variables include WeChat Moments use, mindfulness, self-presentation, social media pressure, social media addiction, as well as distraction within SNS and distraction outside SNS. The study adopts a fixed loading method (unit loading identification constraint), and the model fit results are ideal ( $p = 0.000$ ,  $df = 923$ ,  $\chi^2 = 2777.962$ ;  $\chi^2/df = 3.01$ ,  $TLI = 0.919$ ,  $CFI = 0.928$ ,  $GFI = 0.877$ ,  $AGFI = 0.856$ ,  $RMSEA = 0.045$ ). The relationships between the variables are shown in Figure 1. From the results, we conclude that the overall fit of the CFA model is acceptable. Furthermore, we test the discriminant validity. In Table 6, all correlations between each pair of constructs are less than the square roots of the AVE values, which supports the discriminant validity.

We derive five insights from the data results. (1) People's use of WeChat Moments generates significant positive correlations for the mindfulness and self-presentation variables. Browsing WeChat Moments is positively correlated with positive self-presentation in WeChat Moments ( $\beta = 0.32$ ,  $p < 0.001$ ), and negatively related to perception of mindfulness ( $\beta = 0.53$ ,  $p < 0.001$ ), which supports H4 and H5. (2) While browsing WeChat Moments, people's mindfulness levels were negatively correlated with social media addiction ( $\beta = 0.29$ ,  $p < 0.001$ ), and positively correlated with positive self-presentation on WeChat Moments ( $\beta = 0.17$ ,  $p < 0.001$ ). Thus, H6 and H7 are accepted. (3) After being exposed to WeChat Moments information, People's mindfulness levels are negatively correlated with stress problems ( $\beta = 0.92$ ,  $p < 0.001$ ), which supports H8. (4) The pressure people feel on social media is positively correlated with the willingness to switch to offline interpersonal interactions ( $\beta = 0.51$ ,  $p < 0.001$ ). However, people's offline interaction frequency is positively correlated with their willingness to return to online social media ( $\beta = 0.63$ ,  $p < 0.001$ ). In addition, the pressure people feel is positively correlated with

social media addiction ( $\beta = 0.66$ ,  $p < 0.001$ ), which supports H9. (5) Finally, people's perceived level of self-social media addiction is positively correlated with willingness to switch social media platforms such as Sina Weibo, Tik Tok, and QQ ( $\beta = 0.19$ ,  $p < 0.001$ ), which supports H10.

## Discussion

Based on the results of the data analysis, this study presents the following discussion and research findings.

### Differences mindfulness between social media use and different political affiliations

Our results show that WeChat Moments use weakens public mindfulness. The reason may be that browsing WeChat Moments distracts users from their work or study. By preventing users from focusing their awareness and attention on their current tasks, this can have a negative impact on mindfulness. Existing research also supports this conclusion that regular use of social media leads to a decrease in mindfulness (Du et al., 2021).

The results also show that there are differences in mindfulness among people from different political backgrounds. Among them, the mindfulness of CPC members is higher than that of people from other political backgrounds. The reason may be that the CPC has certain restrictions on the use of social media for its members. Social media is no longer just a tool for interpersonal communication in China, but it has become a platform for theoretical learning and ideological education. For example,

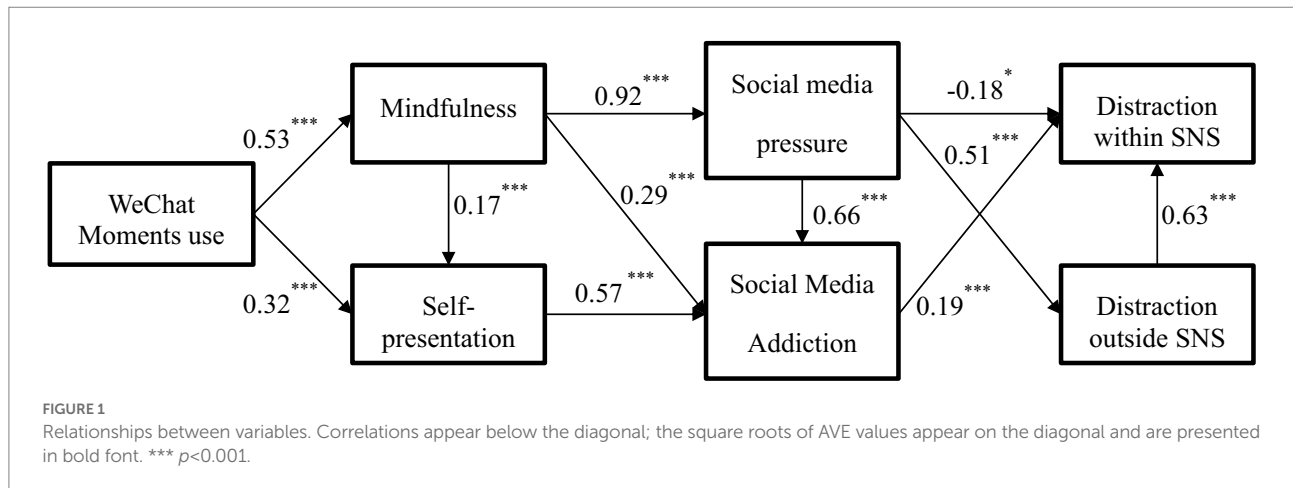


TABLE 6 Means, standard deviation, and correlations.

	Mean	SD	1	2	3	4	5	6
1. WeChat Moments use	3.81	0.97	<b>0.679</b>					
2. Mindfulness	3.36	0.83	0.472***	<b>0.757</b>				
3. Self-presentation	3.47	0.91	0.633***	0.666**	<b>0.682</b>			
4. Social media Addiction	2.82	1.08	0.439***	0.700**	0.663**	<b>0.718</b>		
5. Social media Pressure	3.03	0.98	0.250***	0.752**	0.520**	0.685**	<b>0.658</b>	
6. Distraction within SNS and distraction outside SNS	3.68	0.86	0.320***	0.433**	0.410**	0.373**	0.357**	<b>0.554</b>

\*\* $p < 0.01$  and \*\*\* $p < 0.001$ .

Xuexi Qiangguo is a theoretical learning platform based on the points system (Liu, 2019). Party organizations at all levels of the CPC use this platform to quantify the theoretical learning level of party members. Local party organizations formulate score standards and require their party members to achieve these goals. Therefore, in order to join the CPC, applicants have to spend a lot of energy on improving the points on Xuexi Qiangguo, while formal party members continue to improve their points on Xuexi Qiangguo (Chen, 2021). In addition, CPC members are often asked to repost various CPC Central Committee meeting pushes and announcements on their WeChat Moments, resulting in their Moments being filled with work-related content rather than personal photos and entertainment news. Combined with the above conclusions, lower use of WeChat Moments also contributed to higher levels of mindfulness.

## Self-presentation with social media use

In the WeChat Moments, the primary content of self-presentation is expressed in the naming of the users' online identities. In addition, the choice of avatar is also related to the construction of self-images. Embellished real-life photos, pictures presenting personality, and even emoticons expressing

emotions become the mapping of self-image in daily life (Du, 2020). After successfully establishing identities and adding friends, users perform self-presentation and maintain interpersonal relations by posting content in their WeChat Moments, reposting media articles, browsing others' WeChat Moments, and liking and commenting on interactions. In this process, communicators strategically choose how to present themselves and set the visibility of their messages (Treem et al., 2020).

Users use WeChat Moments to show their identity and present their self-image, expressing inner feelings explicitly or implicitly, directly or abstractly. In another way, this shapes the image in the minds of others through the symbols that reflect users' styles and attitudes to enhance identification with their identity.

Our results show that the more mindful people are, the less inclined they are to present themselves in their WeChat Moments. This may be due to the fact that people with higher mindfulness are not overly concerned with what others think of themselves and do not need excessive self-presentation to seek attention or gain approval from others. Carson and Langer (2006) research shows that when people are mindful, they are less inclined to manipulate their own image or maintain fragile self-esteem in order to gain positive evaluations from others.

## Social media pressure and social media addiction associated with social media use

This study finds that there is a positive correlation between excessive social media use and the audience's perceived stress. In addition, social media addiction behavior increases when the public feels more social media pressure. This finding supports some research that compulsive social media use leads to fatigue with social media (Bai, 2020). Zhang et al. (2019) identify perceived social overload as one of the sources of stress that cause social media fatigue and state that social media addiction can be classified explicitly into information overload, functional overload, and social overload. The specific differences are as follows: (1) information overload is a state in which users are exposed to too much information that they cannot process effectively (Soto-Acosta et al., 2014). Research indicates that due to the limited cognitive abilities of individuals, users are negatively affected when they perceive too much irrelevant or unnecessary information (Maier et al., 2015); (2) functional overload refers to platforms providing more functionality than users need (Thompson et al., 2005). When the level of change in the users' perception of social network functional requirements and the speed of version changes are too fast, users feel social media pressure, because they need to spend a lot of time readjusting; (3) social overload indicates that the user's social network expansion forces the user to spend more time and energy meeting social needs, providing social support, and maintaining social relationships. Social overload can be further categorized into communication overload (refers to individuals receiving communication demands on social media that exceed their processing capabilities) and self-presentation (refers to individuals' efforts to build, change, or maintain an image in the minds of others) according to the subject's affiliation (Cho et al., 2011). Wang and Stefanone (2013) find that users with more positive self-presentation login to Facebook more frequently. Zhang et al. (2019) suggests that self-presentation can promote social overload.

## Mindfulness for social media addiction

As technology develops exponentially, users can access an infinite amount of information at the click of a button. With this privilege comes the potential cost of information overload, social media addiction, and increased distraction. Social media addiction is becoming an increasing problem.

One cure is mindfulness meditation, a training that is being proven by science to be a powerful tool for enhanced well-being and mental focus. However, loving-kindness meditation based on mindfulness meditation does not significantly improve the level of mindfulness (Chen et al., 2021). But loving-kindness meditation can significantly improve people's sense of social presence (Liu et al., 2022d). Mindfulness is a training that helps users to become more present, self-aware, and better able to respond rather than react to everyday situations. Experts, such as the American addiction

psychiatrist Judson Brewer, show that mindfulness can improve impulse control and reduce addictions ranging from social media to drugs (Brewer, 2019). Mindfulness is a practice that supports people to act quickly in order to break bad habits. Mindfulness practice tends to reduce anxiety levels and stress (Liu et al., 2022e). This result also supports our research that strengthening mindfulness can effectively reduce social media addiction.

## Social avoidance behavior

In our study, we find that when users receive negative feedback, e.g., opposing comments on their social media posts, they are more likely to develop negative emotions. Users are then more inclined to change their self-presentation behavior, such as no longer following their WeChat Moments (ignoring behavior), blocking individuals (blocking behavior), reducing their voice (diving behavior), or even closing their WeChat Moments (withdrawal behavior).

Although users tend to stop using online media and turn to offline communication when they feel more social media pressure, they do not permanently stop socializing online. Instead, they even revert to social media and become addicted to it. After the perceived stress is relieved, users return to social media and continue to use it or engage in other social media platforms to overcome the perceived social exhaustion on the previous platform. Previous research on Facebook suggests that passive use of Facebook leads to a decline in emotional well-being over time, consequently causing withdrawal behavior. This finding is sufficiently supported by existing empirical research (Sagioglou and Greitemeyer, 2014; Gil-Or et al., 2015; Dhir et al., 2018).

## Research limitations and future research

A few limitations of the present study require consideration. First, as the current study is conducted with a sample of college students in China, it remains to be determined whether our findings can be generalized to different age groups. Results may differ in heterogeneous groups with different population or cultural backgrounds. Second, our results rely upon self-report data, which might include inaccurate responses from participants. Third, we cannot prove any causal relationships, e.g., between social media pressure factors and social media addiction factors, because this study has a cross-sectional design. Even a reverse directionality is possible (Montag et al., 2018a). Therefore, the explanation proposed here should be treated with appropriate caution and future research should focus on longitudinal investigations.

## Conclusion

In summary, the present study examined a multiple mediation model through which mindfulness is associated with social media



pressure and social media addiction. Our results revealed that a high social media use increases social media pressure and potentially causes social media addiction. Mindfulness can effectively relieve people's social media pressure and therefore can serve as a lever to alleviate social addiction.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the patients/participants or patients/participants legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

## Author contributions

CY led the work carried out on the study, including its conceptualization, research design, data collection and data

analysis, and took the lead in writing the manuscript. YL was involved in the research design, manuscript writing and proofreading, contributed to its write-up.

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## Conflict of interest

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

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# Designing mindfulness information for interaction in social media: The role of information framing, health risk perception and lay theories of health

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In the post-pandemic era, our health is facing unprecedented challenges, and people are more willing to obtain health-related information or interact with each other than ever before. In this context, people's interest in mindfulness information is also growing. However, not enough attention has been paid to the relationship between mindfulness information design and information interaction. The purpose of this study is to assess the impact of information design based on the gain and loss framework on people's willingness to interact with mindfulness information, and to identify the framework for achieving better results. Through two experimental studies, we find that information design based on the framework of gains and losses can produce different effects. Specifically, the findings of the first experiment ( $N = 282$ ) shows the individuals are more willing to interact with mindfulness information when they are exposed to gain-framed information rather than loss-framed. In the second experiment ( $N = 308$ ), we find that loss framing, compared with gain framing, led to greater health risk perception, which in turn make participants more likely to interact with mindfulness information with others. Additionally, our results show that the lay theories of health plays a moderating role in the direct effect of information framework on willingness to interact with mindfulness information in social media. When individuals hold incremental lay theories, they are more willing to interact with mindfulness information under the gain-framed information condition compared with the loss-framed information condition. However, when individuals are in entity condition, there is no significant difference in the willingness to interact with mindfulness information between the gain-framed and loss-framed information. Our studies of integrating information framework into designing mindfulness information suggest a promising strategy of health information interaction in social media.

## KEYWORDS

mindfulness information, information framing, health risk perception, lay theories of health, health information

## 1. Introduction

In the post-pandemic era, we are forced to embrace uncertainty and challenges. There is increasing interest in mindfulness for its potential benefits as a wellbeing practice to improve quality of life (Mars and Abbey, 2010; de Frias and Whyne, 2015; Behan, 2020). The mindfulness movement, which advocates viewing the body, self and life with an accepting and non-judgmental attitude, brings a perspective of attentive awareness on the present moment. While encouraging people to face the uncertainty and impermanence in life, mindfulness brings them to a centered calm without being carried away by negative emotions (Kabat-Zinn and Hanh, 2009). In other words, mindfulness allows people to accept life situation and bodily state with less criticism and judgment.

Over the last few years, the different aspects and dimensions of mindfulness have been touched upon integrating with various disciplines, such as neuroscience, psychology, physiology, art, design and media, to create novel communication and interaction (Vidarthi et al., 2012; Rheden and Hengeveld, 2016). With the development of media technology, people are more and more accustomed to obtaining health-related information and knowledge from new media. Media technologies related to mindfulness and relevant research endeavors have increased markedly, as can be seen from the growing number of academic publications (Terzimehić et al., 2019; Lukoff et al., 2020; Liu et al., 2022a). These studies provided with diverse perspectives and foundations for investigating health information about mindfulness.

With the widespread popularity of mobile networks, people are more likely to use mobile phones to obtain health information (Liu et al., 2022b). Social media platforms have become an important medium for people to search, share, and discuss information (Choi and Toma, 2014; Muir et al., 2020). In this context, many scholars have begun to explore how to achieve health interventions for target groups through the dissemination and guidance of health information. However, in the field of health communication research, many studies are concerned with the influence of health information content on individual health behaviors (Schubbe et al., 2020). However, the relationship between health information design and health behavior has not been paid enough attention. Researchers have found subtle changes in the presentation of information frames cause individuals to choose different action responses (Rothman and Salovey, 1997; Nan, 2012). In other words, the effectiveness of persuasion in promoting behavior change may depend on the way the information is designed, not just the meaning of the content itself. From this sense, health information design takes an important role. For instance, frame is a kind of information customization method, which can influence individual's behavior decision by adjusting the expression of information without changing the meaning of content, so as to promote specific behavior (Rothman and Salovey, 1997). It is found that people's decision-making and behavior preferences are often influenced by

the way of information expression (Akl et al., 2011). Berger and Milkman (2012) have suggested that positive information is more communicative than negative information. They found that most people prefer to be seen as someone who shares optimistic stories or makes others feel good, rather than sharing things that make others sad or upset. Moreover, sharing positive information can also help boost the mood of others or provide information about potential returns. When people are exposed to the negative consequences of behavior, they tend to seek risks, while those exposed to the positive consequences are more risk-averse (Kahneman and Tversky, 2013). It is hard to achieve the ideal intervention effect if only paying attention to the information content. Therefore, grasping the interaction process between information and people by designing a reasonable information framework to influence their behavior preferences can achieve a better communication effect (Xu et al., 2021).

However, it is worth noting that many studies are examined the impact of information framework on health-related behaviors (Rothman and Salovey, 1997; Kim and Lee, 2017; Gao et al., 2022), rather than the willingness to interact with mindfulness information. On the other hand, some key methodological challenges and issues need to be solved in this area. One of the crucial issues is the design of mindfulness information for dissemination through mobile social media based on individual differences (Davidson and Dahl, 2018). Therefore, the purpose of this study was to gain a better understanding of the information characteristics that contribute to effective strategies of designing mindfulness information for a better result of dissemination. By using the lens of framing effect theory and lay theory, we explored the relationship between mindfulness information framework and willingness to interact with the mindfulness information in social media with a focus on the internal possible mechanism through online control experiments.

## 2. Theoretical background and hypotheses

### 2.1. Framing effect, health behavior and information interactions

Persuasive information is used as a way to motivate individuals' health behaviors (Xu et al., 2020). One strategy to optimize the effectiveness of information is to use information framework (Lithopoulos et al., 2017). Information framework originated from prospect theory, and its essence is to design the expression of information to change people's decision preference (Tversky and Kahneman, 1981). Reviewing the past literature, information framework is widely used in health behavior research such as chronic diseases (Gao et al., 2022), HPV vaccination (Xu et al., 2021), smoking (Kim and Lee, 2017). Most health-related information can be explained by benefits or costs. Information framing can play an important role in promoting health behaviors (Akl et al., 2011). Gain-loss framework emphasizes the benefits of



engaging in a behavior (gain framework) and the losses caused by not engaging in a behavior (loss framework; Rothman and Salovey, 1997). For example, gain-framed mindfulness information may emphasize the positive outcomes (such as happiness) associated with practicing mindfulness. Meanwhile, a loss-framed mindfulness messages might be framed in relation to negative outcomes (such as anxiety) of without practicing mindfulness. However, as to which information framework is more effective, the research shows inconsistent results. Rothman and Salovey (1997) put forward dual behavior framework of “prevention-detection,” and found that the loss-framed information was more effective in disease detection behavior, while the gain-framed information was more effective in disease prevention behavior. The effectiveness of the message framework depended on the matching between the information and the audience or situation (Rothman et al., 2020). A meta-analytic review found that the gain framework was more convincing than the loss framework in advocating dental hygiene behaviors. However, in terms of other preventive measures (such as skin cancer prevention, or diet and nutrition), there is no statistically significant differences in the persuasiveness between different frame information (O’Keefe and Jensen, 2007). Gallagher and Updegraff (2012) through meta-analysis also found that the benefit frame information is more convincing than the loss frame information in preventing skin cancer, encouraging smoking cessation and physical activities, while in cancer detection and HPV vaccination, the loss framework is more convincing than the benefit framework (Lee-Won et al., 2017; Xu et al., 2020). Some studies also examined the effects of frame information on the promotion of health sports, which showed that the gain-framed information was more likely to inspire people to participate in sports than the loss-framed information (Gallagher and Updegraff, 2012). According to the dual behavior framework of “prevention-detection” (Rothman and Salovey, 1997), mindfulness can be classified as preventive health behavior. Therefore, we can speculate that the gain-framed information was more likely to inspire people to participate in mindfulness exercises than the loss-framed information. According to the Information-Motivation-Behavior-Skills Model (IMB) proposed by Fisher et al., the factors that affect health behavior change can be divided into three parts, namely, information, motivation and behavior skills. Among them, information is the initial condition for taking health behavior, specifically referring to the information related to health promotion (Misovich et al., 2010). Hence, we advocate that people are more inclined to identify with mindfulness-related information under the gain-framed information rather than the loss-framed one. Some early research has verified that the individuals under the positive frame information are more likely to be at the level of advanced needs, while those under the negative frame information are more likely to be at the level of basic needs (Maslow, 1954). When exposed to the gain-framed (positive) mindfulness information, people may be motivated by higher-level social needs and are willing to engage in more social interactions, such as likes, sharing and commenting on

information. However, when exposed to the loss-framed (negative) mindfulness information, people may be inspired by lower-level security needs due to perceived risks, and their social communication needs are not high enough. Based on the above, we put forward the following hypothesis:

*H1: Compared with the loss framework, mindfulness information in the gain framework is more effective to enhance individuals' willingness of interaction about mindfulness information (such as likes, sharing and commenting on information).*

## 2.2. The intermediary role of health risk perception

To further illuminate the underlying mechanism of the relationship between information framing and willingness to interact with the mindfulness information, we also investigated the mediating effect of health risk perception. Risk perception is a concept that describes individuals' cognitive and psychological response to situations in which something of value is threatened (Setbon et al., 2005). Health risk perception consists of two dimensions: perception of susceptibility and perception of severity. More specifically, perceived susceptibility refers to the audience's subjective perception of their likelihood of falling into a risky situation; while perceived severity accounts for people's beliefs about the risk of experiencing the threat (Witte, 1994). The two complement each other and work together to explain the audience's perception of health risks.

When the level of perceived risk is high, people are very sensitive to all kinds of risk information and have a high demand for information, which leads to active communication behavior about the risks. People's perceived susceptibility to health status after reading information can positively predict the structural viral transmission of information (Meng et al., 2018). As a result, people tend to share risk information with others, and then take various evasive measures to avoid risk harm. In short, risk perception plays an important intermediary role in the public's risk communication behavior (Zhang et al., 2020). Research on the information effects has shown that there is a positive correlation between perceived risk and willingness to share information with others. People with a higher level of perceived risk are more likely to engage in health protection behaviors (Zhang C. et al., 2021; Zhang N. et al., 2021), and there is a significant correlation between risk perception and self-reported preventive health behaviors (Dryhurst et al., 2020). In addition, researchers also found that the severity of perceived risk was associated with recommended behavioral changes (Rubin et al., 2009). Witte (1994) pointed out that perceived severity was the key factor affecting people's behavior change, and the perception of risk was a necessary condition for people to take follow-up action. Perceptual susceptibility also often caused people to ease their emotions

by sharing information and affected their subsequent intentions and actions (Ho et al., 2008).

Previous studies have found that information framework affects risk perception (Cho and Boster, 2008). Specifically, loss frame might be more persuasive than gain frame and increase the levels of perceived severity (Bosone and Martinez, 2017), in turn, which was associated with the possibility that individuals would share information with others (Kirkpatrick et al., 2021). Risk perception plays an intermediary role (Li and Zhang, 2021). Thus, we put forward the following hypothesis on the basis of literature:

*H2: Information framework has an indirect impact on the interaction about mindfulness information through risk perception.*

## 2.3. The moderating effect of lay theories of health

One important variable to predict people's engagement in health-related behaviors is lay theories of health (Bunda and Busseri, 2019). The lay theories of health could be divided into incremental and entity theory: individuals with incremental theory tend to think that their health levels can be improved through their own efforts, whereas individuals with entity theory think that their health levels are more influenced by congenital factors and is hard to change (Zhang and Kou, 2022). Previous research demonstrated that those tended to consider health is malleable (incremental) were more likely to engage in health behaviors than those tended to consider health fixed (entity; Bunda and Busseri, 2019). Recent studies have also shown that lay theories of health can predict the possibility of people participating in health protection behaviors mediated by variables that people consider future consequences (Zhang C. et al., 2021; Zhang N. et al., 2021).

As proposed by Bunda and Busseri (2019), individuals' subjective perceptions of their health status provide valuable information. Belief is the guide of individual actions, which would determine people's actions. In fact, behavioral intention is best predicted by the strong belief that one can change one's health through one's own efforts (conveyed by an incremental lay theory of health) and the perception of self-improvement in the past (Bunda and Busseri, 2019). It is not difficult to infer that individuals who hold incremental lay theories of health have higher self-efficacy and tend to actively regulate health-related behaviors. Indeed, self-efficacy reflects an individual's sense of control over life. Previous researchers have found that higher self-efficacy are related to greater participation in health-promoting behaviors, and higher exercise intensity and frequency (Luszczynska et al., 2011; Dong et al., 2018). Furthermore, in an experimental study, self-efficacy was positively correlated with incremental health theory which was positively correlated with participation in health-related behavior, but negatively correlated

with entity health theory which was negatively correlated with participation in health-related behavior (Zhang C. et al., 2021; Zhang N. et al., 2021). Van't Riet et al. (2010) examined the influence of self-efficacy on skin self-examination on the effects of different framed skin-cancer detection information. For participants with high self-efficacy, they are more willing to perform skin self-examination when exposed to loss-framed information rather than gain-framed information. For participants with low self-efficacy, there was no difference in intention under the condition of gain-and loss-framed information. According to the aforementioned dual behavioral framework of "prevention - detection" (Rothman and Salovey, 1997), the loss framework was more convincing than the gain framework in disease detection behavior (such as skin cancer detection; Lee-Won et al., 2017; Xu et al., 2020), and individual self-efficacy level moderated the effect of information frame on health-promoting behavior (Van't Riet et al., 2010). From this, we could speculate that the gain framework might be more convincing than the loss framework in health prevention behavior (such as mindfulness-related behaviors), and the lay theories of health (related to self-efficacy) would play a moderating role in information framework and health-related behaviors. According to the IMB model, information is the initial condition for taking healthy behaviors, we put forward the hypothesis:

*H3: The lay theories of health moderate the effect of information frame on the interaction about mindfulness information.*

## 3. Study 1

### 3.1. Participants and procedure

A total of 282 undergraduate students (24.8% male and 75.2% female) recruited from a Zhejiang university participated in the experiment in exchange for a small gift. According to the Student IDs, participants were randomly assigned to gain frame or loss frame group. More specifically, students with odd numbers at the end of their student IDs were assigned to the gain frame group, while those with even numbers were assigned to the loss frame group. Their ages ranged from 18 to 22. They all used the social media app WeChat and the features of WeChat moments and groups.

Participants were told that they would take part in a series of short, unrelated studies. The first part included the priming manipulations of information framework. The second part was introduced as a survey, which aimed to seek the willingness to interact mindfulness information. Specifically, participants were asked to view either gain framed or loss framed mindfulness information. After reading each information, they completed a self-administered questionnaire, which included dependent variables and demographic questions. The whole process takes about 12 min.

## 3.2. Research design and variables

One single-factor experimental design was used to test the hypotheses. The independent variable is the frame (gain-or loss-framed information), and the dependent variable is the willingness to interact with mindfulness information. Participants were randomly assigned to gain frame or loss frame group, and the experiment was executed online.

In order to manipulate the types of information frames, two versions of message to promote mindfulness practice were designed. Specifically, the gain-framed information highlighted the ideas about achieving the positive results (e.g., mindfulness can improve happiness; mindfulness can increase the awareness; mindfulness can help with emotions, etc.). The loss-framed information emphasized the ideas about avoiding the negative outcomes (e.g., Without mindfulness, individuals might suffer from depression or anxiety; Without mindfulness, our attention is easily to be distracted; Without mindfulness, one might suffer from negative emotions, etc.). Except for the gain or loss-framed manipulations, all other visual elements in the interface of Wechat moments, such as profile picture, screen name, and layout, remain the same.

The dependent variable is willingness to interact mindfulness information, which was measured by three items. Participants were asked to rate their agreement on a 1–7 scale with the following statements (1 = strongly disagree, 7 = strongly agree): “I’ll give this message a compliment,” “I am likely to share it with WeChat group,” and “I intend to comment on this information.” The three items are averaged to form an index for willingness to interact with mindfulness information ( $\alpha = 0.797$ ).

## 3.3. Results

### 3.3.1. Manipulation checks

As a check of information framework manipulation, a seven-point scale (from 1 = strongly disagree to 7 = strongly agree) was used with two items: (1) The above information emphasizing the benefits of mindfulness; (2) The above information emphasizing the disadvantages of mindlessness. As expected, the score about the benefits of mindfulness in the gain-framed information condition was greater than the score in the loss-framed condition ( $t = -20.415$ ,  $p = 0.000$ ;  $M_{\text{gain}} = 5.40$ ,  $SD_{\text{gain}} = 1.936$ ;  $M_{\text{loss}} = 1.59$ ,  $SD_{\text{loss}} = 1.152$ ). However, the score about disadvantages of mindlessness in the loss-framed information condition was greater than the score in the gain-framed condition ( $t = 15.392$ ,  $p = 0.000$ ;  $M_{\text{gain}} = 3.10$ ,  $SD_{\text{gain}} = 2.084$ ;  $M_{\text{loss}} = 6.08$ ,  $SD_{\text{loss}} = 1.067$ ). Thus, the information framing manipulation was successful.

### 3.3.2. Hypothesis testing

To test the hypotheses, the independent T-test was performed. As expected, the results show that individuals were more willing to interact with mindfulness information when the information

was gain-framed ( $M_{\text{loss}} = 3.061$  vs.  $M_{\text{gain}} = 3.401$ ,  $t = -2.129$ ,  $p = 0.034$ ). Thus, H1 was strongly supported.

### 3.3.3. Discussion and introduction to study 2

In Study 1, it was found that when mindfulness information is represented by gain framework, people show more willingness of interaction compared to loss framework. In a sense, mindfulness is essentially a type of preventive health behavior. Our study demonstrated the gain framework can better promote individuals participation in preventive-related health behaviors, which was consistent with the findings from Rothman and Salovey (1997). Previous studies also have shown the relative persuasiveness of the gain or loss framework depends on the characteristics of the receiver, such as perceived susceptibility (Nan et al., 2016) and independent (interdependent) self-construal (Zhang C. et al., 2021; Zhang N. et al., 2021). Therefore, on the basis of study 1, our following objective was to further explore which characteristics of the receiver influence the relative persuasiveness of the mindfulness information of gains or losses. Specifically, we test the mediating effect of health risk perception (hypothesis 2) and the moderating effect of the lay theories of health (hypothesis 3) in study 2.

## 4. Study 2

### 4.1. Design and participants

A total of 308 undergraduate students (25.3% male and 74.7% female) recruited from a university in Zhejiang Province participated in the experiment in exchange for a small gift. Their ages ranged from 18 to 22. They all used the social media app WeChat and the features of WeChat moments and groups. The participants were randomly assigned to one of two different conditions that were obtained by varying frame (gain vs. loss). The dependent variable was willingness to interact with mindfulness information as in Study 1.

### 4.2. Measures and procedure

**Health risk perception.** The scale of health risk perception is comprised of two dimensions, perception of susceptibility and perception of severity (Witte, 1994; Zhou and Lin, 2020). The first six items describe the perception of susceptibility (e.g., “I feel that my health is vulnerable at present”), and the last 4 items describe the perception of severity (e.g., “Illness will have a bad influence on my social life”). The participants were asked to answer the items on a 7-point Likert scale (1 = strong agreement, 7 = strong disagreement). The average score was calculated as the level of health risk perception. The higher score represent a higher level of health risk perception ( $\alpha = 0.838$ ).

**The lay theories of health.** The scale of the lay theories of health was developed by Bunda and Busseri (2019) with six items. Three of these items measure entity theory of health, e.g., “My

health is a part of me that I cannot change very much.” The remaining three items measure incremental theory of health, e.g., “I can change even my basic level of health considerably.” The participants were asked to answer the items on a 7-point Likert scale (1 = strong agreement, 7 = strong disagreement). After reverse-scoring of the entity item ratings, the average score was calculated as the level of the incremental theory of health. The higher score represent a stronger incremental theory of health ( $\alpha = 0.732$ ).

Procedures were roughly the same as those of Study 1 except adding two variables (health risks perception and the lay theories of health). More specifically, participants were told that they would participate in a series of short, unrelated studies. The first part is a survey, which aimed to find out the lay theories of health of participants; and the next part included the priming manipulations of information framework. The third part was a survey that sought participants' perception of health risks and their willingness to interact with mindfulness information, also including demographic questions. The whole process took about 18 min.

## 4.3. Results

### 4.3.1. Predictors of willingness to interact with mindfulness information

Regression analyses revealed that information framing, health risk perception, and incremental theory of health were significant predictors of people's willingness to interact with mindfulness information except entity theory of health (gender as a control variable). These results suggested that gain-framing information, and a higher level of health risk perception and incremental theory of health was more likely to promote willingness to interact with mindfulness information. However, individuals with higher entity theory of health were impossible to interact with mindfulness information (see Table 1).

### 4.3.2. Mediated analyses of health risk perception

The results of mediator analysis with selected gender as a control variable, information framing as the independent variable, willingness to interact with mindfulness information as the dependent variable, and health risk perception as the mediator are

presented in Table 2. Model 4 of the PROCESS 3.3 macro program was used to analyse the mediating effect of the above variables (Hayes, 2018). The direct effect of information framing on willingness to interact with mindfulness information was significant,  $\beta = 0.370$ , 95% CI: [0.069, 0.671] (confidence interval did not include 0),  $p = 0.016$ . The indirect effect of information framing on willingness to interact with mindfulness information through health risk perception was significant,  $B = -0.058$ ,  $SE = 0.037$ , 95% CI: [-0.146, -0.003] (confidence interval did not include 0; See Table 2). Therefore, health risk perception partially mediated the relationship between information framing and willingness to interact with mindfulness information.

Interestingly, the findings show that the information frame (the code of loss-framed information is 1; the code of gain-framed information is 2) has a positive direct effect on the willingness to interact with information, that is, the gain framework is more likely to promote the willingness to interact with mindfulness information; However, in the indirect path in which information frames affect the willingness to interact with mindfulness information by health risk perception, the loss of frame information makes individuals feel higher risk and more willing to interact with mindfulness information.

### 4.3.3. The moderated meditation analysis of the lay theories of health

We employed the PROCESS proposed by Hayes (2018) to test the moderated mediation effect of the lay theories of health on the indirect effect of information framing on willingness to interact with mindfulness information *via* health risk perception. More specifically, we specified a moderated mediation model that estimates the indirect effect of X (information framing) on Y (willingness to interact with mindfulness information) *via* M (health risk perception) at different levels of V (the lay theories of health). Model 5 of the PROCESS was performed (gender was used as a control variable). The results indicated that the conditional direct effect of information framing on willingness to interact with mindfulness information was significant. When the lay theories of health is low ( $M - 1SD$ ),  $\beta = 0.268$ , 95% CI: [-0.158, 0.693] (confidence interval include 0),  $p = 0.217$ ; however, When the lay theories of health is high ( $M + 1SD$ ),  $\beta = 0.469$ , 95% CI: [0.039, 0.899] (confidence interval did not include 0),  $p = 0.033$ . In addition, the results indicate that the indirect effects of information framing on willingness to interact mindfulness information *via* health risk perception was

TABLE 1 Predictors of willingness to interact with mindfulness information.

Variables	B	SE	$\beta$	<i>t</i>	<i>p</i>	95% CI
Constant	1.081	0.677		1.597	0.111	[-0.251, 2.412]
Information frame	0.372	0.152	0.138	2.445	0.015	[0.073, 0.672]
HRP	0.212	0.077	0.156	2.735	0.007	[0.059, 0.364]
Entity	0.108	0.072	0.092	1.508	0.133	[-0.033, 0.250]
Incremental	0.145	0.067	0.130	2.167	0.031	[0.013, 0.276]

The code of loss-framed information = 1; the code of gain-framed information = 2.  
Abbreviation: HRP=Health Risk Perception.

significant (Effect:  $-0.059$ ,  $SE=0.039$ , 95% CI:  $[-0.153, -0.004]$ ) (as shown in Table 3). Therefore, our findings revealed that there was a moderating effect of the lay theories of health and a mediating effect of health risk perception in the relationship between information framing and willingness to interact with mindfulness information. The model were shown in Figure 1.

We then plotted the nature of the interaction of information framing and the lay theories of health which was divided into high and low groups according to the median (As shown in the

Figure 2). A simple effect analysis further showed that under a low group of the lay theories of health (the entity theory), there was no significant difference in the willingness to interact with mindfulness information between the gain-framed and loss-framed information [ $F(1,302)=0.465$ ,  $p=0.496$ ]. However, under a high group of the lay theories of health (the incremental theory), the willingness to interact with mindfulness information [ $F(1,302)=4.164$ ,  $p=0.042$ ] was significantly more positively under the gain-framed information condition ( $M=3.512$ ,

TABLE 2 Regression analysis of mediated model of health risk perception.

Predictor variables	Model 1 (HRP)				Model 2 (Willingness of interaction)			
	<i>B</i>	<i>t</i>	<i>SE</i>	<i>p</i>	<i>B</i>	<i>t</i>	<i>SE</i>	<i>p</i>
Information framing	$-0.256^*$	$-2.264$	$0.113$	$0.024$	$0.370^*$	$2.416$	$0.153$	$0.016$
HRP					$0.229^{**}$	$2.963$	$0.077$	$0.003$
$R^2$	$0.018$				$0.045$			
<i>F</i>	$2.759$				$4.790$			
<i>p</i>	$0.065$				$0.003$			

Abbreviation: HRP=Health Risk Perception.  $^*p<0.05$ ;  $^{**}p<0.01$ .

TABLE 3 Moderated Mediation analysis: effects of information framing and the lay theories of health on willingness to interact with mindfulness information via health risk perception.

Dependent variable	Conditional direct effects				Indirect effect		
	Moderator	Coefficient	SE	95% CI	Coefficient	SE	95% CI
Willingness to interact information	M-SD	$0.268$	$0.216$	$-0.158, 0.693$	$-0.059$	$0.039$	$-0.153, -0.004$
	M	$0.368$	$0.153$	$0.066, 0.670$			
	M + SD	$0.469$	$0.219$	$0.039, 0.899$			

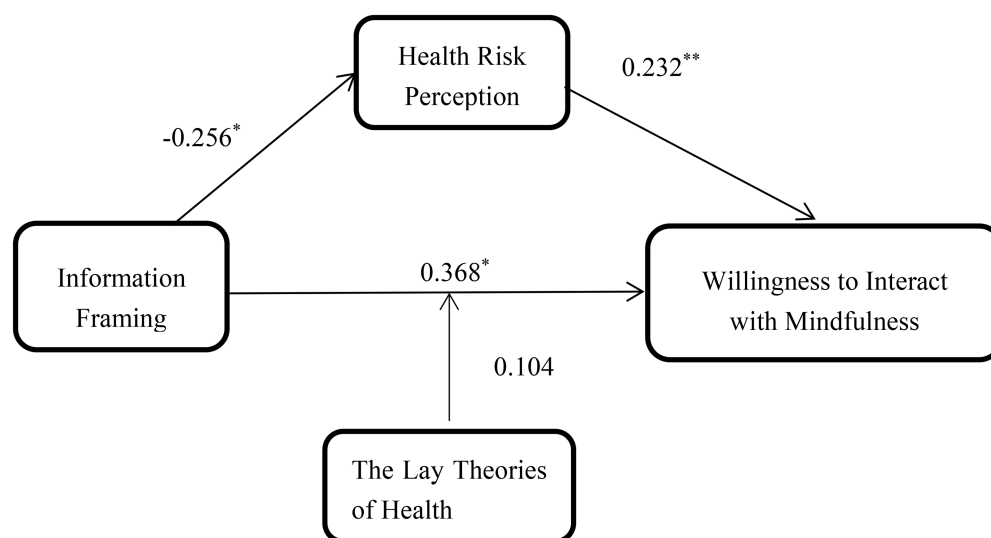


FIGURE 1

The model of a moderating effect of the lay theories of health and a mediating effect of health risk perception. The code of loss-framed information=1; the code of gain-framed information=2;  $^*p<0.05$ ;  $^{**}p<0.01$ .



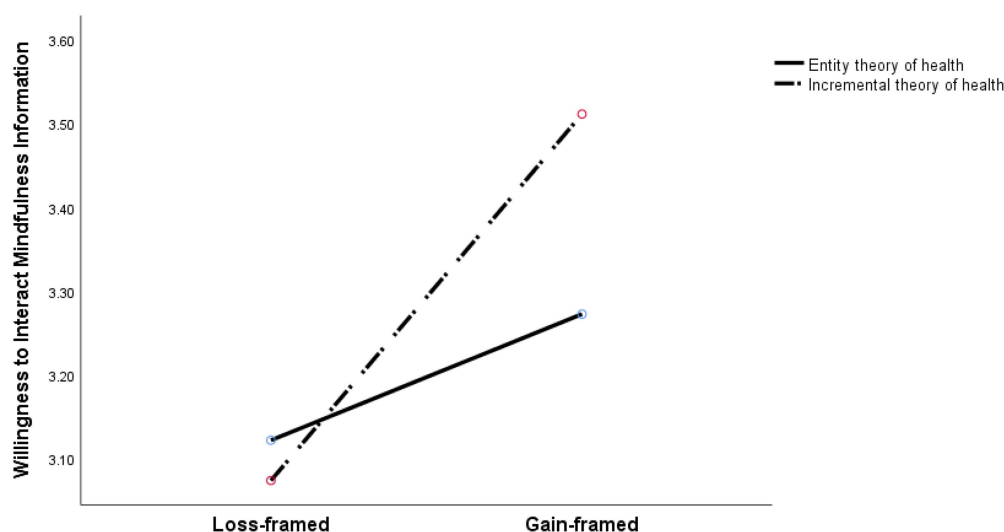


FIGURE 2

The interaction effect of information framing and the lay theories of health on willingness to interact with mindfulness information.

SD=1.271) compared with the loss-framed information condition ( $M = 3.074$ ,  $SD = 1.498$ ).

#### 4.4. Discussion

The current research demonstrated that information framing predicted individuals' willingness to interact with mindfulness information through health risk perception as a mediating variable, and moderated by the lay theories of health. This study contributes to the research on framing theory by demonstrating that information frame could predict people's willingness to interact with mindfulness information. Although previous research found the effect of information framing on health behaviors, it is unclear whether it could predict the willingness to interact with mindfulness information to promote healthy behaviors in others. The current study filled this gap by providing evidence that gain-framing information, a higher level of health risk perception and the incremental theory of health were important predictors of willingness to interact with mindfulness information. This research has the following main findings.

The results of two experiments show that the information framework can directly or indirectly affect the willingness to interact with mindfulness information. In experiment 1, it is found that under the condition of gain framework, people are more willing to interact with mindfulness information than under the condition of loss framework. In experiment 2, we not only verified that the information framework has a significant direct effect, but also found that the information framework can have a negatively significant indirect impact on the willingness to interact with mindfulness information through health risk perception. Loss framing which emphasizes the loss caused by not adopting a certain healthy behavior can induce fear. Some scholars have found that fear makes people more likely to perceive health risks,

and fear indirectly affects attitudes toward recommended health behaviors and intentions to implement health behaviors through health risk perceptions (Nan, 2017).

The data results of experiment 2 showed that the loss framing rather than gain framing was easier to stimulate people's risk perception which was, in turn, more likely to interact with mindfulness information with others. This is consistent with previous studies that when individuals perceive a higher level of risk, they are more sensitive to information and tend to share relevant information with others (Turner et al., 2010; Zhang et al., 2020). Risk perception is an intermediary variable, which affects people's willingness to share information (Li and Zhang, 2021). Therefore, in the design of mindfulness information, if the audience perception risk is not started or very low, the gain-framed information is more effective; while when the audience risk perception is activated or very high, the information of loss framework is more effective. As can be seen from the above results, which effect is better, the gain framing or the loss framing? This is not only related to the "prevention-detection" behavior (Rothman and Salovey, 1997), but also to the specific situation of the individual, such as the level of risk perception. Thus it can be seen that different information frameworks induce different risk perceptions and different persuasion effects. In fact, the relationship between information frame and perceived risk is relatively complicated. Previous studies have found that when information focuses on long-term health risks, loss-framed information is more convincing, while in information that focused on short-term health risks, gain-framed information is more convincing than loss-framed information (Keyworth et al., 2018). Subsequent related research needs to be further refined on this basis.

Additionally, our results show that the lay theories of health plays an important role in message-framing effects. Specifically, the lay theories of health plays a moderating role in the direct effect of information framework on willingness to interact

mindfulness information. However, this process varied depending on the level of the lay theories of health. In other words, information stressing gains may be more effective than messages stressing losses in the direct path of framing effect, but only in individuals with incremental theory. Such findings are consistent with previous research, individuals with more incremental theories of health reported stronger intentions to pursue more health-promoting behaviors than those with entity theorists. Thus, people with a higher level of incremental theory of health believe that they can improve their health status through their own efforts, and have stronger intentions to engage in healthy lifestyles such as exercising and healthy eating (Bunda and Busseri, 2019). These findings suggest that individuals' lay theories of health (changeable or fixed) can affect the health information interaction. In particular, individuals who think that their health can be changed to a large extent believe that their health will improve greatly over time through a mindful lifestyle. These results have great implications for health communication or the effectiveness of public health education activities. For example, if such information encourage individuals to believe that mindfulness practice can increase wellbeing based on individual efforts, such propaganda may lead them to adopt a stronger incremental lay theory, and enhance motivation to implement health-related behavior.

## 5. Implications and prospect of research

There is increasing interest in mindfulness for its potential benefits in digital media to promote human capabilities such as creativity (Chen et al., 2021, 2022a), empathy (Zhu et al., 2017a,b; Chen et al., 2021), self-identity (Thieme et al., 2013), altruism (Liu et al., 2022c) and communication skills (Chen et al., 2021, 2022b). These studies put more focus on human-centered information design. In this paper, we are pioneering to introduce information frame and the lay theories of health into predicting individual willingness to interact with mindfulness information through mobile social media. These results broaden our understanding on the underlying mechanism of the role of information frame on health behavior and information dissemination. Given that information frame, health risk perception, and the lay theories of health could be manipulated to change. Our results have important implications for designing personalized mindfulness information and developing effective health information interaction. Some strategies such as designing a gain framework for information, initiating or promoting a incremental health theory and raising the level of health risk perception could inspire other researchers to plan their own effective health information interaction. As a result, it has a significant impact on hoisting people's health information literacy and promoting positive health outcomes.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

## Author contributions

XW: conceptualization, project administration, writing-original draft preparation, and methodology. BZ: investigation, project administration, and writing and editing. QG: funding acquisition and resources. WW and RZ: investigation, data curation, and software. All authors contributed to the article and approved the submitted version.

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## Conflict of interest

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

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# Erratum: Designing mindfulness information for interaction in social media: The role of information framing, health risk perception and lay theories of health

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# A study of the factors influencing HIV-preventive intentions among “hookup” application users

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“Hooking up” refers to the act of experiencing sexual intimacy with strangers without committing to a romantic relationship. Social media provide more convenient conditions for hooking up; however, it also poses a greater risk for HIV infection. Therefore, it is necessary to study the factors influencing the HIV-preventive intentions of those who engage in online dating to devise effective strategies for preventing the spread of HIV. This study consisted of a questionnaire that was distributed to 520 users of the Hello Group application. The survey results revealed that structural equation modeling is a useful framework for understanding the risk of HIV transmission in casual hookup encounters. In addition, combining the health belief model with the theory of planned behavior can provide recommendations for enhancing HIV-preventive intentions among users of dating applications. The results showed that mindfulness, the Chinese cultural context, perceived benefits, and self-efficacy were the main predictors of users’ HIV-preventive intentions when using online dating applications. Among the perceived HIV risks, only perceived barriers had a negative effect on users’ HIV-preventive intentions. In addition, attitude, subjective norms, and behavior control served as mediating variables between independent variables and HIV-preventive intentions; however, the mediating effect of attitude on perceived benefits and intentions was not significant. According to our study, some users misunderstand the risks and make incorrect assessments of the cultural risks of hooking up. Therefore, it is necessary to pay attention to the research on the psychological tendencies of users and risk intervention when studying the concept of hooking up.

## KEYWORDS

social app, health belief model, planned behavior theory, hooking up, mindfulness, SEM model, HIV prevention

## Introduction

With the advent of the Internet and the growing popularity of smartphones, public acceptance of online dating has increased. Moreover, the way people express themselves emotionally and interact in close relationships is also evolving as a result of technological advancements. Currently, online dating applications (hereafter “apps”) are becoming popular mobile platforms in China, and Chinese people are engaging in “hookups” as a part of their social lives (Chan, 2020). Dating apps are becoming increasingly popular for people to meet each other for dating, sex, relationships, and more. There are now a variety of hookup apps, as they have become a common and routine form of social media. Using these apps allows people to create intimacy in surprising and complex ways (Pettrychyn et al., 2020). Digital devices indeed enable novel methods for sex, intimacy, and sexual community, and they possess unique qualities and limitations (Race, 2015).

As the new generation of young people increasingly engages in digital dating, the penetration rate of online dating apps will continue to increase. However, many problems are emerging. One prominent problem is that dating apps have contributed to the spread of HIV. According to a United Nations study, the increasing rate at which young people are using mobile dating apps is a key factor in the recent resurgence of HIV among young people in Asia. The National Health and Family Health Commission of China recently released new data on HIV transmission. As of October 2021, the total reported HIV incidence was 5,357, and the number of AIDS-related deaths was 1,849 in China (National Health Commission of the People's Republic of China, 2020). At the end of 2020, 1.053 million people were living with HIV/AIDS nationwide, and 131,000 new cases were reported in 2020. In the past decade, the number of new cases reported nationwide each year has increased year over year; however, the growth rate declined in 2020 due to the impact of COVID-19. The number of patients currently living with HIV or AIDS has exceeded 1 million, and there are approximately 100,000 new cases every year (Chinese Center for Disease Control and Prevention, 2021).

In China, HIV is mainly transmitted sexually, with 95% of cases resulting from sexual transmission. The majority of transmission occurs between heterosexual couples, and the infection rate among men is higher, which is related to the fact that men more often have multiple partners, engage in online dating, and are more sexually active. Regarding the age of those infected, China's HIV incidence has displayed a trend of “rising at both ends.” In 2020, the majority of HIV patients over 60 were men. There were a total of 23,976 men over 60 with HIV, accounting for about 18% of the total number of cases.

Moreover, among all cases, heterosexual transmission accounted for 93.8%, and homosexual transmission accounted for 4.7%. There were about 3,000 young students aged 15–24 years with HIV, accounting for 22.3% of all HIV cases among

young people. Moreover, 81.7% of these transmissions were from homosexual sexual activity, while 16.9% resulted from heterosexual contact.

“Hooking up” refers to the act of randomly selecting a sexual partner using some sort of social networking app on the Internet, and it involves going on a date to engage in sexual behavior and obtain sexual satisfaction. Research showed that the intimate publicity available to female users of hookup apps is broader than that afforded by in-app interactions; there is an entire network of intimacy, sociality, and publicity that has been found around hookup apps (Pettrychyn et al., 2020). According to survey data, the incidence of traditional sexual behavior among college students in China is 15.1%. In the same population, the incidence of engaging in sexual behavior *via* online dating is 11%. Because college students seek to satisfy their curiosity and sexual needs, they are more likely to engage in unsafe sex because of their pursuit of novelty, adventure, excitement, and complex sensory experiences (Ren et al., 2022). The secrecy and anonymity of online social networks gradually weaken college students' moral restraint and self-control, which promotes hookups *via* the Internet and in turn increases the risk of HIV transmission. College students have a weak sense of self-protection and lack awareness of sexual safety. Although online dating applications may satisfy users' desires for love and sex, the associated risks are often overlooked (Solis and Wong, 2019). Penhollow et al. (2007) asserted that users' involvement in casual, high-risk sexual encounters facilitated by dating apps exposes college students to sexually transmitted infections and unintended pregnancy. The changing social contexts of HIV are reflected in the evolving phenomenon of the increase in “men who have sex with men” (MSM) in the Philippines who seek out partners online *via* social networking apps (Hollingshead et al., 2020). The administrators of several dating apps have realized the risk of HIV transmission. For example, Blued carried out mobile HIV testing, publicity campaigns, consultation sessions, data-driven studies, and antidiscrimination advocacy; it has also explored a new model of “Internet + HIV prevention and control.” Giles (2021) reported that location-based mobile dating applications are often a rich source of personal information readily accessible to strangers online. In many cases, this information now includes users' HIV status and the date of their most recent sexual health test.

As dating apps continue to evolve and acquire new characteristics, the number of users is also growing. Moreover, people are increasingly using dating apps to meet each other in real life, leading to an increased risk of HIV transmission. According to our survey, the number of “stranger” social app users in China is still rising. Dating apps have become a prominent and contentious topic in discussions over intimacy among the wider public and in academia (Wu and Trottier, 2022). Chan (2020) conducted a detailed empirical study of the multiple uses of Momo, a popular Chinese dating app. It

is difficult to discern whether Momo is an alternative to the new liberalization of intimate relations in China. Therefore, studying the impact of arranging real-life meet-ups *via* dating apps is necessary. Based on existing knowledge in the field, this study attempted to compile in-depth analyses of the relationship between hookup culture and HIV-preventive intentions through dating apps. Dating apps mediate users' dating and sexual practices, as well as their attitudes toward HIV.

After considering the number of users of each online dating app, as well as users' daily activities and their age distribution, we decided to recruit users of the social app Hello Group to participate in a questionnaire with the goal of better understanding users' cognition and influence on online social behavior. Hello Group is an open, video-based smartphone application that was launched in August 2011 and is based on the location of the user. Hello Group dominates the social field of strangers in terms of total users and monthly active users; it has a wide range of users, from teenagers to people in their 70s and 80s. In terms of total monthly use time, Hello Group is a leader. However, Hello Group's penetration rate remains relatively low, indicating that this app still has a significant amount of work to do to attract users.

The rise in dating apps has led to an increase in online dating, which in turn has exacerbated the spread of HIV and other sexually transmitted diseases (Yu, 2021). This has undoubtedly raised the need for the developers of such dating apps to establish norms and remind risks regarding the usage of these apps. In a sense, hooking up in China is not based on a fixed system, which is only maintained by a short sense of freshness and excitement. Simultaneously, due to a lack of effective means of auditing strangers' dating apps, it is hard for users to get the risk reminder on platforms, which increases the risk of the transmission of HIV and other sexually transmitted diseases.

This study combined the health belief model (HBM) with the theory of planned behavior (TPB), which is the successor to the theory of rational action (TRA), to describe the users of online dating applications in China through structural equation modeling (SEM). It also analyzed the relationship between users' mindfulness, perceived benefits, perceived barriers, self-efficacy, and HIV prevention intentions; it also considered whether attitudes, subjective norms, and behavior control play a mediating role between independent and dependent variables. This study might serve as an important reference for subsequent research and prove crucial to preventing the spread of HIV. Through a case study of the popular Chinese online dating app Hello Group, this study examined an understudied aspect of online dating apps: (1) the types of sexual activities that these apps tend to encourage, facilitate, and mediate; (2) the hookup culture that has emerged on social media websites and applications as well as the perceptions surrounding HIV risks.

The literature review section of this paper summarizes existing research on hookup culture and HIV, the HBM and TPB, both within China and abroad, and related research on mindfulness. The third section introduces the research methods used in this study. The fourth section uses SPSS and SEM to analyze the statistical data from the questionnaire before analyzing the influencing factors on HIV-preventive intentions among online dating app users. The final section of the paper is the conclusion, which discusses this study's results, contributions, and limitations; it also discusses possibilities for future research.

## Literature review

Research on hookup culture in Western countries began relatively early, and previous studies examined the relationship between hookup culture, health, and romance, as well as the associated risks. They have connected with dating apps to undertake research. Paul et al. (2000) defined "hooking up" as a form of sexual contact that may or may not include sexual intercourse. Additionally, hooking up implies a single event between two strangers or people who have met briefly. Their study used various social and psychological predictors to explain the differences between different hookup experiences among college students. Fielder et al. (2013) believe that "hookup behavior" refers to sexual interactions between partners who are not in a relationship and do not anticipate mutual commitment. Their study focuses on whether the hookup culture will replace normal romantic behaviors. Through the lens of social theory, Anders et al. (2020) observed that hookup behavior can bring people enjoyment, sexual fulfillment, status, achievement, and the potential to develop a relationship; however, it also brings corresponding costs, such as regret, ambiguity, increased sexual risk, and loss of respect. Garcia et al. (2012) studied various factors affecting hookup behavior, and after reviewing previous studies related to hooking up, they found that hookup behavior is deeply rooted in popular culture.

Moreover, Kalish and Kimmel (2011) believe that hookup culture is strongly related to gender and emphasize the positive impact of hookup culture on young women's social interactions in the United States. Montes et al. (2017) studied the positive correlation between the attitudes of relatives, friends, and participants toward hookup behavior. Scholars exploring digital intimate publics tend to consider social media platforms separately from dating and hookup apps, implying that there is a distance between social and sexual communication practices (Byron et al., 2021). Participants' attitudes toward hookup behavior were positively correlated with their social motivation to hook up. This increase in social motivation is positively correlated with hooking up with multiple partners and its negative consequences.

Media and communication researchers studied dating apps across different cultural contexts to better understand the dynamic relationship between dating apps and social processes. Liu (2016) considers how sexualities can constitute a useful lens for understanding social media in order to clarify the complex interconnections between the political, cultural, economic, and “private” realms of sexual experience. Moreover, Liu T. et al. (2022) investigated how rural migrant workers in China use digital dating services and select daters, revealing that, when dating online, there are many obstacles to achieving sexual and romantic satisfaction. In addition, Albury et al. (2020) identify a significant category of supportive discussions of safer app use within social news and lifestyle reporting and they also reveal app users’ safety strategies, and their experiences of pleasure and playfulness. Furthermore, Conner (2019) demonstrated how gay men’s portrayals of themselves on dating apps perpetuate biases based on body type, age, race, and the HIV stigma.

Similarly, Winter et al. (2020) proposed that it is important to understand the psychosocial variables related to sexual behavior, especially among members of high-risk groups, such as those who engage in hookups; they also found that HIV screening, which is a behavior related to sexual health, is influenced by the body image of those who have sex with others through apps. However, Hollingshead et al. (2020) found that the participants in their study viewed the expanding epidemic and apps as intimately linked and regarded apps as “risky spaces” for “risky behavior.” Additionally, Lauckner et al. (2019) claimed that dating apps can be detrimental to people because of their potential to create negative and traumatic experiences.

This study was based on the HBM and the TPB. Therefore, this study also surveyed the relevant literature. The HBM and the TPB are two widely used theories in the field of health psychology. Because both theories are based on expected value theory and because the concepts intersect with each other, they form a complementary relationship. Therefore, many studies that seek to interpret and predict health-related behaviors have comprehensively applied both theories to improve their accuracy of interpretation. Nothling and Kagee (2013) attempted to determine whether the main components of the health belief model—perceived susceptibility, perceived severity, perceived benefits, and perceived barriers—can predict the acceptance of routine HIV counseling and testing and whether action cues can predict the adoption of routine HIV counseling and testing. Smith et al. (2012) studied the empirical verification of the behavioral health model for HIV risk. Fan et al. (2018) found that behavioral intervention can change health beliefs and that such intervention may make people more willing to accept AIDS testing. Buldeo and Gilbert (2015) explored the HBM and the willingness of 1st-year students at the University of South Africa to voluntarily seek consultation and testing for AIDS. The investigation concluded that knowledge about HIV and AIDS and voluntary counseling and testing are crucial to HIV management and prevention. It also found that

college students’ self-efficacy and action tips may have a positive effect on AIDS prevention. Huang and Pan (2013) studied the predictors of female sex workers’ willingness to prevent HIV exposure in southwest China. They assessed their understanding of AIDS, its psychosocial impacts, demographic data, and their willingness to be tested for AIDS.

The HBM refers to the behaviors and belief prevention adopted by individuals, including the knowledge of the disease and health knowledge, to maintain and promote health and achieve self-satisfaction and self-realization. The HBM is based on the needs and motivation, cognitive, and value expectation theories. It is concerned with people’s attitudes and beliefs toward health and accords importance to the internal and external factors that affect those beliefs. The HBM was the first theory to explain and predict health behaviors. It was proposed in 1952 by three social psychologists, Hochbaum, Rosenstock, and Kegels. The HBM asserts that individual perception, positive action, and the belief that one can take recommended actions are important factors for behavioral change. The model is used to explore various long- and short-term health behavioral problems, including sexual risk behaviors and the spread of HIV and AIDS. The HBM consists of three parts: individuals’ health beliefs, the clues or intentions of behavior, and behavior constraints. Individuals’ health beliefs refer to how people view health and diseases, how they understand the severity and susceptibility of disease, and how they understand the effect of preventive measures and the obstacles encountered when taking such measures. According to the HBM, if people want to accept the advice of medical staff and adopt healthy behaviors or give up harmful behaviors, they need to meet several conditions:

- 1) Individuals must be able to perceive the threat of a disease or risk factor and subsequently recognize the seriousness of the problem, including disease susceptibility (perceived susceptibility) and the perception of disease severity (perceived seriousness). They must be able to estimate the consequences of adopting or abandoning a behavior, which includes understanding the benefits of the behavior (perceived benefits) and the barriers to implementing or abandoning such behaviors (perceived barriers). They must also have efficacy expectations, which refer to one’s ability to implement or abandon a behavior, also known as self-efficacy. Furthermore, Chen et al. (2020) claimed that social support, self-efficacy, and apps are employed in a variety of situations. An app that takes the promotion of social support and self-efficacy as its core and transforms it into a game-based interaction method to achieve the goal of sustainability is more valuable (Chiou et al., 2021).
- 2) They must possess clues or action intentions, which refer to the factors determining whether people will take preventive measures (Chiou et al., 2022) based on media reports, reminders from medical staff, advice from experts, and relatives’ and friends’ experiences with the disease.



- 3) They must be able to constrain their behavior based on demographic characteristics (age, gender, race, place of origin, and so on), social psychological factors (personality, social class, the influence of peers and others, and more), and knowledge structure factors (knowledge about the disease, previous experience with the disease, and so on.).

The framework of the HBM is shown in [Figure 1](#).

The TPB was proposed by [Ajzen \(1988, 1991\)](#). This theory is the successor of the TRA, which was jointly proposed by [Ajzen and Fishbein \(1975, 1980\)](#). Because Ajzen's study found that human behavior is not completely voluntary but rather controlled, he expanded on TRA, adding the new concept of "self-behavior control cognition." Subsequently, TRA developed into a new behavioral theory known as the TPB. The TPB has five elements: attitude, subjective norms, perceived behavioral control, behavior intention, and behavior. Among them, *attitude* refers to an individual's positive or negative feelings about a behavior. In other words, an attitude is formed as a result of the conceptualization of an individual's evaluation of a specific behavior.

Therefore, the components of attitude are often regarded as a function of an individual's significant belief in the result of a behavior. Subjective norms refer to the social pressures that individuals feel when deciding whether to resort to a certain behavior. In other words, it refers to the influence of an individual or group on an individual's decision regarding whether to engage in a certain behavior when predicting others' behavior. Perceptual behavior control refers to the obstacles that arise from individuals' past experiences and expectations. Individuals believe that the more resources and opportunities they have and the fewer obstacles they meet, the stronger their perceptual behavior control will be. It can influence behavior in two ways: First, it has motivational implications for behavioral intention. Second, it can directly predict behavior. Behavioral intention refers to an individual's judgment of the subjective probability of taking a specific action, which reflects an individual's willingness to take that action. Behavior refers to the behaviors in which an individual engages. [Ajzen \(1991\)](#) believes that all factors that can affect behavior also indirectly affect behavior through behavioral intention. According to the TPB, behavioral intention is affected by three related factors. The first factor is the "attitude" of the individual toward adopting a specific behavior. The second is the external "subjective norm" that will drive an individual to take a specific action. The third is "perceived behavior control." The theoretical framework of planned behavior is shown in [Figure 2](#).

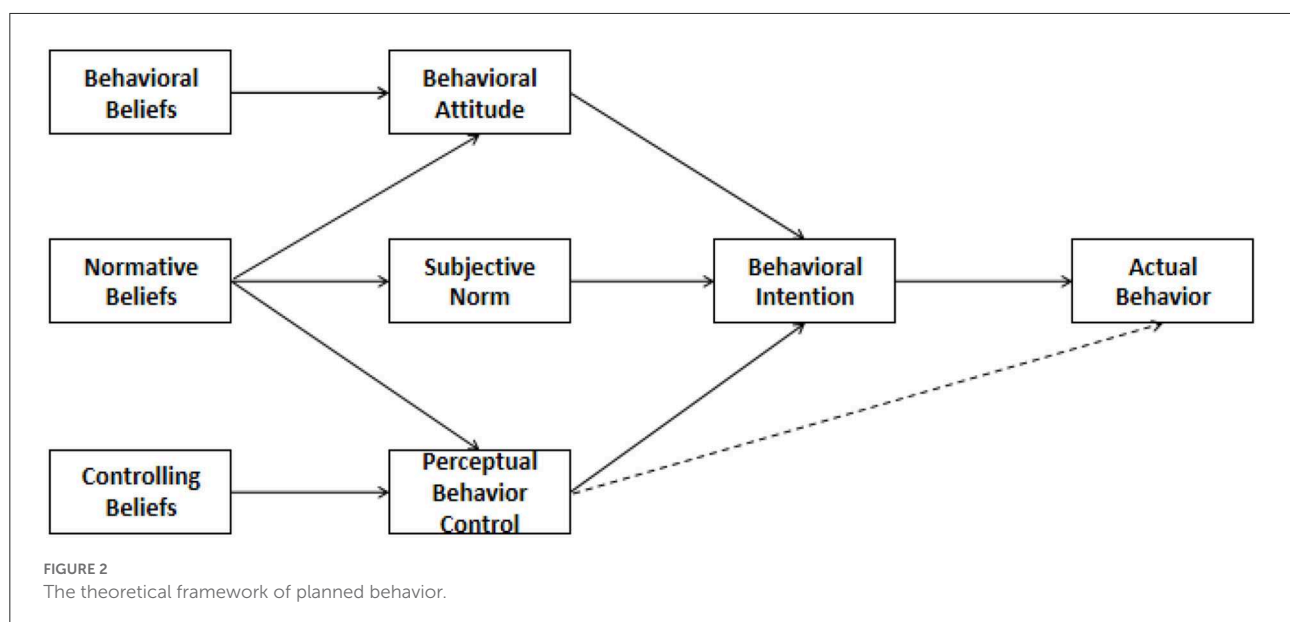
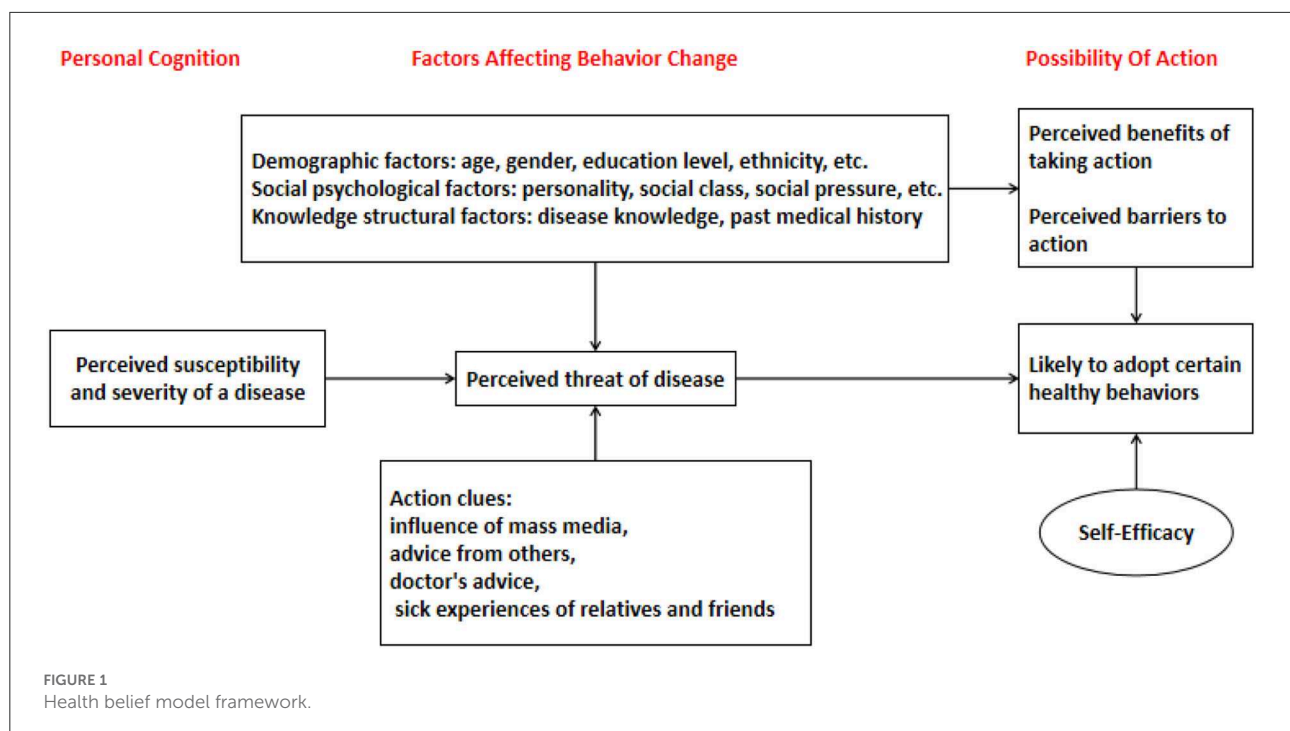
Only a few studies combined the TPB and the HBM to investigate health and health-related behaviors. [McClenahan et al. \(2007\)](#) tested the utility and efficiency of the TPB and the HBM in predicting testicular self-examination behavior, and they found that self-efficacy was the most important predictor of testicular self-examination behavioral intention in both models.

The TPB and the HBM have the potential to both improve our understanding of adherence behaviors and contribute to the design of more effective interventions to promote adherence to TB and HIV/AIDS medications ([Munro et al., 2007](#)). [Reid and Aiken \(2011\)](#) combined key concepts from five health behavior models, including the TPB and the HBM, to predict condom use intention. [Seong and Bae \(2022\)](#) investigated adults' health behaviors in relation to pandemic prevention based on the HBM and the TPB. [Bish et al. \(2000\)](#) used two social cognition models, the HBM ([Maiman and Becker, 1974](#)) and the TPB ([Ajzen, 1991](#)), to report on a study that identified predictors for 142 women receiving cervical screenings in central London. However, most studies linking the two models have focused on comparing the utility of the two models in predicting behavioral intentions, and they have found that the TPB tends to be superior ([Bish et al., 2000](#); [McClenahan et al., 2007](#)).

Although the TPB and the HBM emphasize different aspects of behavior formation, they have some natural linkages. [Lawes-Wickwar et al. \(2021\)](#) investigated the effect of perceived disability on pandemic disease prevention behavior, attitudes toward pandemic prevention behavior, subjective norms, and perceived behavioral control. [Yang \(2015\)](#) compared the predictive power of the TPB, the HBM, and an integrated model and found that several of the HBM variables influenced behavioral intention through the TPB variables. In addition, possible mediating and moderating effects among variables were examined to simplify the direct and indirect effects of key variables on behavioral intentions ([Yang, 2015](#)). Findings from a study by [Seong and Bae \(2022\)](#) suggest that the TPB and the HBM are pursuing essentially the same fundamental constructs that account for behavioral formation. These findings are expected, given that both models are based on expectancy-value theory ([Bish et al., 2000](#)). Both models recognize the influence of self-efficacy on individuals' decisions to adopt healthy behaviors. In other words, behavior control is an important factor that leads to the initiation of behavior. Moreover, the subjective norms of the TPB may impact the subjective norms of the HBM's cues to action that trigger healthy behavioral changes ([Yang, 2015](#)). Particularly, even when exposed to external stimuli in one's social environment, people who are prompted to take precautions are more likely to conform to social norms. [Garcia and Mann \(2003\)](#) explained 19% of breast self-examination behavioral intention using the HBM. Self-efficacy and perceived control over behavior are frequently the most important predictors of health behavior intentions and behavior ([Manstead and Van Eekelen, 1998](#); [Armitage and Conner, 1999](#)). The classic mediation effect in Yang's study explains why the interpersonal discussion was no longer significantly related to behavioral intention after subjective norms were put into the model ([Yang, 2015](#)). Thus, subjective norms are expected to mediate the relationship between action cues and behavioral intentions.

Recent theoretical developments have also demonstrated a connection between the TPB and the HBM. In particular,





communication scholars emphasize that cost-benefit analysis should be an integral part of the conceptualization and evaluation of attitudes within the TPB (Fishbein and Yzer, 2003). Ajzen (1988) suggested that attitude, which is an extension of behavioral beliefs, should contain both instrumental and experiential attitudes toward a behavior. Similarly, the findings of some scholars provide more evidence that supports claims for more studies on response costs, which include concerns about the possible negative consequences of implementing

health behaviors (Champion and Skinner, 2002; Cameron et al., 2009). Bish et al. (2000) suggested that the poor prediction of intention provided by the HBM was due to a lack of correspondence between measures of the HBM variables and measures of intention. This was followed by a cost-benefit analysis, and the potential outcome is that researchers can identify the behavioral beliefs underlying a person's decision to adopt recommended behaviors (Yang, 2015). Therefore, attitude can influence the relationship between perceived benefits

and dependent variables. Fishbein (2007) argued that many behavioral determinants, such as perceived threats and benefits, are reflected in behavioral, normative, and control beliefs. They serve as antecedents to attitude, subjective norms, and perceived behavioral control. The perceived ability to control one's behavior was found to have both direct and indirect effects (Seong and Bae, 2022). Gi theory development, the indirect effects identified through path analysis and additional mediation and moderation tests suggest that most of the HBM variables might be indirectly related to behavior because their relationship with behavioral intentions was either mediated or moderated by the TPB variables (Seong and Bae, 2022). Yang (2015) explored the links between the HBM and the TPB, with a particular focus on how the HBM variables can be used as antecedents for the existing TPB variables to enhance the overall predictive power of the model.

With the rising popularity of the Internet and the emergence of dating apps, there has been an increase in research on dating behavior on dating apps across the globe. Popular media outlets have described intimate relationships among contemporary college students as dominated by a pervasive sexual “hookup culture,” suggesting that students are involved in frequent sexual encounters without expecting a continuing relationship. This hookup culture has been described as “a nationwide phenomenon that has largely replaced traditional dating on college campuses” in the USA (Bogle, 2008; p. 5). Dai (2021) investigated dating apps such as Tinder to study the relationship between smartphones and college students' sexual health and relationship experiences, including sexual attitudes, changes in relationships, and dangerous sexual behaviors. The growing use of dating apps will influence people to be more accepting of sexual indulgence, resulting in more risky sexual behaviors and higher relationship turbulence. Chan (2018) believes that the popularity of mobile dating apps has changed how gay individuals communicate, and he links this online intimacy with online individualism and neoliberalism. Pan and Huang (2012) randomly sampled.

Chinese people aged 14 to 61 years. Their study constituted the first use of data to demonstrate the incidence and linear regression relationship between various situations of online sex among different social classes, thus proving that online sex is a new, mainstream form of culture. Qiu and Huang (2020) believes that the widespread popularity of mobile dating has greatly liberated male sexuality from the orthodox concept of heterosexuality; however, the increase in dating opportunities will also expose this group to a higher risk of contracting AIDS. Some relevant risk-coping strategies include actively choosing sexual partners, building trust, enhancing one's perception of health risks, and adopting safe sexual habits. Li and Wu (2018) studied the engagement behaviors of college students from the perspective of self-rationalization through interviews with 18 college students. They analyzed the relevant factors for the rationalization of the occurrence

and continuation of the engagement as well as the resolution of the engagement, such as physiological and emotional needs, conformity psychology and peer pressure, primary family and major events in childhood, failure to establish romantic relationships, psychological contradictions, and moral confusion of the parties. Tang and Dong (2017) believe that meeting strangers through social media is a strong temptation facing youth; they also assert that the related risks, such as being cheated on and engaging in one-night stands, are substantial. There is an urgent need to guide, educate, control, manage, and standardize the use of social media for meeting strangers. Xu and Wu (2019) discussed a phenomenon that has become popular in mainland China in recent years: “stranger communication.” They paid special attention to an app called Momo, a social discovery and dating platform widely used in China.

In addition, this study explored the impact of mindfulness and traditional Chinese culture on hookup behavior. Mindfulness is defined as bringing one's attention to the experience of the present moment with an attitude of acceptance, and it is associated with engagement in various health behaviors. The term “mindfulness” describes a state of awareness in which one is fully present in the moment without analyzing, judging, or reacting to anything. In other words, mindfulness is the act of simply perceiving things and paying attention to them. Kabat-zin defined mindfulness as a purposeful and conscious focus on the present without judging the present (Kabat-Zinn, 2003). Mindfulness-based stress reduction aims to help people eliminate negativity bias by amplifying intention and minimizing judgment (Liu et al., 2022a). Mindfulness training teaches one not to treat life stress as a difficulty or disaster but rather as an adjustable method for relieving emotional stress (Fernandes et al., 2021). Previous research showed that mindfulness can have a positive impact on different populations. For example, increasing mindfulness among clinicians can improve the safety competence of medical staff (Braun et al., 2019), patients (Liu et al., 2022b), employees (Liu et al., 2022c), and flight attendants (Liu et al., 2022d,e). It has also been demonstrated that mindfulness is an effective method for coping with COVID-19-related stress (Weis et al., 2021). According to Liu et al. (2022a) and Chen et al. (2022c), mobile health overcomes many obstacles associated with traditional mindfulness meditation training. Some studies discussed users' perceptions of HIV prevention using the HBM (Liu H. et al., 2022) or health behavior changes based on the intervention of mindfulness (Asfar et al., 2022). However, few studies explored the effects of dating apps from a perspective that combines mindfulness with the HBM or the TPB. This study attempted to fill this literature gap by employing systems thinking.

Although studies indicate that individual differences in mindfulness do not reliably translate into a pattern of healthy behaviors, mindfulness shows a stronger association with healthy behaviors under certain conditions

(Sala et al., 2020). Mindfulness-based stress reduction leads to increased problem-solving styles, life satisfaction, and increased regulation of negative emotional stimuli while also reducing aggression among HIV-positive young people (Webb et al., 2018). Sala et al. (2020) clarified that the importance and utility of mindfulness in improving health behaviors might be limited in the general population. However, mindfulness had relatively stronger associations with health behaviors in some populations, suggesting that there are important limitations to the associations between mindfulness and health behaviors. Wedell et al. (2022) studied the buffering role of mindfulness in the relationship between sexual orientation, affective lability, and suicidal ideation.

Additionally, they found that several mindfulness facets significantly buffered the indirect relationship between sexual minority identity and suicidal ideation *via* affect lability. Chen et al. (2021) explored and examined the effects of loving-kindness meditation on doctors' mindfulness, empathy, and communication skills. They suggested that the mechanisms that underlie the effects of loving-kindness meditation on mindfulness, empathy, communication skills, and other psychological constructs need further elucidation. Moreover, Chen et al. (2022a,b) reported that focused-attention meditation could significantly improve surgeons' focus, communication skills, and safety attitudes, potentially helping to reduce the frequency of adverse clinical events. In addition, as a simple and effective intervention technique, mindfulness meditation improves patient safety and has a certain promotional value (Liu et al., 2019).

Online dating app users exist "in-between" traditional Chinese culture and new values. They are contributing to the formation of a new form of Chinese cosmopolitanism by cultivating insensitivity toward strangers. Moreover, their participation in unfamiliar modes of communication means that those who engage in online dating are more open to others. Xu and Wu (2019) adopted cultural discourse analysis to analyze the results of online and offline interviews conducted in Beijing and Shanghai. They investigated how Momo users in urban metropolises use the application and analyzed cultural radiation in their communication practices. Online dating apps have impacted contemporary intimacy. One popular app, Bumble, claims to be "shifting old-fashioned power dynamics" by requiring women to "go first" in conversations with "matched" men (Young and Roberts, 2021).

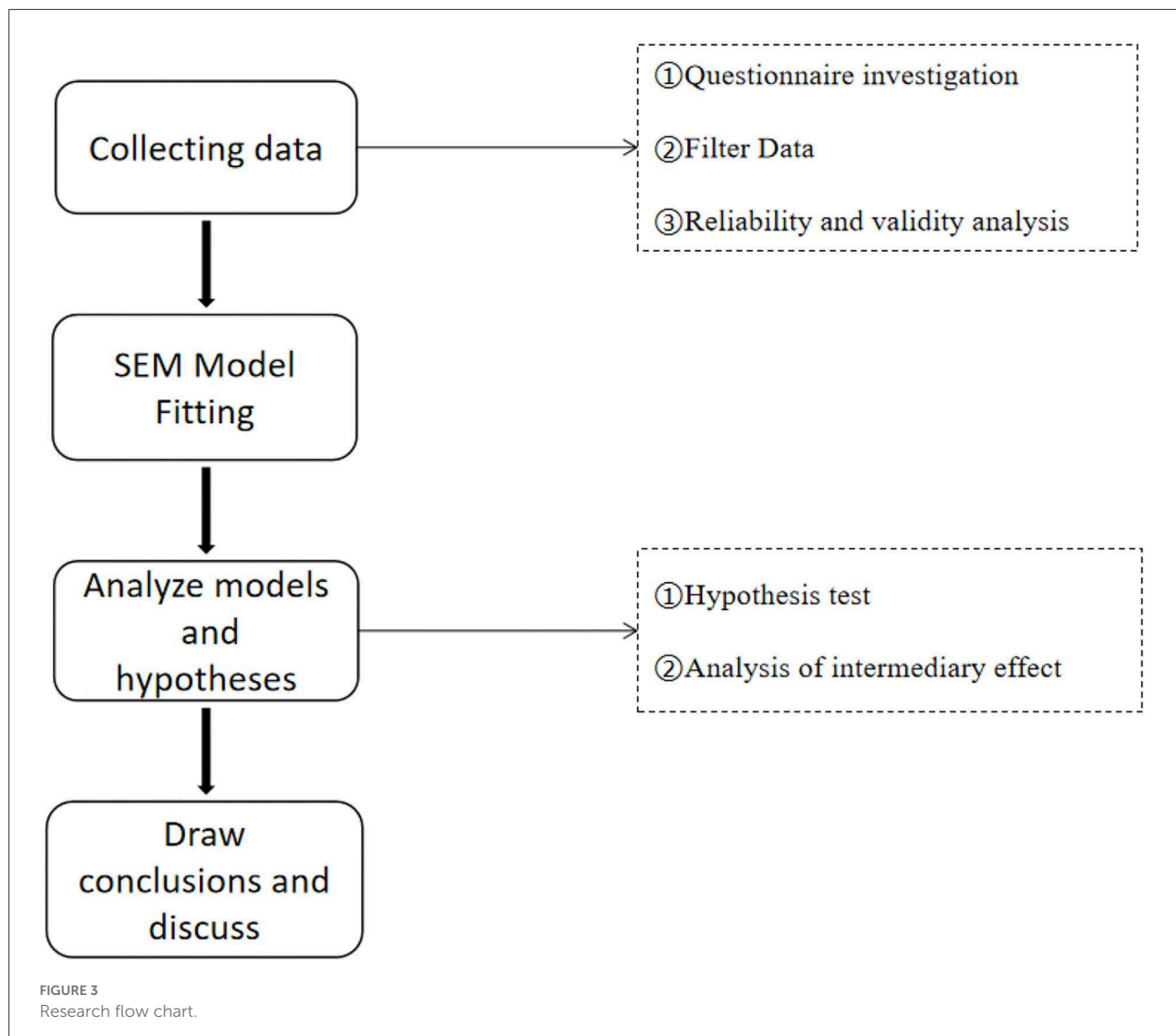
Additionally, Chen et al. (2021) examined the digital dating experiences of members of the Chinese diaspora in Australia who use Chinese- and English-language online dating apps and hookup services. They found that online dating and its constitutive norms play a role in maintaining certain tropes of cultural representation regarding racial subjects and in securing cultural power within an overarching system of white racial entitlement. Hookup culture is consistent with larger cultural

shifts in the "scripts" and terminology surrounding sexuality (Monto and Carey, 2014). Moreover, Liu T. et al. (2022) demonstrated that, while online dating increases a sense of possibility and desire in China, particularly among individuals of lower socioeconomic status, it fails to support these users in tackling the structural inequalities that obstruct the realization of their desires. If culture is a "toolkit" offering culturally competent actors a set of ideas and practices with which to explain their choices, for instance, to use Ann Swider's metaphor from her article "Culture in Action," then the hookup culture offers students many tools for embracing casual sex but few for articulating why they may prefer other kinds of sexual engagement, or none at all (Wade, 2017). In addition, Xiong and Liu (2022) believe that the ways in which the "super-sticky" "all-in-one platform" WeChat acts as the coordinator of a polymedia environment - and not just part of the polymedia environment - in mediating intercultural romantic relationships in the Greater Bay Area of China. However, another study studied online dating platforms as sites. These researchers focused on examining people's quotidian and habitual engagements with online dating platforms, and they perceived them as significant areas for the exercise and negotiation of "new" rules for intimacy (Liu, 2019). However, this study not only examines online dating platforms as hookup group active communities but also focuses on what factors influence hookup app users' perceptions of HIV and whether the establishment of intimate relationships is affected by mindfulness, the Chinese cultural context, and other factors.

Even in the modern era, most young people still fall in love gradually, with many platonic friendships and school relationships progressing to romantic ones. Many people are still hesitant about hooking up and avoid talking about it. In addition, HIV is regarded as a disgrace because it is related to immoral behaviors, such as drug use or sexual promiscuity. However, with the influence of Western culture, young people's acceptance of hookup culture is constantly increasing. This increases the number of dating app users, leading to more hookup behavior. This study summarized the key risk and vulnerability factors for HIV infection and transmission associated with hookup culture through online dating apps and proposed directions for future research.

## Research method

This study collected data on people who engage in hookup behavior using questionnaires. After screening the data, reliability and validity analysis methods were used to ensure the accuracy of the data. In addition, the SEM model was fitted through Amos and hypothesis testing, and intermediary effect analysis was conducted to verify the model's accuracy.

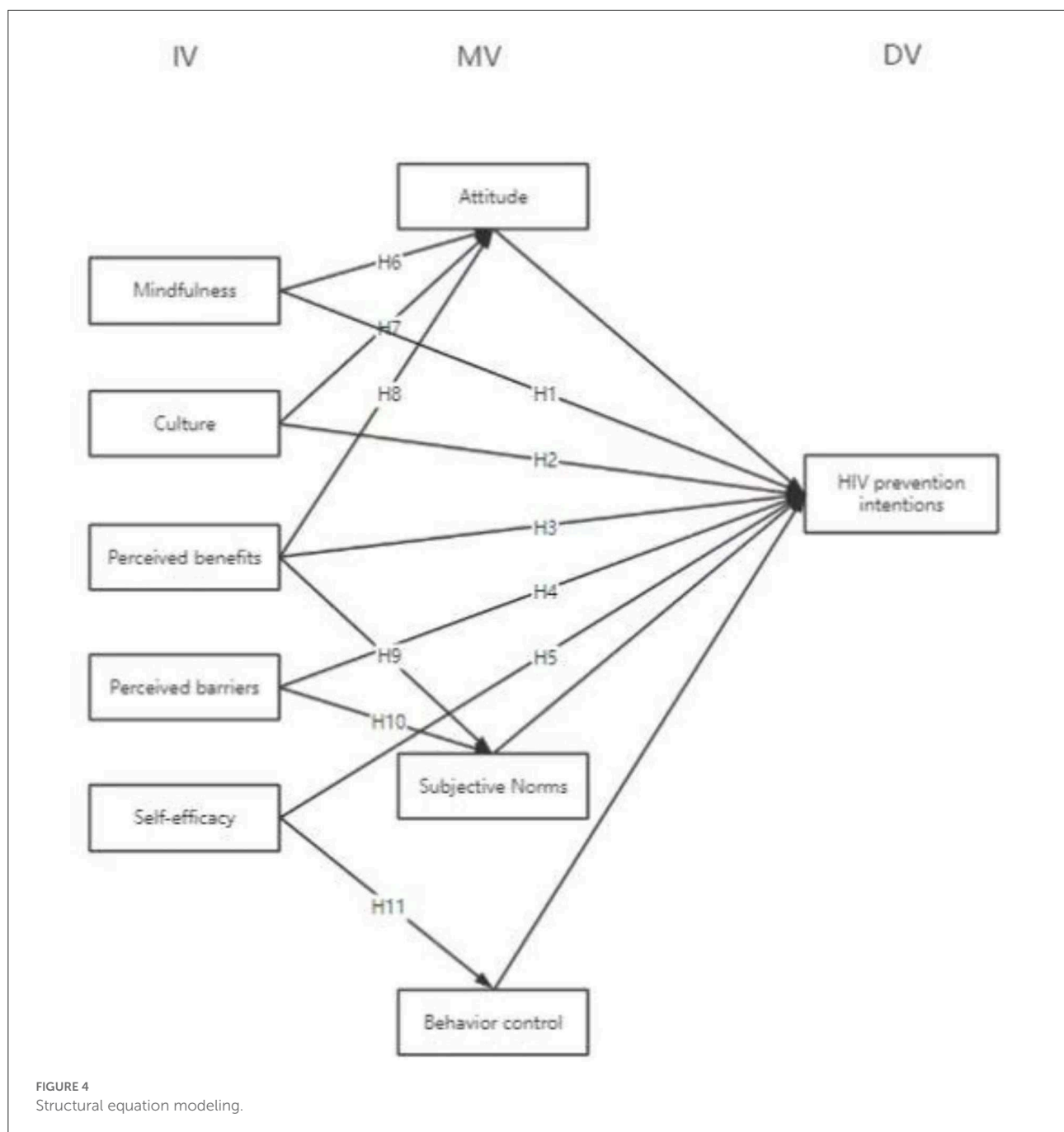


Subsequently, we developed relevant hypotheses. The research flow chart is shown in Figure 3.

The questionnaire collected information on users' gender, age, location, sexual orientation, and current emotional status. It also collected information on whether a participant was a talk-to-strangers app user, whether they had used other dating apps, which dating apps they preferred, and their main reasons for using them, whether they believed dating through a dating app was reliable, whether they were the active or passive party when dating, whether they used their real information on the dating app and their perspective on online dating behavior through dating apps, whether they took safety measures and their perception of the consequences of online dating behavior, whether they thought dating apps contributed to the spread of AIDS, and what measures they thought could be taken by dating apps to prevent the spread of AIDS. These questions were

designed to obtain a comprehensive understanding of the users of dating apps, their characteristics, and hookup behaviors.

The questionnaire survey method offers high efficiency, objectivity, and universality. Because Chinese people tend not to reveal that they engage in hookups and because questionnaire surveys were universal, this study used a quantitative research method to study the relationship between users' mindfulness, culture, perceived benefits, perceived barriers, self-efficacy, and HIV prevention intentions. The online questionnaire survey was carried out using the online survey website. Questionnaire Star, and a 5-point Likert scale was used. Questionnaire participants had to answer several questions, and they were given the options of "totally agree," "agree," "doesn't matter" (uncertain), "disagree," and "totally disagree." The researchers joined the group chat of the Hello Group app and distributed links to users of the Hello Group app. The link to the questionnaire was



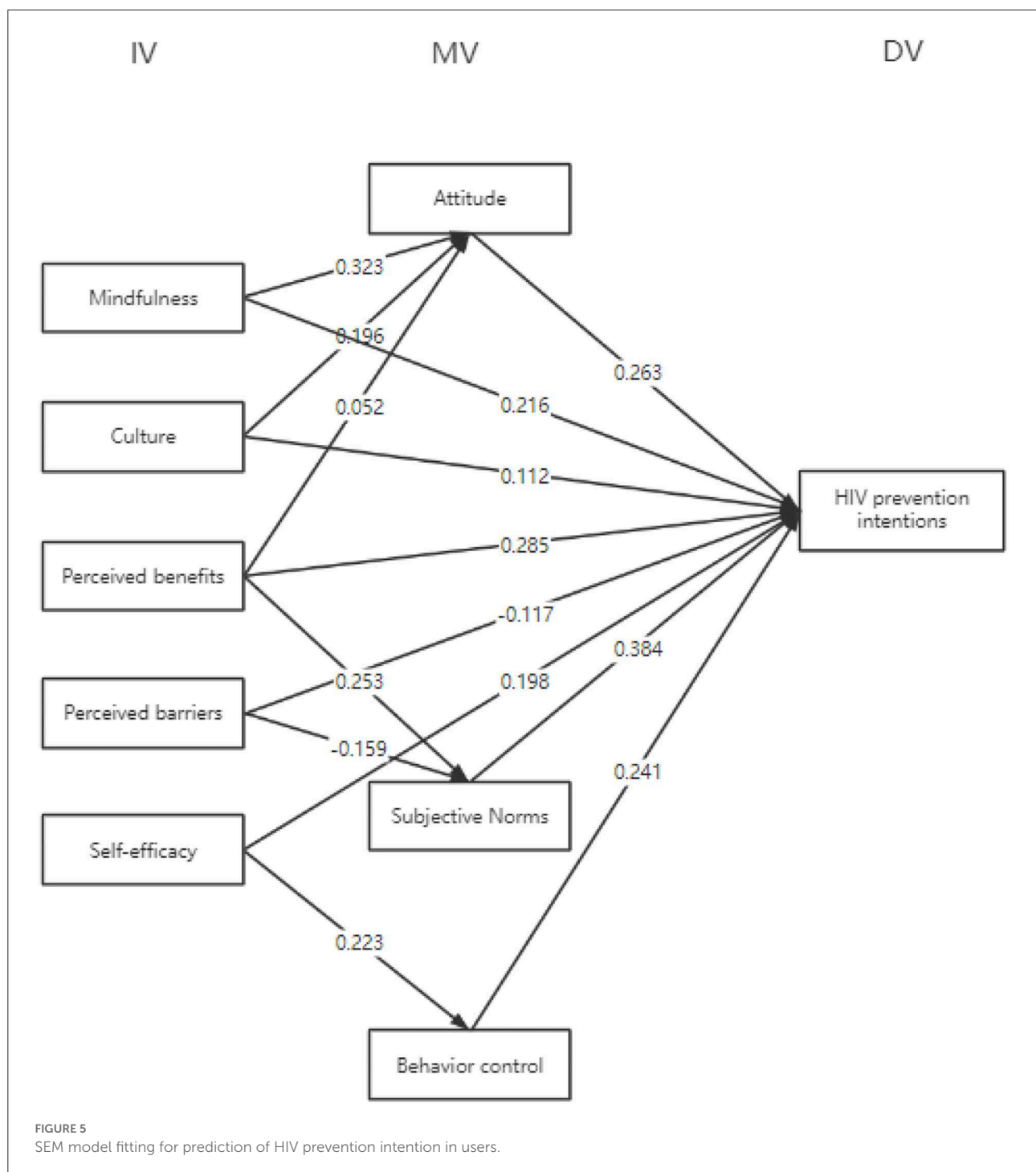
valid for 2 months. In all, 600 questionnaires were distributed, 535 were collected, and 520 valid questionnaires were finally obtained after the screening was conducted. Subsequently, the reliability and validity of the data obtained from the survey were analyzed. This study did not collect any private user information in the data collection process.

Our literature review demonstrated that most existing studies are case studies that employ qualitative methods. This study focuses on measuring data, establishing models, and

testing hypotheses. Therefore, this study adopts a quantitative approach. Based on the HBM and the TPB, this study uses SEM to model and then does fit analysis. Based on the literature review and questionnaire methods, this study aimed to profile the users of hookup apps in China and influence their HIV risk perception and prevention intentions. The basic framework of the model used is shown in Figure 4.

This model positioned mindfulness, culture, perceived benefits, perceived barriers, and self-efficacy as the independent





variables. The dependent variable was HIV-preventive intentions, and the control variables were demographic factors. Demographic factors such as gender and age might affect the final result, making it impossible to determine whether other independent variables influenced the final result. Therefore, demographic factors were considered control variables. In addition, users' attitudes, subjective norms, and behavior

control could not be manipulated and controlled in advance. Moreover, because the aforementioned aspects were internal factors that could not be directly observed, they were considered mediating variables of the model.

To classify the problems, we established mindfulness, culture, perceived benefits, perceived barriers, and self-efficacy as the five independent variables. Attitude, subjective norms, and

behavior control were the mediating variables. Demographic factors served as the control variables, and HIV-preventive intentions were set as the dependent variable. The SPSS and Amos were used to obtain a fitting SEM model. The results are shown in Figure 5.

The fitting analysis of the SEM model was carried out. Table 1 illustrates the specific analysis results and parameters.

The above table indicates that the hypothetical model and data match well (CMIN/DF = 2.285, TLI = 0.953, NFI = 0.914, IFI = 0.952, CFI = 0.954, and RMSEA = 0.059).

This study considered the physiological and psychological needs, cognition, and value expectations of the participants in the network engagement. For this purpose, we presented the following hypotheses:

H<sub>1</sub>: Mindfulness has a positive and significant impact on users' HIV-preventive intentions.

H<sub>2</sub>: Culture has a positive and significant impact on users' HIV-preventive intentions.

H<sub>3</sub>: Perceived benefit has a positive and significant effect on users' HIV-preventive intentions.

H<sub>4</sub>: Perception barriers have a significant negative impact on users' HIV-preventive intentions.

H<sub>5</sub>: Self-efficacy has a positive and significant effect on users' HIV-preventive intentions.

H<sub>6</sub>: Attitude has a significant mediating effect on users' mindfulness and HIV-preventive intentions.

H<sub>7</sub>: Attitude has a significant mediating effect on culture and users' HIV-preventive intentions.

H<sub>8</sub>: Attitude has a significant mediating effect on users' perceived benefits and HIV-preventive intentions.

H<sub>9</sub>: Subjective norms significantly mediate users' perceived benefits and HIV-preventive intentions.

H<sub>10</sub>: Subjective norms have a significant mediating effect on users' perceived barriers and HIV-preventive intentions.

H<sub>11</sub>: Behavioral control has a significant mediating effect on users' self-efficacy and HIV-preventive intentions.

Although researchers carried out a variety of in-depth studies on the popularity of dating apps, the spread of online dating, and the associated risks of AIDS transmission, there remains a lack of research on the generation mechanisms and influencing factors of online dating in the specific cultural and social contexts of China. The hidden influencing factors, intermediary effects, and regulatory effects of online dating are unknown research topics that require further exploration. Only through sufficient investigation and research can scholars more clearly understand how users of dating apps recognize their attitudes toward online dating, the risks of online dating, and HIV-preventive intentions. This study will help us better understand the motivations behind choosing to engage in online dating and its physical and psychological impact. Therefore, the framework model comprehensively considered the influencing factors of HIV prevention intention among online dating app users.

## Results and discussion

### Direct effects

#### Demographics

First, an analysis was done of the demographic factors in the questionnaire, including age, gender, location, wealth index, education level, and occupation (see Table 2 and Figure 4 for the analysis results of the questionnaire).

Because this study primarily explored the impact of mindfulness, culture, perceived benefits, perceived barriers, and self-efficacy on HIV prevention intention, it is uncertain whether age and gender will affect the study results. Therefore, to control for the impact of uncertainty, demographic factors, such as gender and age, were analyzed as control variables.

Table 2 illustrates that young people aged 18–29 years accounted for 33.27% of the survey participants, and people aged 30–45 years accounted for 31.73% of the participants. This demonstrates that users of dating apps are young and middle-aged. Moreover, the number of participants over 45 years old was 28.46%, highlighting the need to pay attention to middle-aged and elderly users.

The results show that most of the participants who responded to the questionnaire were between 18 and 60 years old, and the proportion of men to women was relatively unequal. The statistical data exhibited normal distribution characteristics. In addition, the regional distribution of questionnaire participants was also considered. Except for Tibet, Xinjiang, and Taiwan Province, there were participants

TABLE 1 SEM model fit analysis.

Fit metrics	CMIN/DF	RMSEA	TLI	NFI	IFI	CFI
Value	2.285	0.059	0.953	0.914	0.952	0.954
Standard	<3.0	<0.1		>0.9	>0.9	>0.9

TABLE 2 Questionnaire participants' gender and age statistics.

Age range	Gender		Proportion
	Men	Women	
<18	13	9	4.23%
18–29	99	74	33.27%
30–45	79	86	31.73%
45–60	61	87	28.46%
>60	5	7	2.31%

from all regions of China. Among them, Anhui, Jiangsu, Liaoning, and Fujian provinces had the largest number of participants, which indicates that the users participating in this survey were widely distributed and representative.

The pilot study questionnaire's reliability test can determine the sample data's consistency and reliability. The Cronbach's Alpha value of each variable and each dimension is greater than 0.800, and the Corrected Item-Total Correlation (CITC) value is greater than 0.5. Therefore, each variable in this study is greater than 0.5. The reliability coefficients of its measurement dimensions are all within a reasonable range, indicating that the questionnaire has high consistency and stability, indicating that the reliability results of the pilot study are ideal. Results of reliability test are indicated in [Table 3a](#).

The KMO measure of sampling adequacy (MSA) results is 0.894, which indicates good partial correlation exhibited in the data for this study. The Bartlett's test of Sphericity result is 0.000 which means very significant. The results are shown in [Table 3b](#).

Through confirmatory factor analysis, in the measurement model of this study, the factor loadings of the 56 items are above 0.5, which meets the standard. The combined reliability is 0.933, 0.911, 0.882, 0.830, 0.927, 0.909, 0.874, 0.878 and 0.960, respectively. The mean-variance Extraction amount (AVE) are 0.637, 0.631, 0.601, 0.496, 0.681, 0.666, 0.539, 0.595, and 0.708. All of which were greater than 0.36, indicating the validity of the pilot study questionnaire was good. [Table 3c](#) indicates the results of Variable Convergent Validity.

The reliability and validity analysis and confirmatory molecular analysis found that demographic factors such as age and gender have a measurable impact on safe sexual behaviors and knowledge of AIDS prevention among questionnaire participants. The proportion of young people using dating apps was relatively large (69%), and the scores of young people's prevention intention and understanding of AIDS knowledge were also relatively high ( $M = 3.86$ ,  $SD = 1.03$ ). According to the value of the validation factor, demographic factors affect participants' HIV prevention intention; therefore, it is reasonable to set demographic factors as control variables.

The measurement of HIV-preventive intentions was adapted from the studies by [Abraham et al. \(1992\)](#) and [Zak-Place and Stern \(2004\)](#). The measurement includes the ten following items: (1) In the future, if I have sex with someone new, I will ask them about their past sexual partners. (2) In the future, if I have sex with someone new, I will ask them about their HIV testing status. (3) In the future, I intend to carry condoms if I think I might be going to have sex with someone new. (4) In the future, I intend to use a condom if I have sex with someone new. (5) In the future, I intend to get tested for HIV before having sex with someone new. (6) In the future, I intend to get tested for HIV after having sex with someone new. (7) In the future, before I have sex with someone new, I intend to require them to be tested for HIV. (8) In the future, I intend to require someone new to

TABLE 3a Reliability test results.

Variable	CITC	Cronbach's alpha
Mindfulness	0.736	0.933
	0.751	
	0.764	
	0.743	
	0.803	
	0.765	
	0.809	
	0.768	
Culture	0.736	0.909
	0.707	
	0.769	
	0.664	
	0.801	
	0.819	
Perceived benefits	0.602	0.879
	0.726	
	0.735	
	0.680	
	0.820	
Perceived barriers	0.592	0.827
	0.592	
	0.602	
	0.600	
	0.726	
Self-efficacy	0.787	0.927
	0.796	
	0.810	
	0.699	
	0.825	
	0.808	
Attitude	0.811	0.907
	0.762	
	0.678	
	0.813	
	0.766	
Subjective Norms	0.622	0.868
	0.586	
	0.698	
	0.720	

(Continued)

TABLE 3a (Continued)

Variable	CITC	Cronbach's Alpha
Behavior control	0.639	0.874
	0.732	
	0.643	
	0.783	
	0.726	
	0.804	
HIV prevention intentions	0.566	0.960
	0.751	
	0.823	
	0.858	
	0.852	
	0.756	
	0.875	
	0.794	
	0.848	
	0.830	
	0.828	

TABLE 3b KMO and Bartlett's test for variables.

Kaiser-Meyer-Olkin measure of sampling adequacy		0.894
Bartlett's test for sphericity	approximate chi-square	23272.476
	df	1540
	Sig.	0.000

TABLE 3c Variable convergent validity test.

Variable	Combined reliability (CR)	Mean variance extraction (AVE)
Mindfulness	0.933	0.637
Culture	0.911	0.631
Perceived benefits	0.882	0.601
Perceived barriers	0.830	0.496
Self-efficacy	0.927	0.681
Attitude	0.909	0.666
Subjective Norms	0.874	0.539
Behavior control	0.878	0.595
HIV prevention intentions	0.960	0.708

be tested for HIV after having sex with me. (9) If I test positive for HIV, I will not have sex with anyone. (10) If someone tests positive for HIV, I will not have sex with them. The Cronbach's alpha is 0.927.

## Mindfulness and HIV prevention intentions

Mindfulness was measured using the 15-item mindful attention and intention scale (MacKillop and Anderson, 2007), with higher scores indicating greater mindfulness. In this study, we used eight items among them to investigate participants' mindfulness. The items (Cronbach's alpha = 0.933) are as follows: (1) I can experience an emotion and not be conscious of it until later. (2) I break or spill things because I am being careless, not paying attention, or thinking about something else. (3) I find it difficult to stay focused on what is happening in the present. (4) I tend to walk quickly to where I'm going without paying attention. (5) I tend not to notice feelings of physical tension or discomfort until they really grab my attention. (6) When I learn a new person's name, I forget it as soon as I have been told it. (7) I feel like I am "running on automatic" without paying much attention to what I am doing. (8) I rush through activities without being attentive to them. The results of the hypothesis testing are shown in Table 4. It was found that mindfulness had a positive and significant effect on users' HIV-preventive intentions ( $\beta = 0.216$ ,  $p = 0.001$ ). Thus, H<sub>1</sub> is supported.

This result corresponds with a study of users' HIV preventive perceptions that used the HBM (Liu H. et al., 2022). Moreover, the findings are consistent with those of previous studies by Vallejo and Amaro (2009) and Kerrigan et al. (2021), which found that mindfulness interventions are an important factor in improving mental health and HIV outcomes among female sex workers. In addition, Yang et al. (2015) suggested that prevention messages using mindlessness concepts should be developed in collaboration with the transmission of blood-borne viruses among people who inject drugs. Cluver et al. (2022) also mentioned that mindfulness significantly affects the integration of mental health care into HIV services, community services, and family services for adolescents living with HIV. Furthermore, previous research on mindfulness strongly predicted the essential factors of HIV prevention through models of nursing care (Relf, 2022). The "mindful rational living" approach has been proven to incorporate mindfulness techniques with rational emotive behavioral therapy strategies to address HIV in school settings (Chenneville and John Walsh, 2016). This finding is consistent with that of the study conducted by Koo et al. (2014), which clarified the relationship between mindfulness and HIV

risk behaviors in college students. Therefore, a high degree of mindfulness influenced dating app users' awareness of HIV prevention.

### Culture and HIV prevention intentions

Culture has been defined as a unique meaning and information system that is shared by a group and transmitted across generations, allowing the group to meet its basic survival needs, pursue happiness and wellbeing, and derive meaning from life (Matsumoto, 2007). It has further been categorized into two main dimensions: collectivism and individualism (Singelis et al., 1995). Based on these studies, we designed six questions (Cronbach's  $\alpha = 0.909$ ) to measure people's mindfulness and traditional cultural factors. These questions are as follows: Do my parents think I am bad when I use Hello Group? Do my friends think I am bad when I use Hello Group? Does my spouse think I'm bad when I use Hello Group? Will my use of Hello Group affect my relationship with my parents? Will my use of Hello Group affect my relationship with my friends? Will my use of Hello Group affect my relationship with my spouse?

According to the hypothesis testing results shown in Table 4, Chinese culture had a positive and significant effect on users' HIV-preventive intentions ( $\beta = 0.112$ ,  $p = 0.004$ ). This can be interpreted to mean that most users are deeply influenced by traditional Chinese culture, especially the value of collectivism. Users of online dating apps still attach importance to their relationships with family and friends; therefore, it is necessary to raise HIV-preventive intentions during online dating. Therefore,  $H_2$  was supported.

This finding is in line with previous research that found that culture plays an important role in solving the problem of HIV prevention among young people (Lillie, 2006). Weeks et al. (2010), Le et al. (2018), and Bond and Ramos (2019) also mentioned that the subject matter was culturally relevant and focused on the topic of female-controlled HIV prevention methods. Full use of peer education and social interaction-based interventions may help prevent and control the spread of HIV and AIDS among female sex workers in China (Dong et al., 2019). In addition, some scholars believe that HIV and STI prevention programs can address the cultural, social, and economic constraints facing the migrant population in China (Hong et al., 2006). A study by Zhang et al. (2019), which examined the preferences of MSM for an HIV prevention mobile phone app, also supported this finding. Then, under cultural and family pressure (the Chinese traditional moral code, family values, and gender roles), Jones (1999) also examined the concept of "culture" and its relationship to HIV prevention. Johns found that culture influenced dating app users' awareness of HIV prevention.

### Perceived benefits and HIV prevention intentions

In our model, "perceived benefits" refer to the perceptions of positive outcomes associated with users' HIV-preventive intentions. This study used five items that were outlined by Finkel et al. (2012) to measure users' perceived benefits. The following items (Cronbach's  $\alpha = 0.909$ ) were screened out: (1) Compared with traditional dating services, I am able to access a larger number of potential partners on Hello Group, (2) Compared with traditional dating services, Hello Group allows me to be accessible to more potential partners, (3) Compared with traditional dating services, Hello Group allows me to overcome time and place limitations when interacting with potential partners, (4) Compared with traditional dating services, on Hello Group, I am more able to enter my own search criteria when seeking out partners, (5) Compared with traditional dating services, Hello Group allows potential partners to be more easily matched to me. According to the hypothesis testing results shown in Table 4, perceived benefits had a positive and significant effect on users' HIV-preventive intentions ( $\beta = 0.285$ ,  $p < 0.001$ ). Thus,  $H_3$  was supported.

This outcome is consistent with a study by Fernandez et al. (2019) that found that the perceived benefits of using condoms are an important factor in raising awareness about HIV testing and prevention services. Smith et al. (2012) argue that frequent HIV testing was a perceived benefit. They also found that it is associated with HIV stigma and can enhance the reputation of pre-exposure prophylaxis users. The importance of perceived benefit was also highlighted by Fullerton (2008) study, which found that the perceived benefits of condom use had a positive effect on the acceptance of HIV. These findings are also in line with a previous study on the formation of prevention awareness by Logie et al. (2019).

Moreover, Mootz et al. (2020) proved the acceptability of using electronic healthcare predictive analytics to promote HIV prevention. Thus, perceived benefits influence the awareness of HIV prevention. The results of our study were also consistent with previous research by Isler et al. (2014), which identified minority benefits of engagement in HIV prevention research that can promote community awareness of HIV prevention. Moreover, Mutonyi and Kendrick (2010) believed that the benefits of health literacy programs in Uganda could positively influence awareness of HIV prevention among students.

### Perceived barriers and HIV prevention intentions

We also proposed that the "perceived barriers" refer to the perceptions of negative outcomes associated with users' subjective norms and HIV prevention intentions. It has been suggested that users might hold negative attitudes toward technology with a sense of perceived risk, especially in the context of controversial technologies (Chen et al., 2021). The



measurement was adapted from the studies by Finkel et al. (2012) and Chen et al. (2021). The adapted measurement included the following five items (Cronbach's alpha = 0.879): (1) When using Hello Group, I may be concerned that the platform will disclose too much information about me; (2) when using Hello Group, I may be concerned that the personal information in my profile will be misused by others; (3) the use of Hello Group may negatively affect the way others think of me; (4) the use of Hello Group may lead me be cheated; and (5) the use of Hello Group may expose me to the risk of HIV infection. The results on perceived barriers and users' HIV-prevention intentions indicated a negative relationship ( $\beta = -0.117$ ,  $p = 0.003$ ). This means that using dating apps may expose users to certain risks, such as personal information disclosure or HIV infection. Therefore, H<sub>4</sub> was supported.

The finding is consistent with a previous study by He et al. (2017) on sociocultural barriers and negative methods of coping with AIDS in the gay community. Sutherland (2002) claimed that participation intentions and perceived barriers to online nutrition programs were influenced by knowledge, self-efficacy, and subjective norms. In this regard, perceived barriers are unique in the perceived HIV risk among African American women (Heath, 2014). In addition, this study is consistent with the previous studies which showed that perceived barriers play a role in assessing individuals' willingness to get vaccinated against COVID-19 by using the HBM and the TPB as theoretical frameworks (An et al., 2021). Furthermore, the importance of perceived barriers to HPV vaccination influences the intention to vaccinate (Nyaga, 2020). Powell and Karraker (2017) explain that parenting behavior intention is affected by barriers to parenting knowledge and subjective norms and attitudes.

### Self-efficacy

The questionnaire investigated participants' HIV-preventive intentions and safe sexual behaviors *via* the following six survey items (Cronbach's alpha = 0.927): (1) I am confident that it is best to use condoms during sexual behavior; (2) I negotiate with netizens before engaging in sexual behavior; (3) I avoid engaging in sexual acts with drug addicts; (4) I test myself after engaging

in dangerous sexual behavior; (5) I keep using condoms during sexual acts; and (6) I frequently use condoms during sexual acts with strangers. According to the hypothesis testing results, self-efficacy has a positive and significant effect on users' HIV-preventive intentions ( $\beta = 0.198$ ,  $p = 0.002$ ). Therefore, H<sub>5</sub> was supported.

This study is also consistent with a study that found that self-efficacy is associated with introducing free antiretroviral therapy (Makishe, 2013). In addition, middle-class African American women's attitudes, beliefs, perceptions, and behaviors related to HIV risk are influenced by social and cultural norms and self-efficacy (Heath, 2014). In China, the self-efficacy of minority groups strongly influences the awareness of HIV prevention (Dai, 2018). The self-efficacy of laborers was effective at increasing HIV knowledge and decreasing HIV risk behaviors (Dong et al., 2019). Buseh et al. (2006) also mentioned that condom use self-efficacy affected HIV-protective intentions.

So far, we have discussed the direct effects of mindfulness, culture, perceived benefits, perceived barriers, and self-efficacy on users' HIV prevention intentions, and all the hypotheses were supported. In the following section, we will discuss the mediating effects of each variable.

## Indirect effects

### Measurement of attitude, subjective norms, and behavior control

Several studies demonstrated the relationship between attitudes and HIV-preventive intentions (Zak-Place and Stern, 2004; Traube et al., 2011; Qiu and Huang, 2020). In this study, the following five items (Cronbach's alpha = 0.907) were used to measure users' attitudes toward HIV: (1) Nobody deserves to be HIV-positive; (2) people with HIV have nothing to feel guilty about; (3) it is safe for people with HIV to work with children; (4) people with HIV are no different from anybody else; and (5) the needs of people with HIV should be prioritized (Green, 1995). In research by Ross and Mclaws (1992) and Smerecnik and Ruiter (2010), the following items were used to measure users' subjective norms: (1) Most people who are important to

TABLE 4 Hypothesis testing.

Variable path	Standardized parameter estimate $\beta$	S.E.	C.R.	P	Hypothesis test results
Mindfulness=>HIV prevention intentions	0.216	0.056	3.293	0.001	Support H1
Culture=>HIV prevention intentions	0.112	0.029	2.983	0.004	Support H2
Perceived benefits=>HIV prevention intentions	0.285	0.040	5.975	***	Support H3
Perceived barriers=>HIV prevention intentions	-0.117	0.029	-2.957	0.003	Support H4
Self-efficacy=>HIV prevention intentions	0.198	0.063	3.115	0.002	Support H5

\*\*\* Means  $p < 0.001$ .

me think that I should use a condom; (2) all my friends think that I should use a condom; (3) casual sexual partners think I should use a condom during unsafe sex; (4) I generally observe my casual sexual partners closely; (5) partners in the Hello Group think that I should use a condom; and (6) I generally closely observe my partners in the Hello Group (Cronbach's  $\alpha = 0.868$ ). The items for measuring behavior come from Michael and Monk's study (Michael Monk, 2012), including the following statements: (1) I reduced the frequency of intercourse; (2) I decreased my number of sex partners; (3) I reduced my frequency of using the Hello Group app; (4) I used condoms when I had sex; and (5) I got tested for HIV (Cronbach's  $\alpha = 0.874$ ).

### Mediation effect analysis

This study added attitude, subjective norms, and behavior control as mediating variables between the five independent variables (mindfulness, culture, perceived benefits, perceived barriers, and self-efficacy) and the dependent variables (HIV prevention intentions). It can be seen from Table 5 that users' subjective norms and behavior control toward sexual acts have obvious mediating effects between their mindfulness, attitude, culture, perceived benefits, perceived barriers, self-efficacy, and HIV prevention intention. The number of repeated samplings for all samples is 520, and the confidence interval is set at 95%. Table 5 shows the results.

When mindfulness, perceived benefits, self-efficacy, attitude, subjective norms, and behavior control were used to predict HIV prevention intention simultaneously, attitude ( $\beta = 0.263$ ,  $p < 0.01$ ), subjective norms ( $\beta = 0.384$ ,  $p < 0.01$ ), and behavior control ( $\beta = 0.241$ ,  $p < 0.01$ ) had a significant and positive impact on HIV prevention.

However, when using perceived barriers, attitude and subjective norms, and behavior control to predict HIV

prevention intentions, perceived barriers had a negative impact on HIV-preventive intentions ( $\beta = -0.101$ ,  $p < 0.01$ ). This suggests that it should enable the participants to shed their existing misconceptions in each node of the network agreement and improve their intentions for HIV prevention.

To explore the mediating effect between the users' attitude toward HIV, subjective norms, and behavior control of the five independent variables—mindfulness, culture, perceived benefits, perceived barriers, self-efficacy, and the users' intention of HIV prevention—this study used the bootstrap method. Attitude mediates the relationship between mindfulness and intentions ( $\beta = 0.189$ ,  $p < 0.01$ ) and the relationship between culture and intentions ( $\beta = 0.101$ ,  $p < 0.01$ ). Therefore,  $H_6$  and  $H_7$  were supported.

Zang et al. (2014) believed that HIV stigma might mediate the relationship between collectivist culture and social network support, providing an empirical basis for interventions that include aspects of culture in HIV intervention strategies. Sexuality, condoms, and drugs are sensitive topics in Vietnamese culture, especially when men and women communicate with each other (Van Nguyen et al., 2013). Sanchez et al. (2016) also established the efficacy of SEPA, a CDC evidence-based and culturally tailored HIV risk reduction intervention practiced among Latina immigrants in the farmworker community. In addition, He et al. (2017) found that sociocultural factors influence gay men's sexual beliefs and behaviors in contemporary China; they also analyzed the implications of this finding for the HIV epidemic. Having a cohesive family (a collective culture that values family relationships), a strong social network, and peers who encourage healthy behaviors and discussions of sexual health help Vietnamese adolescents achieve a higher level of HIV knowledge (Nguyen et al., 2015). Therefore,  $H_7$  was supported.

However, the mediating effect of attitude on perceived benefits and intentions is insignificant ( $p > 0.05$ ). Therefore,  $H_8$  was not supported. This conclusion differs from previous

TABLE 5 Standardized Bootstrap mediation test results.

Path	Direct effect value	Mediation effect value	Total effect value	Hypothesis test results
Mindfulness,	0.173**	0.189**	0.216**	Support H6
Culture,	0.097*	0.101**	0.112**	Support H7
Perceived Benefits=> Attitude=> HIV Prevention Intentions	0.082	0.053	0.285**	Not support H8
Perceived Benefits,	0.262**	0.172**	0.285**	Support H9
Perceived Barriers=> Subjective norms=> HIV Prevention Intentions	-0.101**	0.121**	-0.117**	Support H10
Self-efficacy=> Behavior control=> HIV Prevention Intentions	0.149**	0.133**	0.198**	Support H11

\* Means  $p < 0.05$ , \*\* means  $p < 0.01$ .

studies. Morar et al. (2018) mentioned that positive attitudes toward HIV prevention mediate the relationship between condom use and the benefits of active testing on peer prevention behavior. Attitude has a mediating effect on the perceived benefits of HIV prevention services and prevention awareness (Otengah and Omolo, 2020). Kim (1996) maintained that the benefits of condom use had increased HIV awareness and prevention knowledge among Korean Americans. In line with the TPB, participants' attitudes and self-efficacy toward the course were significant and meaningful predictors of their learning intention and subsequent behavior change (Cooley et al., 2020). The benefits of the theater performance were described as conducive to learning, and it indicated changed attitudes and awareness toward LGBT persons and issues following a participatory theater intervention in Swaziland and Lesotho (Logie et al., 2019). Additionally, Clark et al. (2006) suggested that the perceived benefits of HIV education caused an increase in student attitudes and increased awareness of HIV prevention among young people.

Subjective norms mediate the relationship between perceived benefits and intentions ( $\beta = 0.172, p < 0.01$ ) and the relationship between perceived barriers and intentions ( $\beta = 0.121, p < 0.01$ ). Therefore,  $H_9$  and  $H_{10}$  were supported. Previous studies by Du et al. (2020) showed that facilitating factors, such as HIV prevention awareness, may be supported by subjective norms and the perceived benefits of taking HIV antiretroviral therapy. Several studies related to HIV prevention awareness showed that perceived benefits are effectively influenced by subjective norms (Glick and Sahn, 2007; Cui et al., 2022). Alzahrani and Daim (2019) explain that, among patients with AIDS, the adoption and use of and perceived benefits of tethered electronic personal health records were indirectly affected by subjective norms. In addition, this study is also consistent with research on pregnant Ghanaian women's knowledge, attitudes, and intentions regarding voluntary prenatal testing for HIV (Lee, 2003). Umuhire (2020) proposed that subjective norms, perceived benefits, and attitudes positively influenced women's use of contraceptive methods to prevent unwanted pregnancies. In this regard, non-adherence across multiple therapeutic classes among the elderly is based on the influence of perceived benefits and subjective norms (Ding, 2010). Thus, the current study supported this hypothesis.

Moreover,  $H_9$  was supported. An et al. (2021) stated that, for the HBM and TPB constructs, respondents were more likely to accept vaccination if they had a higher level of cues to action and self-efficacy and a lower level of perceived barriers. In addition, this study is also inconsistent with a previous study by Tweed (2008) that emphasizes the role of perceived barriers and highlights that the relationships between perceived barriers to exercise and determinants of physical activity are indirectly influenced by subject norms. Smith (2018) examined the interaction of clinicians' subjective norms and perceived

clinical screenings for depression disorders among older adults to influence clinical behavior. Consumer rejection of the practice of coupon use is influenced by attitudes, subjective norms, and perceived barriers (Andrews, 2016). These studies also align with our conclusions. Therefore,  $H_{10}$  was supported.

In addition, behavior control has a significant mediating effect on self-efficacy and intentions ( $\beta = 0.133, p < 0.01$ ). Previous research demonstrated that behavioral control motivates HIV prevention awareness. When people use HIV prevention services, they tend to maintain strong self-efficacy, which is mediated by education and behavioral control (Omolo, 2018). Zhao et al. (2020) believe that people with higher self-efficacy in China were associated with HIV-related behaviors (history of STI testing) and influenced by personal behavior control. Many studies in the field of health communication found that the ability to correctly use available services is enhanced by knowledge and behavior control, which have an impact on HIV prevention and treatment interventions (Fishbein and Cappella, 2006; Makishe, 2013; Chimoyi et al., 2022). Shongwe (2014) also claimed that young peoples' intentions to adopt a mobile health information system implemented as an HIV information dissemination tool were influenced by behavioral control. Actual control, self-efficacy of condom use, and the intention-to-behavior relationship with AIDS were important moderators (Dai and Harrington, 2021). Thus,  $H_{11}$  was also supported.

## Conclusions

Due to the influence of traditional culture and public values, hookups have a low level of social acceptance in China, and it is more common to ask strangers through online social apps. This has also led to a lack of attention and research on hookup culture in China. Online dating applications, such as Hello Group, allow mobile users to meet potential partners through social media, causing more radical attitudes among Chinese people toward sex. Although these apps may satisfy users' needs for love and sex, the associated risks are often overlooked. Indeed, the risk of HIV infection should be considered when deciding whether to arrange a meet-up with a stranger.

This study investigated the influencing factors related to hookups in the context of the Hello Group app and HIV prevention intentions. The results showed that mindfulness, the Chinese cultural context, perceived benefits, and self-efficacy were the main predictors of users' HIV-protective intentions when using online dating apps. Among the HIV-related perceived risks of mobile dating, only perceived barriers have a negative effect on users' HIV-preventive intentions. In addition, attitude, subjective norms, and behavior control act as mediating variables between independent variables and HIV-protective intention; however, the mediating effect of attitude on perceived benefits and intentions is insignificant.

The main contributions of this study are as follows: First, most existing studies that employed qualitative methods were case studies. This study used quantitative research methods and complemented studies on groups that engage in hookups. For this study, we collected a large amount of data through online questionnaires, used SPSS software and SEM to analyze the data, drew a portrait of groups of Chinese people who engage in hookups, and corrected their perception of HIV risk while increasing their HIV protection intention. Second, this study combined the HBM with the TPB and incorporated the connection between traditional culture and mindfulness for users' HIV prevention intentions. The study found that users are afraid of unsafe sex and believe that safe sex can effectively reduce their risk of HIV infection; therefore, they are more likely to adopt safe sex practices. Mindfulness not only relieves the psychological discomfort of patients with AIDS but also improves their HIV prevention intentions. The study also found that some users have misconceptions regarding HIV risks. Without condoms, one can gain the trust of one's partner, use testing to prevent AIDS, and more. These actions increase the risk of AIDS infection among people who engage in hookups. As a first step, those interested in online dating should correct the common misunderstandings that exist at every stage of the process, focus on public awareness campaigns and sexual health education messaging, spread the word about drug prevention before and after AIDS exposure, fortify psychological counseling, enhance relevant legal systems, standardize the development of online dating applications, contain the outbreak at its source, sever all possible avenues of transmission, and thereby effectively halt the disease's spread.

This study also has certain limitations because there are many dating apps in China and because users' characteristics vary according to each app. This study only investigated the users of the app Hello Group. Due to privacy concerns regarding questionnaire participants and the lack of trust in cyberspace, it is difficult to collect survey data; therefore, our sample size was small. In addition, the hypothesis model mainly emphasizes the rational factors of engagement behavior; however, in some situations, HIV prevention behavior is affected and controlled by other factors, such as personal habits, moral norms, social identity cognition, emotional factors, and other irrational factors, all of which can determine people's behavior choices in different situations. Therefore, in future research, other factors should be considered to study the HIV-preventive intentions of hookup app users. In addition, other methods to enrich the collection of relevant data should be considered to ensure the accuracy and representativeness of the data. This will ensure that the research is more meaningful and can contribute to preventing HIV transmission.

## Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

## Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the patients/participants or patients/participants legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

## Author contributions

ML and NL: conceptualization, methodology, and survey and data analysis. ML: coding and writing—original draft preparation. NL: supervision and writing—review and editing. All authors have read and agreed to the published version of the manuscript.

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## Conflict of interest

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

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# A study on the relationship between mindfulness and work performance of web editors: Based on the chain mediating effect of workplace spirituality and digital competencies

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**Introduction:** Based on the job demands-resources model, this study aims to explore the relationship between mindfulness in web editors, work performance, workplace spirituality, and digital competencies.

**Methods:** Online data from the Tencent Questionnaire Platform was used to examine the proposed research model. We distributed questionnaires to new media companies, and a total of 431 valid questionnaires were collected.

**Results and Discussion:** The results suggested that mindfulness in web editors can improve workplace spirituality, digital competencies, and work performance. In addition, workplace spirituality was found to act as a mediator between mindfulness and work performance. And, digital competencies did not play a mediating role between mindfulness and work performance, but workplace spirituality and digital competencies played a chain mediating role between mindfulness and work performance. The study explained the internal impact mechanism of mindfulness on work performance in web editors, and proposed methods to improve mindfulness, revealing the chain mediating role of workplace spirituality and digital competencies in the impact of mindfulness on work performance, which might provide new insights into existing research. It can provide a reference for new media companies to manage the team of web editors and improve the work performance of web editors.

## KEYWORDS

mindfulness, work performance, workplace spirituality, digital competencies, web editors



## Introduction

Today, we live in an era of Omnimedia. According to the 49th Statistical Report on Internet Development in China as of December 2021, the number of netizens in China has reached 1.032 billion, and the Internet penetration rate has reached 73.0%. The new media industry is developing rapidly, and web editors play an important role as employees of new media companies. Web editors are an emerging profession with the rapid development of the Internet. Their main job content is to use their own professional knowledge and computer software and hardware knowledge and other modern information technologies to design and build website content (Wu, 2016). Therefore, web editors are defined as “someone who rely on the Internet, engage in the production and dissemination of online information and knowledge in units or institutions with online publisher qualifications, and provide online publications and related services to online user groups to achieve social and economic benefits.” Wu (2016) stated that, different from traditional media editors, web editors have the following characteristics, namely mastering network editing operation skills, flexible real-time interaction capabilities, and editing integration capabilities for resource libraries. This puts forward higher requirements for the work competencies of web editors. Most of the existing research on web editors focused on the cultivation of web editors talents and the improvement of their quality (Mu, 2010), but had not specifically research the working environment of web editors, nor explore how to improve the work performance of web editors from the perspective of psychology. This study fills the research gap in this field.

Since the COVID-19 outbreak in 2020, web editors have exerted strong initiative and dynamism to strengthen the production and dissemination of high-quality network information knowledge content. As an important part of the editorial team, web editors are an important support for the development of media integration in China (Wang, 2022). However, at the same time, a small number of online publishers, driven by economic interests, have excessive pursuit of click-through rate, ranking list, and update rate, and have affected the career of web editors' value and job identity by adjusting the platform's internal operating system, assessment and incentive mechanisms (Wang, 2022). Compared to employees in other organizations, web editors face greater career challenges and occupational pressures. Therefore, the professional ethics and professional quality of the web editors team need to be strengthened, and how to effectively improve the work competencies (e.g., digital competencies) and work performance of web editors has become a serious issue for new media companies. Early research has noted that the modern workplace is often full of distractions that challenge attentional control, impair occupational functioning, and even affect performance (Jett and George, 2003). Web editors face greater concentration challenges than other professional employees. It is particularly important to effectively improve the mindfulness of web editors.

And, it is necessary to improve the stability of attention through mindfulness practice and help web editors focus on the current work (Hasenkamp et al., 2012), thereby improving work performance.

Currently, there is growing enthusiasm for mindfulness research, and mindful-based training programs are gaining popularity in the workplace to reduce stress, improve employee well-being and boost output. With organizations, including Google, Aetna, Mayo Clinic, and the U.S. Army used mindfulness training to enhance workplace productivity (Tan et al., 2012; Wolever et al., 2012; West et al., 2014; Jha et al., 2015). After mindfulness training, people see life stress not as difficulty or disaster, but as modifiable ways to relieve emotional stress (Liu et al., 2022a). In addition, mindfulness enables employees to accept a variety of information, breaks fixed thinking, and is more likely to have conflicts and brainstorming, which is conducive to employees generating innovative ideas (Chen et al., 2022a). In fact, since the 1980s, mindfulness—a Buddhist spiritual practice, has been researched in the field of psychology (Bishop et al., 2004), and has been defined by some scholars as present-centred attention and awareness (Brown and Ryan, 2003). Mindfulness was being used in multiple fields, with research in disciplines such as psychology, medicine, and neuroscience. The research provided that mindfulness affects attention, cognition, emotion, behavior, and physiology in positive ways (Good et al., 2016). Organizational sociology and organizational psychology scholars have also shown great enthusiasm in the concept of mindfulness (Reb and Atkins, 2015; Good et al., 2016), and have gradually applied mindfulness training to organizational practice.

Existing research on mindfulness has established that mindfulness can improve work performance, reduce turnover intentions, etc. (Dane and Brummel, 2014), help employees understand themselves and others, and improve work engagement (Federman, 2009; Kahn, 2010). The association between mindfulness and workplace spirituality has been studied by previous study (Petchsawang and McLean, 2017), mindfulness and competencies (Liu et al., 2022b), however few research have examined the connection between workplace spirituality and digital competencies in mindfulness and work performance. Although the existing research has extended the competencies to digital competencies, it mainly focuses on the digital competencies of teachers in China to meet the needs of teachers to be competent for digital education in the future. This study fills the research gap on digital competencies for web editors and analyzes the further work and literacy requirements for web editors in the Internet era, and studies the relationship between digital competencies, work performance, mindfulness, and workplace spirituality. Therefore, in order to reveal the relationship between mindfulness and web editors' workplace spirituality, digital competencies and work performance, this study mainly applies the job requirement-resource (JD-R) model and resource conservation theory, attempts to examine mindfulness as a cognitive resource how to improve workplace spirituality, digital competencies, and work performance of web editors.



The main purposes of this study are: (1) to explore whether mindfulness has a significant positive impact on the workplace spirituality, digital competencies, and work performance of web editors; whether the workplace spirituality has a positive effect on the digital competencies and work performance of web editors and whether digital competencies has a significant positive impact on the work performance of web editors; (2) to explore whether workplace spirituality and digital competencies have a mediating role between web editors' mindfulness and work performance; (3) to explore whether there is a chain mediating role in the relationship between mindfulness and work performance of workplace spirituality and digital competencies. Theoretically, this is the first study to investigate the impact mechanism between mindfulness and workplace spirituality, digital competencies and work performance. In this regard, the comprehensive model presented in this study extends research on mindfulness and work performance while making theoretical contributions to the current management literature. In practice, the results of this study can provide useful suggestions for the improvement of work performance of web editors, that is, by improving the mindfulness of web editors can affect their workplace spirituality and digital competencies, and ultimately can promote their work performance, thereby promoting development of new media companies.

## Theoretical basis and hypothesis development

### Theoretical basis

The job demand-resource (JD-R) model, based on Karasek's (1979) job-demand control model and Siegrist's (1996, 2002) effort-reward imbalance model, was introduced as an alternative to the employees health and well-being. It originally proposed by Demerouti et al. (2001), and was initially only applied to job burnout. A few years later, Schaufeli and Bakker (2004) incorporated engagement into the JD-R model, and Xanthopoulou et al. (2009) incorporated personal resources into the model as well. These three papers have been cited tens of thousands of times in Google Scholar, indicating that the JD-R model has received extensive attention in the academic and practical circles, and has achieved a lot of research results. The core assumption of the JD-R model is that although each occupation may have factors related to working conditions, these conditions can be divided into two broad categories of job demands and job resources, thus forming an overall model. Bakker and Demerouti (2007) published the article The Resource Model for Job Requirements: Recent Developments, which made an in-depth analysis of the related concepts of the JD-R model and outlined the roadmap of the JD-R model.

According to literature review, JD-R model has two different roadmaps. The first one is from Bakker and Demerouti in 2007, they said, the health-damaging process and the motivation-driven process are two relatively distinct but interdependent causal processes found

in the JD-R model. The health-damaging process is where high job demands lead to negative organizational outcomes by increasing stress; the motivation-driven process is where job resources may act as intrinsic motivators, due to the fact that they foster employees' development, learning, and growth and may also play an extrinsic motivating function, by satisfying the basic needs of occupational individuals (Deci and Ryan, 1985), promoting their formation of motivation that helps to achieve work goals, thereby positively affecting positive organizational outcomes.

Another roadmap is from Schaufeli in 2017, he describes the JD-R model roadmap somewhat differently from Bakker and Demerouti (2007). The roadmap clearly marked the path of health-damaging process and the motivation-driven process, the mediator variable was burnout or work engagement, and the dependent variable was negative outcome or positive outcome. Compared with Bakker and Demerouti (2007) using the outcome of the organization as the dependent variable, it is equivalent to expanding the scope of the dependent variable, and the negative or positive impact on the individual is also included in the scope of the outcome variable. Furthermore, the JD-R model generalized by Bakker and Demerouti (2007) shows an interaction effect between job demands and resources, but Schaufeli (2017) argues that current evidence on demand-resource interaction effects suggests that, even if significant, this actual correlation of these interactions is also very low (Xanthopoulou et al., 2007), therefore, the two causal processes included in the JD-R model are essentially independent, and many existing empirical studies are based on one of the path of the JD-R model to design research models (Wang et al., 2021; Xu and Lin, 2021). The JD-R model can be said to be an influential framework for understanding how job demands or job resources foster employee well-being (Lesener et al., 2019).

### The relationship between the JD-R model and this study

Based on the motivation-driven process of the JD-R model, this study designs a research model to improve job performance by reducing job burnout caused by job requirements by providing job resources. Job resources are components of the work that might expedite task completion, reduce the psychological cost of job requirements, and enhance work performance (Huang et al., 2022). In this study, the independent variable mindfulness is the psychological resource of web editors, which corresponds to work resources and helps web editors to focus on the current work, reduce negative emotions at work, and improve work performance. Job demands are different aspects of job conditions that call for a consistent amount of physical or mental effort (Huang et al., 2022). In this study, the mediating variables workplace spirituality and digital competencies are the performance of a kind of work ability generated by job resources motivated by occupational individuals, which require continuous efforts to cultivate individuals. Finally, the dependent variable

work performance corresponds to positive outcomes for the organization. Therefore, the research logic of this study is as follows: mindfulness, as an individual psychological resource for web editors, can not only play an internal motivating role, positively affect workplace spirituality, and then positively affect work performance; it can also play an external motivating role to promote employees improve digital competencies, which in turn positively affects the work performance of web editors. At the same time, because there is a correlation between workplace spirituality and competencies, it is assumed that workplace spirituality and digital competencies play a chain mediating role between mindfulness and work performance. Accordingly, the model of this study is constructed based on the model of the JD-R model, as shown in Figure 1.

## Hypothesis development

### Mindfulness and work performance

Due to empirical studies demonstrating the benefits of mindfulness on one's psychological, physical, and performance, it has recently drawn more attention (Hyland et al., 2015). Initially, mindfulness was thought to be a fundamental aspect of the Buddhist tradition and was mostly explored in the context of philosophy and religious studies (Gunaratana, 2001). In 1993, scholars brought mindfulness to the management literature, but they reframed it as an emphasis on novelty and cognitive flexibility (Weick and Roberts, 1993), which was largely different from the Buddhist concept. Receptive attention and awareness of what is going on right now are two characteristics of mindfulness (Brown and Ryan, 2003; Quaglia et al., 2015). Being mindful involves being consciously alert, in the present, and without passing judgement on anything (Liu et al., 2022c). Its core features,

receptive attention to current events, reflected in a persistent awareness of ongoing experience (Brown and Ryan, 2003), demonstrate the importance of mindfulness in web editors' work. Instead of being a concept, mindfulness is described as a set of skills, that is, it includes the ability to: (1) observe and pay attention to numerous stimuli; (2) concentrate and take action; (3) respond to non-evaluative verbal descriptions of observations; (4) avoid immediate evaluation (Baer et al., 2006).

Collective attention is referred to as mindfulness at the organisational level, and it is said that practising mindfulness helps leaders and staff make fewer mistakes, stay alert, and respond to unforeseen situations in a productive way (Rerup and Levinthal, 2014). Work performance refers to how successfully employees perform their duties and contribute to the outcomes and success of the business (Shooshtarian et al., 2013). Research has shown that mindfulness can affect the functioning of teams and organizations, and numerous previous studies have shown a direct relationship between employee mindfulness and work performance (Shao and Skarlicki, 2009). Regarding the indirect relationship between mindfulness and work performance, scholars Ngo et al. (2020) proved through empirical research that creative process participation and employee creativity mediate the relationship between mindfulness and work performance of service employees, which is a new breakthroughs in research of the indirect influence mechanism of mindfulness. In addition, studies have shown that mindfulness practice is effective in increasing work engagement and indirectly affects work performance through its impact on work engagement (Huang et al., 2022).

According to Baytos and Kleiner (1995), it is possible to measure work performance accurately using a variety of factors, including job quality, punctuality, performance, productivity, etc. The three qualities of attention that mindfulness can influence positively are stability, control, and efficiency (Good et al., 2016).

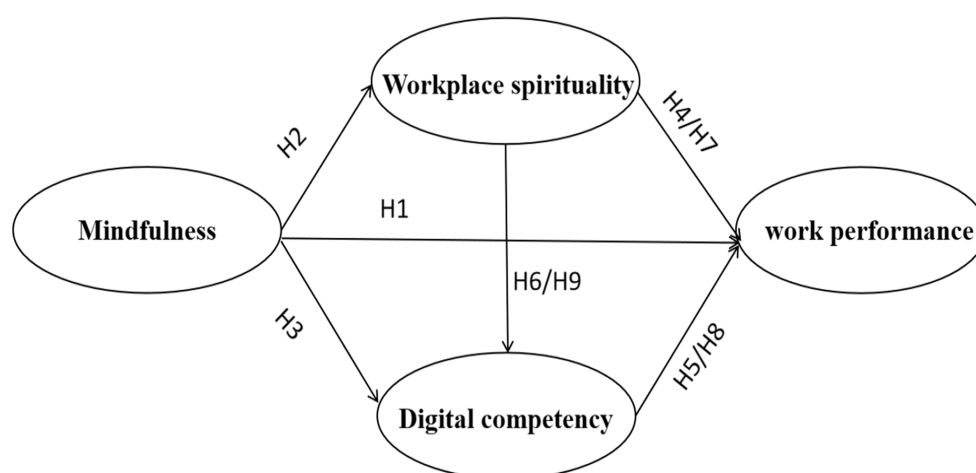


FIGURE 1  
Hypothesis model.

Mindfulness prevents mind wandering by maintaining focus in the present. Mindfulness as a personal resource can help individuals maintain a state of concentration at all times, avoid possible distractions in the workplace, and increase productivity (Huang et al., 2022). According to resource conservation theory, all individuals have a tendency to retain and accumulate valuable resources, which in organizational settings may include working conditions, job rewards, social support, employment opportunities, and personal energy (Hobfoll, 1989; Dollard and Bakker, 2010), while mindfulness is able to improve the quality of attention and enable individuals to harness these available energy resources to produce more effective creative work (Montani et al., 2018). As a result, mindful individuals are able to direct their attention to related needs rather than distraction, they are better able to direct their attention to their tasks with greater stability, control and efficiency, resulting in expanding their effective attention skills. Therefore, they might be able to comprehend information more effectively and act more logically as a result (Kirk et al., 2011), thereby guaranteeing the quality of work by reducing individual errors due to inattention, while at the same time controlling and stabilizing the current task by effectively controlling and stabilizing attention to information to help individuals demonstrate better task performance (Smallwood and Schooler, 2015). From this, we assume that:

**Hypothesis 1:** Mindfulness has a significant positive effect on work performance.

## Mindfulness and workplace spirituality

Purity of mind is the foundation of healthy living (Pawar, 2008). In fact, a person with a pure heart can acquire the human values of health and wholesomeness, which are the basis of workplace spirituality. In other words, workplace spirituality requires purification of the mind and heart (Petchsawang and McLean, 2017). Workplace spirituality is distinct from religion, which involves formally structured institutional belief systems, while spirituality focuses on personal experience from inner strength (Petchsawang, 2008). Workplace spirituality refers to “having compassion for others and experiencing a conscious inner awareness in pursuit of meaningful work, thus achieving transcendence” (Petchsawang and Duchon, 2009). At the same time, workplace spirituality can deeply understand the organizational context in which employees need “mental enrichment, spiritual fulfillment, soul satisfaction and financial reward” (Dhiman and Marques, 2011). Liu et al. (2022d) provided a deeper understanding of animated pedagogical-guided loving-kindness meditation by linking mindfulness, spirituality, and subjective well-being and indicated that mindfulness has a positive effect on subjective well-being. And, high levels of mindfulness may allow for high spiritual experiences, which would increase a person's subjective well-being (Liu et al., 2020a). Mindfulness, on the other hand, is a “state of being awake and attentive, not mixed with

competing images, thoughts, or feelings” (Heaton et al., 2004), which helps people identify their needs, problems, and conflicts (Brown and Ryan, 2003), resulting in effective emotion regulation, increased empathy, reduced stress, improved ability to manage distractions, and improved well-being (Davis and Hayes, 2011). Mindfulness thus purifies the mind and helps people see the truths of nature or wisdom, inspires human strength and positive emotions, and at the same time helps people understand themselves and others, which enables them to improve their spiritual world and have a better understanding of others, which is the main concept of workplace spirituality (Petchsawang and McLean, 2017).

According to Gupta et al. (2014), many major corporations, including IBM and Microsoft, have used meditation, spiritual lectures, and yoga sessions to enhance their employees' workplace spirituality. These lessons exemplify the role of mindfulness, which helps people be in the present moment and helps people connect with others and engage in work (Federman, 2009). In fact, by paying attention to and being aware of current experiences, mindful individuals are able to observe rather than identify with the contents of consciousness (i.e., thoughts, emotions, feelings, and judgments), but see them in a clearer and more objective way, able to relate the self to negative affective dissociation at work (Baer et al., 2006; Hülshager et al., 2014), thereby keeping the mind pure. From the perspective of resource conservation theory, mindfulness can be viewed as a cognitive resource and a competency resource. Dollard and Bakker (2010) have shown that resources in organizational settings include working conditions, job rewards, social support, employment opportunities and personal energy etc. Mindfulness can improve employees' personal energy, providing the energy resources needed at work, so that they can focus more on the current work (Montani et al., 2018). As a result, mindfulness training in organizations becomes more meaningful. Scholars mention that practicing mindfulness meditation has positive effects on psychological, spiritual, physical, and organizational benefits. Petchsawang and McLean (2017) empirically study the mechanism of the relationship between workplace spirituality and work engagement by establishing a link between mindfulness, mental outcomes (workplace spirituality) and organizational outcomes (work engagement). Liu et al. (2020b) stated that mindfulness can boost workplace spirituality for flight attendants, and Izak (2012) proposed that workplace spirituality can promote work engagement, and employees with workplace spirituality can find the meaning of their work. The more they feel that their work is meaningful, the more enthusiastic (dedication) they are in their work, and the more energy they have to overcome difficulties (vitality) at work, and thus become more engaged in their work. Therefore, mindfulness practice is seen as one of the tools to improve workplace spirituality, thereby improving work performance, based on which we draw the following hypotheses:

**Hypothesis 2:** Mindfulness has a significant positive effect on workplace spirituality.

## Mindfulness and digital competencies

The term “competency” was first introduced into the psychological literature in 1973 (McClelland, 1973), and it comes from Latin and means “fit” (Bueno and Tubbs, 2004). Competency refers to “an individual’s demonstrated knowledge, skill, or ability” (Ulrich et al., 1995) that activates actual performance and employee potential (Luna Arocas and Morley, 2015). Spencer and Spencer (1993) identified five categories of competency characteristics, including motivation, characteristics, self-concept, knowledge, and skills. First, motivation is the thought that a person keeps thinking or wants to stimulate action. Motivation drives, guides, and chooses behavior toward certain actions or goals and away from others. Recent research has found that mindfulness can improve job satisfaction, intrinsic motivation, and reduce emotional load (Parchment, 2022), and it is able to range from deep stimulation to conscious awareness of employees self-concept, traits, and motivational abilities, which are also important predictors of competency.

With the transformation of the current era, the market has developed many new industries, such as the new media industry, which are specially built on the basis of digitalization, and will even gradually form the entire online world, even the “traditional” industries have experienced a huge digital revolution (Bitay and Kovács, 2010). Therefore, in these emerging industries, traditional competencies should be transformed into digital competencies in the new era, and the new skill requirement for web editors should be digital competencies. Digital competencies is defined as “exploring and confronting new technological situations in a flexible manner, analyzing, selecting and critically evaluating data and information, exploiting the potential of technology to represent and solve problems, building shared and collaborative knowledge, and at the same time cultivate a sense of personal responsibility and respect for mutual rights and obligations.” As a result, new media companies are increasingly aware of the gap between the existing and required digital competencies of web editors (Oberländer et al., 2020), and improving the digital competencies of web editors to meet the challenges of working in a digital future has become a new media company’s current development strategy. Ngo et al. (2020) stated that mindfulness is a state of being able to actively focus on the present moment and practice acceptance without judgment. Mindfulness for web editors can help them become aware of digital transformation trends and focus on assessing their own job competencies in the moment. Digital competencies is a new skill that web editors need to grow, and mindfulness can foster greater awareness among employees of internal experiences and intuitions they may not be aware of. Web editors with this awareness are more likely to continuously learn, thereby increasing the competencies required in their work (Gawande et al., 2019), it means increasing digital competencies for web editors. Therefore, we can assume that:

**Hypothesis 3:** Mindfulness has a significant positive effect on digital competencies.

## Workplace spirituality and work performance

Over the past few decades, workplace spirituality has drawn increased attention, especially its impact on job outcomes (Petchsawang and Duchon, 2012; Petchsawang and McLean, 2017). The concept of workplace spirituality is not a new one, as it is based on organizational and management theory (Driscoll and Wiebe, 2007). Workplace spirituality is defined as the organisational encouragement of employees’ work-related spirituality, which focuses on meaning, community, and connection (Ashmos and Duchon, 2000). Employees crave a deeper sense of purpose, they are more motivated by spiritual than material benefits, and they voluntarily put more effort and time into achieving various tasks (Kolodinsky et al., 2008). Past research has shown that the myriad benefits of workplace spirituality include reduced deviance, increased job satisfaction, increased employee engagement, improved innovative behaviors, and improved work performance (Jnaneswar and Sulphrey, 2021). Work performance is the efficiency with which employees complete their work and contributes to the overall success of the organization. Work performance includes two main factors, task performance and situational performance. Among them, situational performance refers to discretionary additional role behavior beyond formal job responsibilities (such as guiding colleagues), and is an important component of work performance (Huang et al., 2022). According to the concept of workplace spirituality, employees with high workplace spirituality are willing to try to help their colleagues to relieve pain, and can easily put themselves in others’ shoes (Petchsawang, 2008). These behaviors will help to improve the situational performance of employees and thus improve the overall performance of the organization.

In addition, workplace spirituality goes beyond the nature of interesting and satisfying work into the spiritual horizon of work, which involves finding deeper meaning, purpose, and being satisfied with one’s work (Petchsawang and McLean, 2017). The spillover theory states that when people are content in their spiritual lives, their satisfaction transfers to their professional lives (Kolodinsky et al., 2008), and when they are happy at work, they become more engaged in their work. And, developing mental strength in the workplace influences employees’ positive perceptions of the organization. In fact, when employees realize that their organizational support fosters their spiritual well-being, they are more likely to be engaged and put more effort into their work (Saks, 2006).

Researchers have provided empirical evidence that workplace spirituality, as a mixture of personal experience and organizational background, is positively associated with important organizational variables, such as job satisfaction (Lee et al., 2003; Pawar, 2009; Altaf and Awan, 2011; Gupta et al., 2014), job engagement (Milliman et al., 2003; Pawar, 2009), organizational commitment (Milliman et al., 2003; Pawar, 2009; Kazemipour et al., 2012; Gatling et al., 2016). From a theoretical point of view, organizational spiritual



support for employees will improve employees creativity, motivation, commitment, and work engagement (Osman-Gani et al., 2013), and these factors are closely related to organizational performance. When organizations increase workplace spirituality and job engagement, they can expect the best results, including improved work performance. Furthermore, in addition to employee performance, Albuquerque et al. (2014) empirically report that workplace spirituality can positively influence performance at the organizational level. Additionally, Benefiel et al. (2014) demonstrated through a thorough research that workplace spirituality is favourably correlated with performance and productivity across cultures and nations. As a result, we can assume that:

**Hypothesis 4:** Workplace spirituality has a significant positive effect on work performance.

## Digital competencies and work performance

New technologies are having a significant impact on how we work, in addition to the enormous impact that our society's ongoing digitalization is having on our daily lives (Zaphiris and Ioannou, 2016; Murawski and Bick, 2017; Nyikes, 2018). Employers' preferred skills and the labour market are changing as a result of technological advancements, so the concept and research of competencies has been extended to digital competencies (Karsenti et al., 2020). Vathanophas (2007) stated that, when implementing effective human resource management, consideration should be given to introducing a competency building program for each job or task, as the competency of employees are usually related to their jobs and therefore to organizational performance. Most workplaces require at least basic digital competencies, with employees making greater use of digital information and communication technologies at work to increase productivity and facilitate the work. In new media companies, the digital competencies of web editors are closely related to their daily work, and these competency will have a significant impact on their work performance. Broadly, digital competencies are defined as "the set of skills required to use digital technologies confidently, critically and creatively to achieve goals in areas such as learning, work, leisure, integration or participation in society" (Ferrari, 2012). Digital competencies is closely related to the work tasks and professional development of web editors. As employees of new media companies, web editors need to meet the job requirements of the position and have digital competencies to better complete the work tasks of the position. They must use digital resources and enhance the application of new technologies to keep their professional skills updated to complete their tasks efficiently and improve work

performance. Today, employees in most typical office workplaces spend most of their work time using digital devices, especially for web editors. Employees with digital competencies can use digital devices and technologies flexibly and freely at work, which is conducive to saving resources and completing work tasks efficiently and quickly. We can reasonably assume that:

**Hypothesis 5:** Digital competencies has a significant positive impact on work performance.

## Workplace spirituality and digital competencies

Existing research suggests that definitions of workplace spirituality can be divided into three camps: personal experience, organizational facilitation and a mixture of personal experience and organizational facilitation (Petchsawang and McLean, 2017). In personal experience, an individual's experience of energy, pleasure, consistency, a sense of transcendence between personal values and meaningful job, is referred to as workplace spirituality (Kinjerski and Skrypnek, 2004). Therefore, employees with high workplace spirituality have strong self-concept, they have personal work motivation, and they will actively work on improving their work ability, such as knowledge and skills. Back in 2006, the European Parliament and Council identified digital competencies as one of eight key competencies for lifelong learning. In new media companies, web editors with high workplace spirituality have strong motivation to study and work, and will continue to acquire new abilities through lifelong learning to adapt to the rapidly changing work environment and growing job demands (Oberländer et al., 2020). Therefore, employees with high workplace spirituality will strive to improve their digital technology literacy to pursue the consistency of their personal values and meaningful work when they are in their own jobs, so as to study hard to have the digital competencies required for the position. From this we assume that:

**Hypothesis 6:** Workplace spirituality has a significant positive impact on digital competencies.

## The mediating role of workplace spirituality

Scholars Jnaneswar and Sulphey (2021) reviewed the previous literature and found that mindfulness is significantly related to workplace spirituality. Mindfulness-based stress reduction programs can improve employees' workplace



spirituality, thereby helping employees experience meaning and job satisfaction at work. Because mindfulness enables the brain to achieve a focused ideology (Payutto, 2002). In this state, a person is constantly aware of his thoughts and actions (Petchsawang and McLean, 2017). This can help employees to purify their minds, stimulate their work force and positive emotions, and make individuals more engaged in work (Saks, 2006). This shows the impact of mindfulness on workplace spirituality. In addition, workplace spirituality plays a key role in leadership, and its role in improving employees and organizational efficiency is widely recognized. Workplace spirituality is based on humanistic values (Jnaneswar and Sulphey, 2021), such as interconnectedness with others at work (human resources). At the same time, workplace spirituality can promote employees' mental health (psychological resources), help employees achieve workplace happiness and harmony, and focus on work meaning and contribution to the organization. Therefore, building workplace spirituality in an organization can increase productivity and reduce turnover rate. According to the investment principle in the resource conservation theory, individuals must continuously invest in existing resources for the purpose of protecting their own resources from depletion, recovering quickly from resource depletion that has occurred, or acquiring new resources (Hobfoll, 1989). Therefore, in order to obtain stable interpersonal and psychological resources, employees will invest their existing resources by working hard and improving work performance. For example, Timms and Brough (2013) found that if employees are satisfied with the psychological resources in the workplace, they will dedicate their resources, such as work engagement, improve work performance, etc. This proves that workplace spirituality is beneficial to improve work performance. Based on the above analysis, we can assume that:

**Hypothesis 7:** Workplace spirituality plays a mediating role in mindfulness and work performance.

## The mediating role of digital competencies

According to research, the “beginner’s mindset” is one of the key attitudes of mindfulness, which refers to the mindset of being able to experience the present moment as a first experience (Kabat-Zinn, 2013). Beginner mentality of web editors can maintain a learning attitude towards digital knowledge and skills at all times, and continuously improve their digital competencies. This illustrates the impact of mindfulness on digital competencies. And, Liu et al. (2022e) have added loving-kindness meditation to the organization, and said that loving-kindness meditation can improve the effectiveness of knowledge acquisition (digital knowledge), prevent knowledge loss, better allocate knowledge resources, and improve the core competitiveness of the

organization. The current study found that employees job competencies are usually related to organizational performance and can improve work performance (Luna Arocas and Morley, 2015). Scholars Oberländer et al. (2020) redefine digital competencies in the context of the workplace by reviewing past definitions and frameworks of digital competencies. Digital competencies at work are a set of essential knowledge, skills, abilities, and other characteristics that enable workers to efficiently and successfully perform work tasks related to digital media at work. This definition shows that digital competencies have the characteristics that can help workers to better complete their work tasks and improve work performance. Therefore, we assume that:

**Hypothesis 8:** Digital competencies plays a mediating role in mindfulness and work performance.

According to the analysis and demonstration of the above eight hypotheses, the relationship between mindfulness and workplace spirituality, workplace spirituality and digital competencies, digital competencies and work performance are fully supported by the literature. Therefore, we can reasonably assume:

**Hypothesis 9:** Workplace spirituality and digital competencies play a chain mediating role between mindfulness and work performance.

In summary, this study constructs a chain mediation model of mindfulness, workplace spirituality, digital competencies and work performance. The hypothetical model is shown in Figure 1.

## Materials and methods

By reading a large amount of domestic and foreign literatures on employee mindfulness, workplace spirituality, digital competencies, and work performance, we organizes and summarizes them, and finds a scale with high reliability and validity, which is widely used and most suitable for web editors. Mindfulness variables, mainly refer to the 15-item scale revised by Brown and Ryan (2003); workplace spirituality variables, mainly refer to the 22-item scale designed by Petchsawang (2008); digital competencies variables, constructed by Castaño-Muñoz et al. (2017) 6-item scale; work performance variables, mainly refer to the 9-item scale developed by Rodwell et al. (1998). Because mindfulness, workplace spirituality, digital competencies, and work performance are all mature scales borrowed from the English context, the translation of the scales needs to be considered. The translation of the original questionnaire determines the items of the initial questionnaire. After determining the initial scale, in order to make the scale of each variable more suitable for the measurement of web editors, a small-scale expert interview was conducted with four experienced

web editors, and some unclear expressions, repeated meaning or difficult to answer questions were deleted under the advice of experts. We developed a formal questionnaire that is more in line with Chinese expression habits and cultural background, and is more suitable for measuring web editors. The formal questionnaire contains a total of 31 items, including 10 items of mindfulness, 12 items of workplace spirituality, 3 items of digital competencies, and 6 items of work performance. The scale uses a five-point Likert scale ranging from 1 “strongly disagree” to 5 “strongly agree.” The complete questionnaire measurement items are shown in Table 1.

The participants in this study are web editors working in new media companies in China. After the formal questionnaire was confirmed, we created a formal questionnaire on the Tencent questionnaire platform<sup>1</sup>, and used the formal questionnaire to conduct large-scale surveys. In the process of collecting large sample data, the method of convenience sampling was adopted. First, the questionnaires were sent privately to WeChat friends who are professional web editors,

<sup>1</sup> <http://wj.qq.com>

TABLE 1 Measurement Items.

Construct	References
Mindfulness	Brown and Ryan (2003)
I could be experiencing some emotion and not be conscious of it until some time later.	
I break or spill things because of carelessness, not paying attention, or thinking of something else.	
I find it difficult to stay focused on what's happening in the present.	
It seems I am “running on automatic” without much awareness of what I'm doing.	
I rush through activities without being really attentive to them.	
I get so focused on the goal I want to achieve that I lose touch with what I am doing right now to get there.	
I do jobs or tasks automatically, without being aware of what I'm doing.	
I find myself preoccupied with the future or the past.	
I find myself doing things without paying attention.	
I snack without being aware that I'm eating.	
Workplace Spirituality	Petchsawang (2008)
Compassion	
I can easily put myself in other people's shoes.	
I am aware of and sympathize with others.	
I try to help my coworkers relieve their suffering.	
I aware of my coworkers' needs.	
Meaningful Work	
I experience joy in my work.	
I look forward to coming to work most days.	
My spirit is energized by my work.	
I understand what gives my work personal meaning.	
The work I do is connected to what I think is important in life.	
Transcendence	
At times, I experience an energy or vitality at work that is difficult to describe.	
At times, I experience happiness at work.	
At moments, I experience complete joy and ecstasy at work.	
digital competencies	Castaño-Muñoz et al. (2017)
I can conduct an internet search using one or more keywords.	
I can judge the reliability of a website.	
I can participate in an online chat session.	
Work Performance	Rodwell et al. (1998)
I am currently working at my best performance level.	
Employees should only do enough to get by.	
I try to be at work as often as I can.	
My work is always of high quality.	
I set very high standards for my work.	
I am proud of my work performance.	

and they were invited to help fill in the questionnaires. A total of 40 questionnaires were received. Then, through the Tencent questionnaire platform, questionnaires were distributed to web editors across the country, and a total of 460 questionnaires were distributed. After excluding incomplete, pattern responses and quick responses, 431 valid data were retained for the final analysis, and the response rate of the questionnaire was 86.2%.

## Data analysis

The research uses SPSS25.0 and Mplus8.3 to conduct statistical analysis on 431 valid samples to understand the relationship between the mindfulness, workplace spirituality, digital competencies and work performance variables of web editors, and to verify the research model and research hypothesis proposed in this study. Firstly, the reliability assessment is carried out by reliability analysis, construct validity test, discriminant validity test and common method bias analysis; then, structural equation model analysis is carried out to test whether the 9 groups of hypotheses in this study can be supported by empirical data; Finally, a mediation effect analysis was carried out to test whether the three groups of mediation hypotheses could be supported by empirical data.

## Demographic characteristics

In terms of obtaining basic personal information, the problems mainly relate to gender, age, marriage, education and years of work. Among the sample of participants in this study, 51.3% were male and 48.7% were female. About 44.8% of the respondents were between the ages of 26 and 35, 4.4% were over the age of 55, and 69.4% were married. In addition, 52.9% of the sample has an undergraduate education, and only 3.5% are high school or less, 43.4% have worked for more than 8 years, and 7.7% have worked for less than 1 year. The details of the respondents are shown in Table 2 below.

## Reliability analysis

This study uses SPSS25.0 software to conduct reliability analysis and test of each variable to ensure the reliability and consistency of the formal questionnaire. First, the overall Cronbach's alpha value of the 31 measurement items in this study was measured, and the measured result was 0.935, which indicated that the measurement items of the overall scale in this study had good internal consistency, thus showing good reliability. Then, the reliability of the four latent variables was analyzed separately, and the Cronbach's alpha value of mindfulness was 0.920, and the Cronbach's alpha value of workplace spirituality was 0.912 (the

Cronbach's alpha value of the three dimensions of COM/MW/TRA was 0.912, 0.919, 0.880), the Cronbach's alpha value of digital competencies is 0.760, and the Cronbach's alpha value of work performance is 0.8610. This indicates that the reliability of each latent variable is good, and further analysis can be carried out.

## Construct validity analysis

In this study, the robust maximum likelihood estimation (MLR) was used in the Mplus8.3 software to test the construct validity of the six latent variable measurement scales using confirmatory factor analysis. The confirmatory factor analysis model is known as a general structural equation model (SEM) measurement model. The measurement model and the structural equation model are consistent with the evaluation index and evaluation standard of the degree of fit, mainly including:  $\chi^2$  (chi-square), df (degree of freedom), the smaller the ratio of  $\chi^2$  to df, the better the fit of the model. Schumacker and Lomax (2004) considered a ratio of  $\chi^2$  to df below 5 to be acceptable. In this study, the ratio of  $\chi^2$  to df was 1.15, which indicated that the model fit in this study was very good. Asymptotic residual mean square and square root (RMSEA), Browne (1992) believed that when the RMSEA value was lower than 0.05, the model fit was good, and when the RMSEA value was lower than 0.1, the model fit was reasonable (Wu, 2009, Structural Equation Modeling). In this study, the RMSEA value was 0.019, which was lower than 0.01, indicating that the model fit in this study was reasonable. In addition, comparing the fit index (CFI), Bentler (1990) believed that the CFI value was greater than 0.9, indicating that the model fit was good. Non-standard fit index (TLI), Bentler and Bonett

TABLE 2 Characteristics of respondents.

Variables	Characteristics	Frequency(n = 431)	(%)
Gender	Male	221	51.3
	Female	210	48.7
Age	18-25 years old	53	12.3
	26-35 years old	193	44.8
	36-45 years old	121	28.1
	46-55 years old	45	10.4
	55 or older	19	4.4
Marriage	unmarried	129	29.9
	Married	299	69.4
	other	3	0.7
Education levels	High school or less	15	3.5
	Technical school	90	20.9
	Undergraduate	228	52.9
	Graduate or more	98	22.7
Working years	1 year or less	33	7.7
	1-3 years	80	18.6
	4-8 years	131	30.4
	8 years or more	187	43.4

(1980) considered that the TLI value was greater than 0.9, indicating that the model fit was better. The standard residual mean square and square root is SRMR, and the general standard is  $SRMR < 0.1$ , the smaller the better (Wu, 2009, structural equation model). The data of this study showed that  $CFI = 0.992$ ,  $TLI = 0.991$ ,  $SRMR = 0.029$ , all in line with the ideal indicators.

In the analysis of the measurement model, the indicators to observe the aggregate validity mainly include the average variance extracted (AVE). In general, the larger the AVE value, the stronger the commonality of the measurement items, the more it can reflect the same variable, and the higher the aggregation validity. Fornell and Larcker (1981) believed that the convergent validity was ideal if the AVE value was greater

than 0.5. In this research model, the minimum AVE value is 0.510, and the others are higher than this value, indicating that the convergent validity of the research model has reached ideal. Secondly, the composite reliability (CR) is one of the criteria for judging the intrinsic quality of each measurement item. If the composite reliability value of each measurement item is greater than 0.6, it corresponds to the CR value of the study shown in Table 3. The minimum CR value is 0.759, indicating that the internal consistency of each structure was achieved, and it also showed that the internal consistency of the measurement scale was better. These data fully indicate that the model is well fitted, and further analysis can be carried out.

TABLE 3 Results of the measurement model.

Construct	Indicators	Factor loading	S.E.	Est./S.E	p-value	CR	AVE
Mindfulness	MF1	0.745	0.024	31.442	***	0.921	0.537
	MF2	0.706	0.026	26.747	***		
	MF3	0.749	0.023	31.957	***		
	MF4	0.747	0.024	31.791	***		
	MF5	0.728	0.025	29.262	***		
	MF6	0.742	0.024	30.984	***		
	MF7	0.754	0.023	32.685	***		
	MF8	0.717	0.026	27.967	***		
	MF9	0.726	0.025	29.059	***		
	MF10	0.714	0.026	27.695	***		
Compassion	COM1	0.874	0.015	59.022	***	0.912	0.723
	COM2	0.857	0.016	53.756	***		
	COM3	0.844	0.017	50.269	***		
	COM4	0.825	0.018	45.094	***		
Meaningful Work	MW1	0.855	0.016	54.555	***	0.919	0.696
	MW2	0.848	0.016	52.496	***		
	MW3	0.847	0.016	52.207	***		
	MW4	0.799	0.020	40.450	***		
	MW5	0.820	0.018	44.800	***		
Transcendence	TRA1	0.872	0.017	50.829	***	0.883	0.716
	TRA2	0.887	0.016	53.816	***		
	TRA3	0.775	0.023	33.892	***		
digital competencies	DC1	0.698	0.034	20.463	***	0.760	0.514
	DC2	0.738	0.033	22.599	***		
	DC5	0.714	0.034	21.245	***		
Work Performance	WP1	0.760	0.025	30.990	***	0.862	0.510
	WP2	0.726	0.027	27.233	***		
	WP3	0.682	0.030	23.114	***		
	WP5	0.694	0.029	24.173	***		
	WP6	0.718	0.027	26.348	***		
	WP7	0.705	0.028	25.122	***		
	COM	0.734	0.034	21.567	***		
Workplace Spirituality(second order)	MW	0.733	0.034	21.521	***	0.759	0.513
	TRA	0.680	0.037	18.190	***		

$\chi^2/df = 488.371/425$ ; RMSEA = 0.019; CFI = 0.992; TLI = 0.991; SRMR = 0.029.

\*\*\* indicates that the factor loading of the measurement item is significant when the standard line  $p < 0.001$ .

## Discriminant validity test

Discriminant validity refers to the degree to which a latent variable is truly different from other latent variables according to the criteria of empirical research, and any measurement item should reflect only one latent variable. Use SPSS25.0 to test the correlation coefficient matrix of each variable in the sample data of the formal questionnaire, and calculate the AVE square root of each variable. The results are shown in Table 4. It can be seen from Table 4 that the correlation coefficient between the six latent variables is between 0.290 and 0.499, none of them are 1, and they all reach a significant level. In addition, most of the correlation coefficients between all variables in this study and another variable are less than the square root of the AVE value of the variable, indicating that the six variables in this study have good discriminant validity.

## Common method bias

Common method bias may seriously confuse research results and potentially mislead research conclusions, which is a systematic error (Xiong et al., 2012). Common method bias exists widely in researches using questionnaires and psychology, so it is necessary to test the common method bias for measurement items.

This study has adopted a variety of methods to reduce the common method bias in the research design stage of the questionnaire, such as interview method, expert opinion consultation method and so on. However, most of the measurement data of the six main variables in this study are obtained from the survey on the Tencent platform, and there may be common method bias. Therefore, this study needs to test whether the data of the questionnaire survey has the problem of common method bias.

There are many ways to test the common method bias, and the Harman single factor method is the most commonly used method by scholars to test the common method bias (Tang and Wen, 2020). In this study, Mplus 8.3 software was used to test the common method deviation of the questionnaire data by Hannan's single factor method. The results are shown in Table 5. From Table 5,  $\chi^2/df = 8.632 > 5$ ,  $RMSEA = 0.133 > 0.1$ ,

$CFI = 0.568 < 0.9$ ,  $TLI = 0.537 < 0.9$ ,  $SRMR = 0.109 > 0.08$ . According to the test results, the fitness indicators of the Harman single-factor model are inconsistent with the standard value of the fitness of the structural equation model, and the fit of the single-factor structural model is very poor, which shows that the measurement items of each variable in this study are no risk of common method bias, which does not need to be controlled.

## Measurement model

### Structural equation model

When the evaluation indexes and standards of the fitness of the above structural equation models reach the ideal value, the fitting degree of the model in this study is acceptable and suitable for structural equation model analysis. Structural Equation Modeling (SEM) is a powerful statistical technique that combines measurement models (confirmative factor analysis) and structural models (regression analysis or path analysis) together with statistical tests to test and compare theoretical models and ideal technique for refining and testing construct validity (Garver and Mentzer, 1999). This study uses structural equation model to test and analyze all hypotheses.

As stated in the theoretical framework, the purpose of using structural equation model analysis is to test whether nine sets of hypotheses can be supported by empirical data, including (1) mindfulness has a significant positive effect on work performance. (2) Mindfulness has a significant positive impact on workplace spirituality. (3) Mindfulness has a significant positive impact on digital competencies. (4) Workplace spirituality has a significant positive impact on work performance. (5) Digital competencies has a significant positive impact on work performance. (6) Workplace spirituality has a significant positive impact on digital competencies. (7) Workplace spirituality plays a mediating role between mindfulness and work performance. (8) Digital competencies plays a mediating role between mindfulness and work performance. (9) Workplace spirituality and digital competencies play a chain mediating role between mindfulness and work performance. This study intends to use Mplus8.3 to test the constructed research model.

TABLE 4 Correlation coefficient matrix and square root of AVE value of each variable in the formal questionnaire.

Constructs	MF	COM	MW	TRA	DC	WP
MF	0.537					
COM	0.421**	0.723				
MW	0.425**	0.491**	0.696			
TRA	0.356**	0.444**	0.462**	0.716		
DC	0.309**	0.290**	0.291**	0.239**	0.514	
WP	0.492**	0.483**	0.461**	0.448**	0.499**	0.510

The shaded value on the diagonal is the square root of the AVE value.

\*\*Indicates a significant correlation at the 0.01 level (two-tailed).

### Structural equation model fit

Ensuring that the fitting degree between the proposed research model and the data of each measurement variable conforms to the evaluation index and standard of the structural equation model fitting degree is the premise of structural equation

TABLE 5 Common method bias test (N=431).

Model	$\chi^2$	df	$\chi^2/df$	RMSEA	CFI	TLI	SRMR
Hannan	3746.221	434	8.632	0.133	0.568	0.537	0.109



model analysis. This study uses Mplus8.3 to test the constructed structural equation model, and obtains that the specific model fitting index measurement model is consistent, indicating that the fitting index meets the requirements of the structural equation model, which indicates that the research on the relationship between latent variables proposed in this study has a good fit with the measured data and can be used for subsequent analysis.

## Summary of hypothesis testing results and path analysis of the model

The road map of the model in this study is shown in Figure 2, and the results of the hypothesis validation results are summarized in Table 6.

Thus, the correlation between the latent variables can be analyzed. (1) Mindfulness and work performance. According to the output results of the structural equation model, the standardized path coefficient of mindfulness on work performance variables is 0.118, the *t* value is 1.999, and the *p* value is less than 0.05, indicating that mindfulness has a significant positive impact on work performance. This study assumes that hypothesis 1 is

supported. It can be seen that the stronger the mindfulness of web editors at work, the higher their work performance. (2) Mindfulness and workplace spirituality. According to the output results of the structural equation model, it can be seen that the standardized path coefficient of mindfulness on the workplace spirituality variable is 0.618, the *t* value is 14.896, and the *p* value is less than 0.001, indicating that mindfulness has a significant positive impact on workplace spirituality. This study assumes that hypothesis 2 is supported. It can be seen from this that the stronger the mindfulness of web editors, the stronger their workplace spirituality. (3) Mindfulness and digital competencies. According to the output results of the structural equation model, the standardized path coefficient of mindfulness on digital competencies is 0.129, the *t* value is 1.675, and the *p* value is less than 0.01, indicating that mindfulness has a significant positive impact on digital competencies. This study assumes that hypothesis 3 is supported. It can be seen that the stronger the mindfulness of web editors, the stronger their digital competencies. (4) Workplace spirituality and work performance. According to the output results of the structural equation model, the standardized path coefficient of workplace spirituality to work performance is 0.498, the *t* value is 7.415, and the *p* value is less

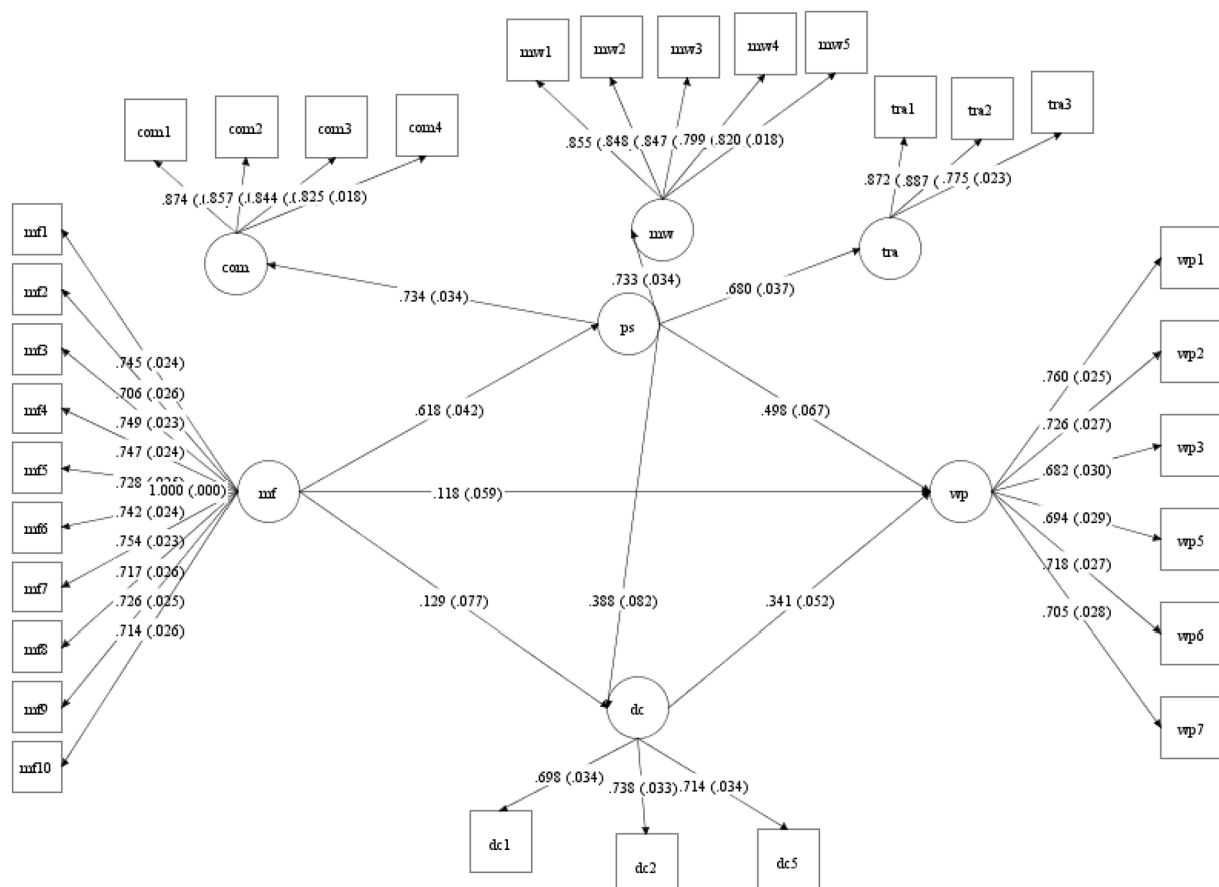


FIGURE 2  
The output of the structural equation model.

TABLE 6 Structural equation model analysis table.

Path	Standardization coefficients	S.E.	Est./S.E	p-Value	Results
Mindfulness→Work Performance	0.118	0.059	1.999	0.046*	Supported
Mindfulness→Workplace Spirituality	0.618	0.042	14.896	***	Supported
Mindfulness→digital competencies	0.129	0.077	1.675	0.094*	Supported
Workplace Spirituality→Work Performance	0.498	0.067	7.415	***	Supported
<b>Performance</b>					
digital competencies→Work Performance	0.341	0.052	6.493	***	Supported
Workplace Spirituality→digital competencies	0.388	0.082	4.718	***	Supported
Model fit: $\chi^2$ (df) = 488.371/425; RMSEA = 0.019; CFI = 0.992; TLI = 0.991; SRMR = 0.029.					

\*\*\*, \*\*, \* indicate that p is significant at the level of 0.001, 0.01, and 0.1, respectively; in Mplus, Est/S.E. = *t* value.

than 0.001, indicating that workplace spirituality has an significant positive impact on work performance, hypothesis 4 of this study is supported. It can be seen that the stronger the workplace spirituality of the web editors, the higher the work performance. (5) Digital competencies and work performance. According to the output results of the structural equation model, the standardized path coefficient of digital competencies variables to work performance variables is 0.341, the *t* value is 6.493, and the *p* value is less than 0.001, indicating that digital competencies has a significant impact on work performance. There is a significant positive effect on performance, and this study assumes that hypothesis 5 is supported. It can be seen that the stronger the digital competencies of the web editors, the higher the work performance. (6) Workplace spirituality and digital competencies. According to the output results of the structural equation model, the standardized path coefficient of workplace spirituality to digital competencies is 0.388, the *t* value is 4.718, and the *p* value is less than 0.001, indicating that workplace spirituality has a significant positive impact on digital competencies. This study suppose hypothesis 6 is supported. It can be seen from this that the stronger the workplace spirituality of web editors, the stronger their digital competencies.

## Mediation effect analysis

In this study, Mplus software is used, and the Bootstrap method is used, and the number of repeated samples is 5,000 to examine the mediation effect relationship between the workplace spirituality and digital competencies of web editors between their mindfulness and work performance. Bootstrap method is an important statistical method for interval estimation in nonparametric statistics. The Bootstrap method creates multiple simulated data sets by repeating sampling with replacement for a given data set, thereby generating a series of empirical distributions of the statistics to be tested. The Bootstrap method can calculate standard errors, construct confidence intervals and hypothesis tests can be performed on many types of sample statistics. The statistical results calculated by the Bootstrap method, if the

estimated value of the indirect effect (*p*-value) is significant, and does not include 0 in the 95% confidence interval, it means that there is a mediating effect characteristic (Lau and Cheung, 2012). This study uses the Bootstrap method to test the mediation effect, and the results are shown in Table 7.

In the mediating path “P1: Mindfulness→Workplace Spirituality→Work Performance,” the 95% confidence interval for the specific indirect effect of mindfulness on work performance is [0.221, 0.424], 0 is not included, so the mediating effect is significant; The direct effect of is significant, and the 95% confidence interval is [0.041, 0.126], 0 is not included, so the partial mediating effect of workplace spirituality between mindfulness and work performance is significant. The specific indirect effect size was 0.308, the direct effect size was 0.118, and the total effect size was 0.552. The ratio of indirect effect to total effect was 0.308/0.552=0.557, which indicated that when mindfulness had an impact on work performance, 55.7% of the variance was caused by workplace spirituality.

In the mediating path “P2: Mindfulness→Digital competencies→Work Performance,” the 95% confidence interval for the specific indirect effect of mindfulness on work performance is [−0.007, 0.0107], including 0, so the mediating effect is not significant, so hypothesis 8 invalid.

In the mediating path “P3: Mindfulness→Workplace Spirituality→Digital competencies→Work Performance,” the 95% confidence interval of the specific indirect effect of mindfulness on work performance is [0.041, 0.126], 0 is not included, so the mediating effect is significant; The direct effect of mindfulness on work performance is significant, and the 95% confidence interval is [0.041, 0.126], excluding 0. The chain mediating effect of workplace spirituality and digital competencies between mindfulness and work performance is significant. The specific indirect effect size between mindfulness and work performance was 0.082, the direct effect size was 0.118, and the total effect size was 0.552. The ratio of indirect effect to total effect is 0.082/0.552=0.149, which indicates that when the mindfulness of web editors has an impact on work performance, 14.9% of the variation is through workplace spirituality that affects digital competencies, which in turn affects their work performance.

TABLE 7 Mediating effect test.

The mediation path	Indirect effects			Direct effects			Total effect		
	SE	95% confidence interval	p-Value	SE	confidence interval	p-Value	SE	confidence interval	p-Value
P1: Mindfulness → Workplace Spirituality → Work Performance	0.308 (0.062)	[0.221, 0.424]	0.000	0.118 (0.065)	[0.041, 0.126]	0.070	0.552 (0.050)	[0.466, 0.628]	0.000
P2: Mindfulness → Digital competencies → Work Performance	0.044 (0.035)	[-0.007, 0.107]	0.208						
P3: Mindfulness → Workplace Spirituality → Digital competencies → Work Performance	0.082 (0.026)	[0.041, 0.126]	0.002						

## Discussion and conclusions

The primary objective of this study was to explore the relationship between mindfulness, workplace spirituality, digital competencies, and work performance. This study verified that mindfulness has a significant positive effect on work performance, which is consistent with previous research (Huang et al., 2022). However, the impact of mindfulness on work performance has a relatively complex mechanism, and its complex mechanism still needs to be continuously explored. This study confirms that workplace spirituality plays a strong mediating role in the relationship between web editors' mindfulness and work performance. When web editors' mindfulness has an impact on work performance, 55.7% of the variation is caused by their workplace spirituality. Workplace spirituality and digital competencies play a chain mediating role between web editors' mindfulness and work performance. When web editors' mindfulness has an impact on work performance, 14.9% of the variation is that digital competencies is affected by workplace spirituality, and then affect their work performance, which shows that employees with high mindfulness will be more likely to focus. They will focus more on the current work and awareness, spiritually think the current work is meaningful and valuable, and are committed to continuous improvement of their own job skills to improve work performance.

Workplace spirituality is largely based on the mindfulness of web editors. This study confirmed that mindfulness has a significant and positive impact on the workplace spirituality of web editors, with a path coefficient of as high as 0.618 ( $p < 0.001$ ), indicating that mindfulness is an important antecedent variable of workplace spirituality. This is in line with Payutto's (2002) view that practicing mindfulness meditation trains the brain and brings it to a fully focused state of consciousness, which increases employees' workplace spirituality, allowing employees to discover the meaning of their

work. They will be passionate about their work, and dedicate themselves to work (Petchsawang and McLean, 2017), thereby improving work performance.

Finally, the study found that the impact of workplace spirituality on work performance is greater than the impact of digital competencies on work performance. The results of this study show that the workplace spirituality of web editors has a significant positive impact on work performance, with a standardized coefficient of 0.498 ( $p < 0.001$ ); digital competencies has a significant positive impact on work performance with a standardized coefficient of 0.341 ( $p < 0.001$ ), which indicates that the workplace spirituality of web editors has a greater impact on work performance than digital competencies. This confirms from the side that for a group of web text workers such as web editors, they identify with the values of groups and organizations and the meaning of work in their work, and then surpass themselves and generate a sense of interconnectedness. Experience has a great role in promoting the improvement of their work performance. As a professional skill of web editors, digital competencies also plays a very important role in today's labor market and has a significant positive impact on work performance. However, compared with the spiritual resource of workplace spirituality possessed by web editors, its importance is relatively low.

## Theoretical contributions

Numerous studies have confirmed the validity of the JD-R theoretical model, but limited research has been done on mindfulness, workplace spirituality, digital competencies, and work performance in web editors. Therefore, we use the JD-R theoretical model to make some breakthroughs in theoretical contributions. Firstly, the concrete representation of work resources in the JD-R model is extended. From the perspective of research model construction, based on the JD-R model, this

research classifies “mindfulness” as an individual’s intrinsic work resource, and believes that it can generate intrinsic motivation, prompting web editors to improve workplace spirituality, and thus produce good organizations result. The results of the empirical study confirmed the hypothesis that when web editors’ mindfulness had an impact on work performance, 55.7% of the variance was caused by their workplace spirituality. This suggests that it is appropriate to consider mindfulness as an individual work resource, extending the specific representation of work resources in the JD-R model. Based on the motivation-driven process of the JD-R model, this research constructs a chain mediation model of “mindfulness-workplace spirituality-digital competencies-work performance” for web editors, which is supported by empirical research. This shows that mindfulness, as an internal resource of an individual, has a very complicated mechanism to improve work performance by motivating professional individuals. Professional individuals with high mindfulness tend to identify with the meaning and value of work at the spiritual level, have more good inner experience of work, and are committed to continuously improving their work skills, thereby improving work performance. At the same time, it also shows that it is appropriate and effective to use the JD-R model to study the multiple and interactive influencing factors of Chinese web editors’ work performance, which verifies and expands the applicable boundaries and application scenarios of the JD-R theoretical model.

Second, it confirms that the mechanism of mindfulness’s impact on work performance is quite complex. Previous studies have shown positive effects of mindfulness on work performance and other outcomes in the workplace, suggesting that mindfulness can positively impact workplace performance, relationships, well-being, and job satisfaction (Glomb et al., 2011; Dane and Brummel, 2014; Hyland et al., 2015). This study is consistent with previous theoretical and empirical evidence that mindfulness has a positive effect on improving work performance (Good et al., 2016). Ngo et al. (2020) reviewed the past literature and indicated that few scholars have simultaneously studied the indirect effects of mindfulness on work performance. Our study goes a step further by exploring the entire impact mechanism of mindfulness, examining how workplace spirituality and digital competencies, separately and together, indirectly affect work performance. This somewhat expands the existing literature in the field of mindfulness. In addition, we also provide a new research perspective. Different from the previous research on mindfulness of factory employees and mindfulness of medical clinic employees, the subject of our research is web editors, and almost no research has been carried out on this subject. The more challenging and distracting nature of the work of web editors makes mindfulness even more important in this working group.

In addition, compared to other groups, the mindfulness of web editors has a greater impact on workplace spirituality. After

empirical testing, this study found that the path coefficient of the influence of mindfulness on web editors’ workplace spirituality reached 0.618 ( $p < 0.001$ ), that is, the higher the mindfulness of web editors, the higher their workplace spirituality, and there is a strong relationship between the two variables. This is in line with the existing literature (Petchsawang and McLean, 2017) studying the population of education, public health services and industrial organizations in Bangkok, which has demonstrated a positive relationship between mindfulness and workplace spirituality. The path coefficient  $r$  is 0.39 ( $p = 0.01$ ) have some differences. This suggests that the mindfulness of writers such as web editors has a greater impact on their workplace spirituality than people in education, public health services, and industrial organizations. Web editors with high mindfulness will be more awake, focused, concentrate on thinking about problems, and be aware of their emotions and consciousness, which will greatly promote them to find deeper work meaning, purpose, value, etc., and produce better work experience.

Finally, there are few current research literatures on digital competencies, most of which focus on the teaching of digital competencies in colleges and universities, and are rarely used in organizations. Today, digital competencies is closely related to the professional development of employees (Karsenti et al., 2020), and research in organizations is urgent. Through literature collection, we found that there is a lack of existing valid scales for digital competencies, and our research can further validate the validity of digital competencies scales in professional settings (Castaño-Muñoz et al., 2017), which will expand research on digital competencies boundaries, thereby promoting the widespread use of digital competencies scales. In addition, digital competencies does not have a mediating effect between mindfulness and work performance, which also makes a major breakthrough.

## Practical implications

Taken together, these results demonstrate the impact of employees mindfulness on workplace spirituality, digital competencies, and work performance. As such, mindfulness has been recommended in organizations as a potential remedy (FitzGerald, 2020) to help employees focus on their work in the moment through mindfulness practices in the organization. Organizations should bundle mindfulness practices into company training programs (Hülshager et al., 2013; Kabat-Zinn, 2013), such as the use of lectures for thought guidance, discussions to generate thought exchanges, and meditation exercises to reinforce mindfulness (Chen et al., 2022b) and so on, help employees grow, improve work focus, and ultimately the focus of employees can be transformed into improved employees follow-up work performance. Liu et al. (2022a) investigated animated guided mindfulness meditation can increase flow ergonomics for flight attendants. New media companies can learn from this practice and use animation to

guide the mindfulness of web editors. At the same time, individual web editors should also have the awareness of mindfulness exercises, and turn these exercises into their own personal resources to stimulate the positive impact of the workspace (Huang et al., 2022), reduce their negative work emotions, and improve work happiness. Considering the current COVID-19 pandemic, web editors are working from home more often, so new media companies should also start exploring ways to improve employee mindfulness through online training.

In addition, the positive influence of workplace spirituality needs to be paid attention to. In today's technologically complex and highly competitive contemporary business environment, new media companies need to fully consider the spiritual needs of web editors, combine the company's own characteristics, and learn from the workplace spirituality programs implemented by organizations such as Apple, HP, and Ford to improve employees' awareness and skills (Jnaneswar and Sulphey, 2021). Organizations should pay attention to how to create a humanistic environment, treat employees at a spiritual level (Cacioppe, 2000), pay attention to employees' needs at a deep level, support employees' continuous learning and growth, and meet employees' psychological needs in the workplace. Specifically, new media companies should consider meditation classes and follow-up programs to motivate employees to practice meditation as a routine to purify their minds (Petchsawang and McLean, 2017). For example, new media companies can increase their workplace spirituality by allowing employees to practice meditation in the office for 10–15 min before starting work and at the end of the workday to help them maintain meaning and enthusiasm for their work. In addition to the spiritual plan, meaningful work should be designed according to the organizational environment, promote the alignment of organizational goals with personal goals, and promote employees learning, which is also an important factor in workplace spirituality.

Finally, by examining the relationship between mindfulness and digital competencies, and the relationship between digital competencies and work performance, we also recommend that companies focus on digital competencies. Digital competencies is crucial in today's world (Karsenti et al., 2020), it is closely tied to fast-paced technological advancements and evolves with the implementation of new tools, technologies and applications that change the way we work. Therefore, in the face of the ever-changing market environment, new media companies should carry out flexible, dynamic and professional vocational skills training and learning to help web editors learn to use digital resources and technology to solve work problems to meet the needs of future work. In addition to this, HR managers can add specific digital competencies based on web editors' job profiles, identifying the job requirements and development potential of current and future employees.

## Limitations and future research

Although the findings of this study provide a very important contribution, there are still some limitations worth discussing. First, our research was conducted in new media companies, and we do not rule out the possibility that specific corporate environments and cultures influence exercises between mindfulness, workplace spirituality, digital competencies, and work performance. Therefore, future research should attempt to replicate and extend existing findings across different enterprises.

Second, our study extends the study of mindfulness and work performance from a new perspective, adding two variables, workplace spirituality and digital competencies, but digital competencies play a lesser role in structure. In the future, it can continue to expand its research boundaries and explore the mediating mechanism of other variables, such as work engagement, creativity, etc.

In addition, there are some limitations regarding the collection of data. Questionnaires were distributed through the Tencent questionnaire platform in this study, and there may be data quality problems. Future research can collect data from multiple sources, such as contacting specific new media companies, and issuing questionnaires to employees through internal emails from HR managers to improve the accuracy of the questionnaires.

Finally, the focus of this study is primarily at the individual level, focusing on individual employees mindfulness, workplace spirituality, digital competencies, and individual work performance, without linking them to overall organizational performance. Therefore, future research can view mindfulness as a collective phenomenon, termed mindful organization (Sutcliffe et al., 2016), or link organizational effects to existing individual-level work performance, both for the organization as a whole and for future research may be more useful.

## Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

## Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the patients/ participants or patients/participants legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.



## Author contributions

J-ZH: Put forward the research ideas, design the research plans, analyze the data of the questionnaires, participate in the writing of the manuscript, and participate in the revision of the manuscript. X-WL: Write the manuscript, revise the manuscript according to expert opinions, and participate in the design of research ideas and research plans. H-YW: Participate in the design of research ideas and research plans, and participate in the data analysis of questionnaires. Z-WX: Participate in the design of research ideas and research plans, and participate in the revision of the manuscript. All authors contributed to subsequent revisions and approved the final manuscript.

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## Conflict of interest

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

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# Effects of online mindfulness-based interventions on the mental health of university students: A systematic review and meta-analysis

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**Objectives:** Mental health problems among university students are a cause of widespread concern. Mindfulness-based interventions (MBIs) delivered online have considerable potential to help university students manage mental health challenges. However, there is no consensus regarding the efficacy of online MBIs. This meta-analysis aims to determine whether MBIs are feasible and effective for improving university students' mental health.

**Methods:** Randomised controlled trials (RCTs) in Web of Science, PubMed, Cochrane Library, Embase and the US National Library of Medicine (Clinical Trial Registry) published through August 31, 2022, were searched. Two reviewers selected the trials, conducted a critical appraisal, and extracted the data. Nine RCTs met our inclusion criteria.

**Results:** This analysis showed that online MBIs were effective in improving depression (standardised mean difference [SMD] =  $-0.27$ ; 95% confidence interval [CI],  $-0.48$  to  $-0.07$ ;  $P = 0.008$ ), anxiety (SMD =  $-0.47$ ; 95% CI,  $-0.80$  to  $-0.14$ ;  $P = 0.006$ ), stress (SMD =  $-0.58$ ; 95% CI,  $-0.79$  to  $-0.37$ ;  $P < 0.00001$ ), and mindfulness (SMD =  $0.71$ ; 95% CI,  $0.17$  to  $1.25$ ;  $p = 0.009$ ) in university students. No significant effect was found on wellbeing (SMD =  $0.30$ ; 95% CI,  $-0.00$  to  $0.60$ ;  $P = 0.05$ ).

**Conclusion:** The findings indicated that online MBIs could effectively improve the mental health of university students. Nevertheless, additional rigorously designed RCTs are required.

**Systematic review registration:** <https://inplasy.com/inplasy-2022-9-0099/>, identifier INPLASY202290099.

## KEYWORDS

online, mindfulness, mental health, university, students, meta-analysis, systematic review



# 1. Introduction

Young people's mental health has been recognised as a global public health problem for a long time and has received increasing attention (Fusar-Poli et al., 2021). Adolescence and early adulthood are considered the peak life stages for the onset of psychiatric disorders, and three-quarters of adults with diagnosable mental health problems experience symptoms of poor mental health status before age 25 (Solmi et al., 2022). University students are especially vulnerable to the effects of stress and are at high risk for alcohol and drug abuse (Fond et al., 2018; Perino et al., 2022). Studies indicate that one-third of university students experience or are experiencing severe mental health problems (Auerbach et al., 2018) and experience higher levels of depression, anxiety, and distress compared with non-students of the same age (Kovess-Masfety et al., 2016; Lo et al., 2020). This can be explained by the fact that the students have cumbersome coursework, poor interpersonal relationships with their classmates and/or teachers, and study-life imbalance (Bergin and Pakenham, 2016; Urbina-Garcia, 2020). These stressors affect their physical and emotional health and lead to declining academic performance, poor life satisfaction, decreased self-confidence, increased dropout rates and, in some cases, suicidal thoughts (Cuijpers et al., 2019; Sheldon et al., 2021). In particular, over the past 3 years, the COVID-19 pandemic has led to serious disturbances to college students' lives and education, owing to the prolonged closing of educational institutions or delayed school opening, as well as isolation from classmates during the lockdown period. There is evidence that the pandemic dramatically impacted college students' mental health, with a significant increase in the incidence of psychiatric symptoms during successive lockdowns (Fu et al., 2021; Taylor et al., 2022). In fact, depression, anxiety and stress are still the most common mental problems in the university population (Hamaideh et al., 2022). Therefore, promoting mental health and preventing these mental disorders among university students is paramount.

In recent years, growing evidence suggests that mindfulness-based interventions (MBIs) are becoming increasingly popular among universities, and many apply different types of MBIs to help handle university students' mental health (Smit and Stavroulakis, 2021; Taylor et al., 2022). Mindfulness can be characterised as the capacity to realise feelings, thoughts, and bodily sensations in the current moment, to have an open and accepted mind toward one's experience, to understand one's emotions, and to foster wisdom and love (Sala et al., 2020). In Kabat-Zinn (1982), for the first time, applied mindfulness derived from Buddhist ideas to clinical practice for the treatment of chronic pain. Since then, MBIs have been continuously developed and have been incorporated into various therapies in mental health care, including mindfulness based cognitive therapy (MBCT), mindfulness based stress reduction (MBSR), acceptance and commitment therapy (ACT), and dialectical behavioural therapy (DBT) (Zhang et al., 2021). Among them, the most frequently adopted MBI programmes are MBSR and MBCT (Zhang et al., 2021), and these two types of MBIs have proven effective in reducing some common mental health problems (e.g., anxiety, depression, distress) and physical health problems (Spikerman et al., 2016; Malboeuf-Hurtubise et al., 2021).

With the rapid development of information technology, increasing numbers of MBIs, including other psychotherapy interventions, are being provided online (Mrazek et al., 2019). Compared with face-to-face interventions, online interventions

have many advantages, including: (1) participants can practice in their own space, especially during the COVID-19 pandemic, and can conveniently continue exercising at home; (2) 24-h availability, there is no long waiting list and is easy to join; (3) participants can remain anonymous; and (4) lower cost. In addition, a cross-sectional United States survey showed that, of 500 adults, 42% of the participants preferred individual and online MBIs over group forms (Wahbeh et al., 2014). This indicates that online MBIs can be applied as an alternative to face-to-face interventions. Studies have confirmed the effectiveness of face-to-face MBIs in healthy people and patients with chronic diseases (Zhang et al., 2021). Online MBIs is also considered an effective therapeutic intervention for common psychological problems (Ma et al., 2018; Ungar et al., 2022).

Despite increasing randomised controlled trials (RCTs) studies proving that online MBIs benefit university students' mental health (Simonsson et al., 2021; Sun et al., 2022), evidence remains weak and sometimes inconsistent.

The impact of online MBIs on psychological problems among university students remains to be comprehensively evaluated in a meta-analysis review. Some earlier meta-analyses of RCTs (Spikerman et al., 2016; Liu et al., 2022) have evaluated the effects of online MBIs for enhancing mental health aspects (such as depression, anxiety, and stress). However, they primarily concentrated on people with physical conditions, with only a small portion focussing on university students. Although a recent meta-analysis (Dawson et al., 2020) evaluated the impact of MBIs on university students' mental health, it pools studies that investigated face-to-face mindfulness interventions rather than an online one. To the best of our knowledge, the only study that examined online MBIs for improving the mental health of medical students was conducted and reported in a narrative style (Yogeswaran and El Morr, 2021). Thus, there remains a lack of quantitative evidence regarding the effectiveness of widely used online mindfulness programmes on university students' mental health, which compelled us to perform this systematic review.

To address this gap in the literature, we formulated three research questions: (1) Are online MBIs effective for improving university students' mental health compared with active and passive control conditions? (2) What is the effectiveness of online MBIs on mental health in university student populations? (3) What intervention characteristics are common to effective interventions delivered *via* the internet?

Therefore, the main objectives of the current study are threefold. First, we aimed to investigate the evidence for the effectiveness of online MBIs on university students' mental health and to propose whether to conduct online MBIs for university students in the future. Second, to statistically summarise the reported efficacy of online MBIs on depression, anxiety, and stress. Other factors, such as wellbeing and state of mindfulness, were examined as secondary outcomes. Third, we sought to determine the quality of this evidence. Finally, given the diversity of this population, it is crucial to understand the varying characteristics of the studied population.

## 2. Materials and methods

### 2.1. Study registration

This systematic review and meta-analysis protocol was registered on the International Platform of Registered Systematic Review and



Meta-Analysis Protocols (INPLASY) with a registration number of INPLASY 202290099. This study was designed and conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021).

## 2.2. Search strategy

A systematic search for eligible reports of trials was conducted in five online databases: PubMed, Embase, Web of Science, Cochrane Library, and [Clinical Trials.gov](https://www.clinicaltrials.gov/). All searches ended before August 31, 2022. We used the following main keywords in the initial search: “mindfulness,” “online,” “students,” and “randomised controlled trial.” Afterward, medical subject headings (MeSH) and thesaurus terms were added to construct the specific search terms. The full search string was provided in the [Supplementary Appendix](#).

## 2.3. Inclusion criteria and study selection

We adopted the Populations, Interventions, Comparisons, Outcomes, and Study framework. Studies included in this review were required to meet the following criteria: (1) the study was an RCT; (2) it was conducted using a university student sample; (3) it included an online and MBIs; (4) it included a measurement of mental health outcomes (stress, anxiety, depression, mindfulness state, and wellbeing); and (5) it was available in English.

Studies were excluded if: (1) the intervention was not delivered online (e.g., face-to-face); (2) mindfulness did not form most of the intervention (e.g., yoga, Baduanjin, and ACT); and (3) MBIs were combined with other interventions, such that the individual effects of MBIs could not be assessed.

After removing duplicate articles, all retrieved records were reviewed by two reviewers (X-GG and L-PW) independently. The titles and abstracts of these articles were read to determine whether it was required to retrieve the full text. If either of the reviewers deemed the article inconclusive and required further consideration, they retrieved the full text for review. Subsequently, articles were selected independently by the two reviewers based on the inclusion/exclusion criteria. Any disagreement was resolved by discussing with the corresponding author to reach a consensus.

## 2.4. Appraisal of methodical quality

Two reviewers (X-GG and L-PW) independently assessed the quality of the included RCTs by the Cochrane risk of bias tool (Higgins and Green, 2011). The evaluation contents comprise (1) random sequence generation; (2) allocation concealment; (3) blinding of participants and investigators; (4) blindness of outcome assessments; (5) incomplete outcome data; (6) selective outcome reporting; and (7) other biases. According to the Cochrane Handbook, each domain of the included studies was rated as having a low-risk bias, a high-risk bias, or an unclear risk of bias. Any disagreements were resolved by consensus on the opinion of a third reviewer (A-YZ).

## 2.5. Extraction of the data

The data was extracted in a standardised form by one reviewer (X-GG), and a second reviewer (GR) subsequently tested whether the data was accurate. For the included studies, the following information was extracted: general information (title, authors, year of publication, and geographical location of trials conducted); study characteristics, including baseline sample size, age, gender (% of women), and the number of participants in each group, intervention characteristics (online MBIs programmes, delivery mode, guidance, therapeutic duration, length of session and control group, assessment times), and outcome measures for depression, anxiety, stress (primary outcomes), wellbeing, and mindfulness state (secondary outcome).

For articles with missing data, we contacted the corresponding author through e-mail to request the necessary information. Necessary discussions and consensus with the corresponding author were conducted to settle the disagreements.

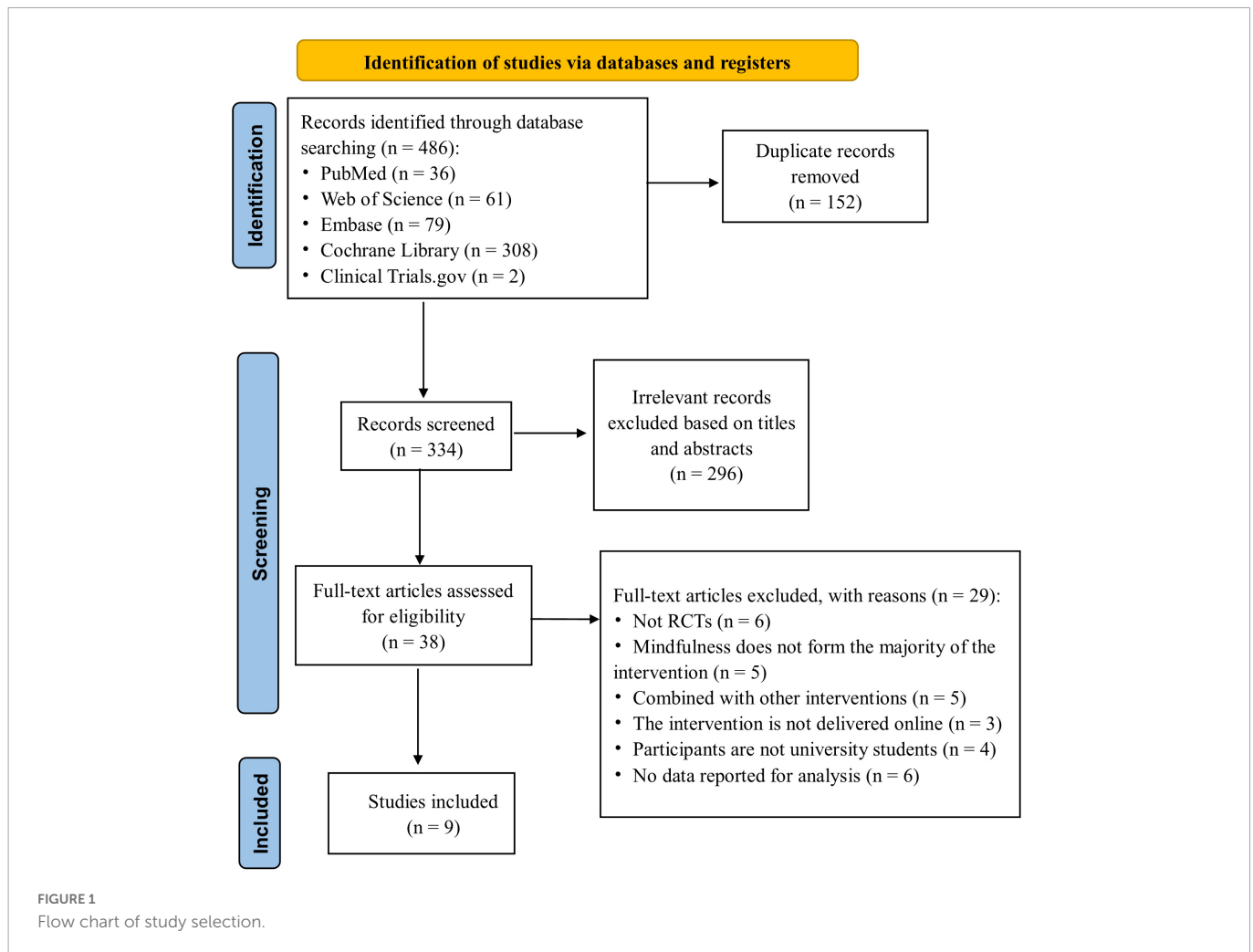
## 2.6. Data synthesis

The RevMan 5.4 software of Cochrane Collaboration was used to conduct the meta-analysis (Higgins and Green, 2011). To investigate the effect of online MBIs, separate qualitative analyses were performed on the five different mental health outcomes: depression, anxiety, stress, wellbeing, and mindfulness. Their effect sizes were summarised using the inverse variance of the individual studies as weights. For each outcome, quantitative data was provided, and the weighted mean difference (WMD) with its 95% confidence interval (CI) was reported. The statistical heterogeneity of included studies was assessed by  $I^2$  statistics.  $I^2$  values between 25 and 50%, 25 and 50%, and  $>50\%$ , respectively, indicated mild, moderate, and high heterogeneity. A fixed-effects model was used with an  $I^2 < 50\%$  and  $p > 0.1$ . Otherwise, we switched to a random-effects model. When study data could not be collected, a narrative synthesis was done. When at least ten publications were included, funnel plots were used to detect potential publication bias.

## 3. Results

### 3.1. Literature search

A total of 486 potential studies were identified in the initial search for the analysis. After removing 152 duplicated articles, 334 studies remained, of which 296 were excluded after the screening of titles and abstracts. We reviewed the remaining 38 full-text articles and excluded 29 studies that did not meet the inclusion criteria: (1) no RCTs ( $n = 6$ ), (2) mindfulness did not form the majority of the intervention ( $n = 5$ ), (3) combined with other interventions ( $n = 5$ ), (4) the intervention was not delivered online ( $n = 3$ ), (5) participants were not university students ( $n = 4$ ), and (6) no relevant data reported for analysis ( $n = 6$ ). Finally, nine RCTs were included in this review (Cavanagh et al., 2013; Noone and Hogan, 2018; Yang et al., 2018; Huberty et al., 2019; Throuvala et al., 2020; Orosa-Duarte et al., 2021; Simonsson et al., 2021; Kam et al., 2022; Sun et al., 2022). The detailed process of the study selection is illustrated in [Figure 1](#).



### 3.2. Study characteristics

**Table 1** displays the summarised characteristics of the included studies. Overall, nine RCTs were conducted in six countries: the UK ( $n = 3$ ) (Cavanagh et al., 2013; Throuvala et al., 2020), USA ( $n = 2$ ) (Yang et al., 2018; Huberty et al., 2019), Canada ( $n = 1$ ) (Kam et al., 2022), Ireland ( $n = 1$ ) (Noone and Hogan, 2018), Spain ( $n = 1$ ) (Orosa-Duarte et al., 2021) and China ( $n = 1$ ) (Sun et al., 2022). These studies yielded 1,100 participants (all university students; mean age = 20–30 years), of which 557 received MBIs, and 543 were included in the control sample. One study reported that the participants were students of psychology background (Throuvala et al., 2020), one reported the students were from a medical university (Yang et al., 2018), and the remaining RCTs did not mention the background of student participants. The study sample size ranged from 62 to 252. Women covered over six percent of the total participants in all studies. Six studies examined MBCT, one MBSR, one MBSH, and one applied a combination of MBCT and MBSR interventions. Three studies performed interventions with guidance, while others performed without guidance. According to delivery mode, the experimental groups can be divided as follows: mobile applications ( $n = 6$ ), videoconferences ( $n = 1$ ), and websites ( $n = 2$ ). The duration of online MBIs in the intervention groups varied from 10 days to 2 months, and the training sessions varied from 4 to 14. Seven RCTs used an inactive control condition, all of

which were waiting list groups. An active control was used in the remaining two RCTs, in which participants got social support ( $n = 1$ ) or sham meditation ( $n = 1$ ). The primary outcome measures were depression in four comparisons, anxiety in six comparisons, and stress in four comparisons. Secondary outcome measures were wellbeing in two comparisons and mindfulness in six comparisons. All the instruments possess good psychometric natures. After the intervention, follow-up periods of 1 to 3 months were investigated in the three studies. No adverse events related to online MBIs were reported in the included RCTs.

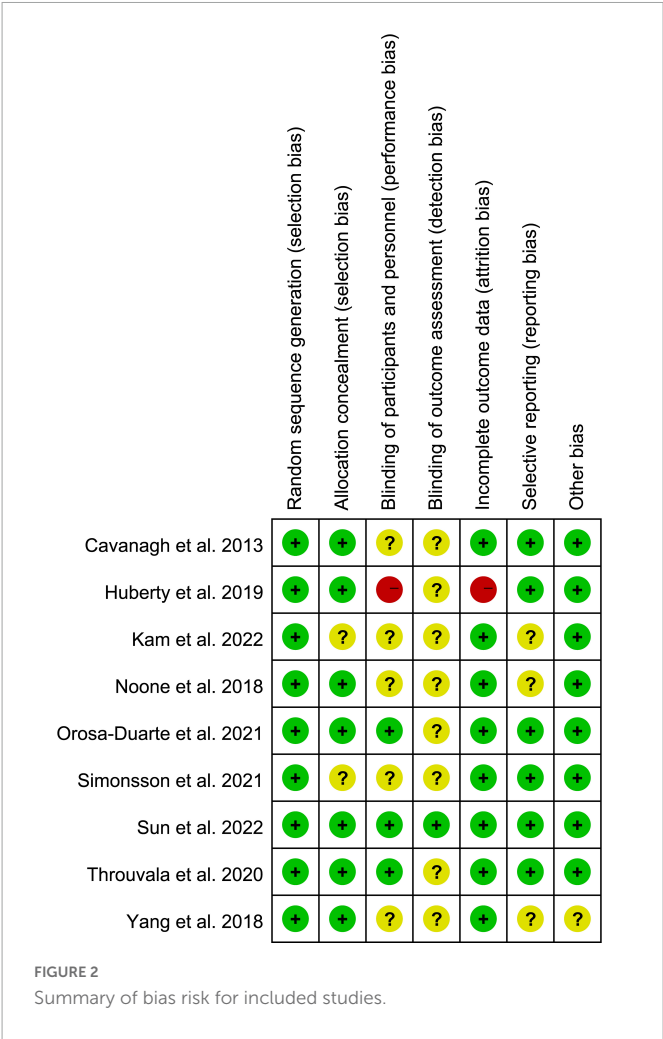
### 3.3. Methodological quality

The risk of bias assessment for each included study is summarised in **Figure 2**. Random sequence generations were applied in all studies. Seven studies described specific methods of allocation concealment, which were not provided by the remaining two studies. The outcome assessors were blinded in two trials, and the remaining RCTs rated as unclear for detection bias were not reported. The participants and/or personnel were blinded in three studies; one study reported that blinding was not used. One study reported partial data loss and was considered at a high risk of attrition bias; the remaining RCTs were rated as low risk. Six RCTs reported trial registration rated as low risk, and the remaining three, with no mention, were rated as

TABLE 1 Characteristics of included studies.

References	Study location	BSZ (MBIs/CG)	%F <sup>a</sup>	Age, mean (SD) (years)	Intervention	Guidance	Deliverymode	N sessions, duration in weeks	Control group	Measurements	Outcome measured
Cavanagh et al., 2013	United Kingdom	104 (54/50)	88.5	24.7(6.4)	MBSH	Without	Website	14 sessions, 2 weeks	Inactive (waitlist)	Pre, post	Depression/anxiety: PHQ-4; stress: PSS; mindfulness: FFMQ
Huberty et al., 2019	United States	109 (56/53)	88.9	21.18 (5.5)	MBCT	Without	Mobile application	8 sessions, 8 weeks	Inactive (waitlist)	Pre, post, 12-weeks follow-up	Stress: PSS; mindfulness: FFMQ
Kam et al., 2022	Canada	62 (32/30)	83.9	29.9 (8.8)	MBCT	Without	Mobile application	10 sessions, 2 weeks	Inactive (waitlist)	Pre, post	Depression/anxiety: PROMIS
Noone and Hogan, 2018	Ireland	91 (48/43)	75.8	20.92 (4.4)	MBCT	With	Website	6 sessions, 6 weeks	Active (sham meditation)	Pre, post	Wellbeing: WEMWS; mindfulness: FFMQ
Orosa-Duarte et al., 2021	Spain	103 (54/49)	84.5	23 (4.2))	MBSR	Without	Mobile application	8 sessions, 8 weeks	Inactive (waitlist)	Pre, post	Anxiety: STAI-T; mindfulness: FFMQ
Simonsson et al., 2021	United Kingdom	177 (88/89)	64.4	23.27 (5.6)	MBCT	With	Videoconferencing	8 sessions, 8 weeks	Inactive (waitlist)	Pre, post, 1-month follow-up	Depression/anxiety: PROMIS
Sun et al., 2022	China	114 (57/57)	73.7	22.21 (2.7)	MBSR and MBCT	With	Mobile application	4 sessions, 4 weeks	Active (social support)	Pre, post, 2-months follow-up	Depression: PHQ-9 anxiety: GAD-7 mindfulness: MAAS
Throuvala et al., 2020	United Kingdom	252 (123/129)	82	20.72 (3.1)	MBCT	Without	Mobile application	10 sessions, 10 days	Inactive (waitlist)	Pre, post	Anxiety: GAD-7 stress: PSS; mindfulness: MAAS
Yang et al., 2018	United States	88 (45/43)	63.6	25.11	MBCT	Without	Mobile application	4 sessions, 2 months	Inactive (waitlist)	Pre, post	Stress: PSS; wellbeing: GWBS; mindfulness: FFMQ

BSZ, baseline sample size; CG, control group; FFMQ, five facets of mindfulness questionnaire; GAD-7, generalised anxiety disorder-7; GWBS, general wellbeing schedule; MAAS, mindful attention awareness scale; MBCT, mindfulness-based cognitive therapy; MBIs, mindfulness-based interventions; MBSH, mindfulness-based self-help; MBSR, mindfulness-based stress reduction; PHQ-4, patient health questionnaire for depression and anxiety; PHQ-9, patient health questionnaire; PROMIS, patient-reported outcomes measurement information system; PSS, perceived stress scale; STAI-T, state-trait anxiety inventory–trait subscale; UK, United Kingdom; USA, United States; WEMWS, Warwick-Edinburgh mental wellbeing Scale; %F<sup>a</sup>, percentage of women in the total study population at baseline.



unclear selective reporting bias. Only one RCT did not report that the authors received a government grant, so the trial was rated as having an unclear other bias.

3.4. Meta-analysis outcome

3.4.1. Primary outcomes

3.4.1.1. Effects on depression

Four included studies (Cavanagh et al., 2013; Simonsson et al., 2021; Kam et al., 2022; Sun et al., 2022) involving 186 online MBIs and 198 control subjects assessed depression outcomes (Figure 3A). The results were  $I^2 = 0\%$  and  $p = 0.85$ , indicating that heterogeneity was negligible. Compared with the control condition, the meta-analysis found a significant effect of online MBIs in alleviating depression ( $SMD = -0.27$ ; 95% CI,  $-0.48, -0.07$ ;  $P = 0.008$ ).

3.4.1.2. Effects on anxiety

Six included studies (Cavanagh et al., 2013; Throuvala et al., 2020; Orosa-Duarte et al., 2021; Simonsson et al., 2021; Kam et al., 2022; Sun et al., 2022) involving 289 participants in the online MBIs intervention groups and 299 controls were analysed to determine the effect on anxiety (Figure 3B). A high level of heterogeneity was observed ( $P = 0.002$ ;  $I^2 = 73\%$ ). For the meta-analysis, compared with controls, aggregated results showed significant benefit in favour

of online MBIs on anxiety ( $SMD = -0.47$ ; 95% CI,  $-0.80$  to  $-0.14$ ;  $P = 0.006$ ). By examining the forest plot, a potential outlier was identified (Orosa-Duarte et al., 2021). After removing outliers, the pooled effect was reduced to  $SMD = 0.34$ , 95% CI (0.57, 0.11). However, we found that the effect of improving anxiety remained significant ( $P = 0.004$ ). In addition, the heterogeneity was reduced to a moderate level ( $I^2 = 42\%$ ,  $P = 0.14$ ).

3.4.1.3. Effects on stress

We successfully included four studies (Cavanagh et al., 2013; Yang et al., 2018; Huberty et al., 2019; Throuvala et al., 2020) involving 176 online MBIs and 193 control participants (Figure 3C). The results showed that online MBIs were more effective than the controls in alleviating stress ( $SMD = -0.58$ ; 95% CI,  $-0.79$  to  $-0.37$ ;  $P < 0.00001$ ). No significant heterogeneity was found between studies ( $P = 0.44$ ;  $I^2 = 0\%$ ).

3.4.2. Secondary outcomes

3.4.2.1. Effects on wellbeing

Of the nine RCTs, only two (Noone and Hogan, 2018; Yang et al., 2018) reported the data on wellbeing (Figure 4A). The results showed  $I^2 = 0\%$  and  $p = 0.91$ , exhibiting no statistical heterogeneity. Compared with the control condition, the meta-analysis showed no statistically significant improvement in wellbeing in the online MBIs group ( $SMD = 0.30$ ; 95% CI,  $-0.00$  to  $0.60$ ;  $P = 0.05$ ).

3.4.2.2. Effects on mindfulness

Six RCTs (Cavanagh et al., 2013; Yang et al., 2018; Huberty et al., 2019; Throuvala et al., 2020; Orosa-Duarte et al., 2021; Sun et al., 2022) reported the data on mindfulness (Figure 4B). The meta-analysis indicated that online MBIs had a significant effect on mindfulness ( $SMD = 0.71$ ; 95% CI, 0.17 to 1.25;  $P = 0.009$ ) compared with the control condition. The results were  $I^2 = 88\%$  and  $P < 0.00001$ , indicating high statistical heterogeneity. By assessing the forest plot, a potential outlier was identified (Orosa-Duarte et al., 2021). After removing outliers, the pooled effect was reduced to  $SMD = 0.45$ , 95% CI (0.05, 0.84), yet there still was a significant statistical effect ( $P = 0.03$ ). In addition, the level of heterogeneity was high ( $I^2 = 77\%$ ,  $P = 0.002$ ).

4. Discussion

4.1. Main findings

The present meta-analysis identified nine RCTs with 1,100 participants to examine the effectiveness of online MBIs on university students' mental health. The pooled analyses demonstrated that online MBIs reduced depression, anxiety, and stress and improved mindfulness significantly. Nevertheless, we did not detect an overt substantial impact on wellbeing.

The fact that eight out of the nine studies were just recently published highlights the growing interest in this kind of intervention. The impact of online MBIs on the mental health of all college student groups remains unproven, despite the rise in studies in this area. Our findings in this study are comparable to those from the earlier publication of MBIs based on a healthy population (Khoury et al., 2015; Liu et al., 2022). Prior meta-analyses did not, however, exclusively focus on university students, and the MBI types examined

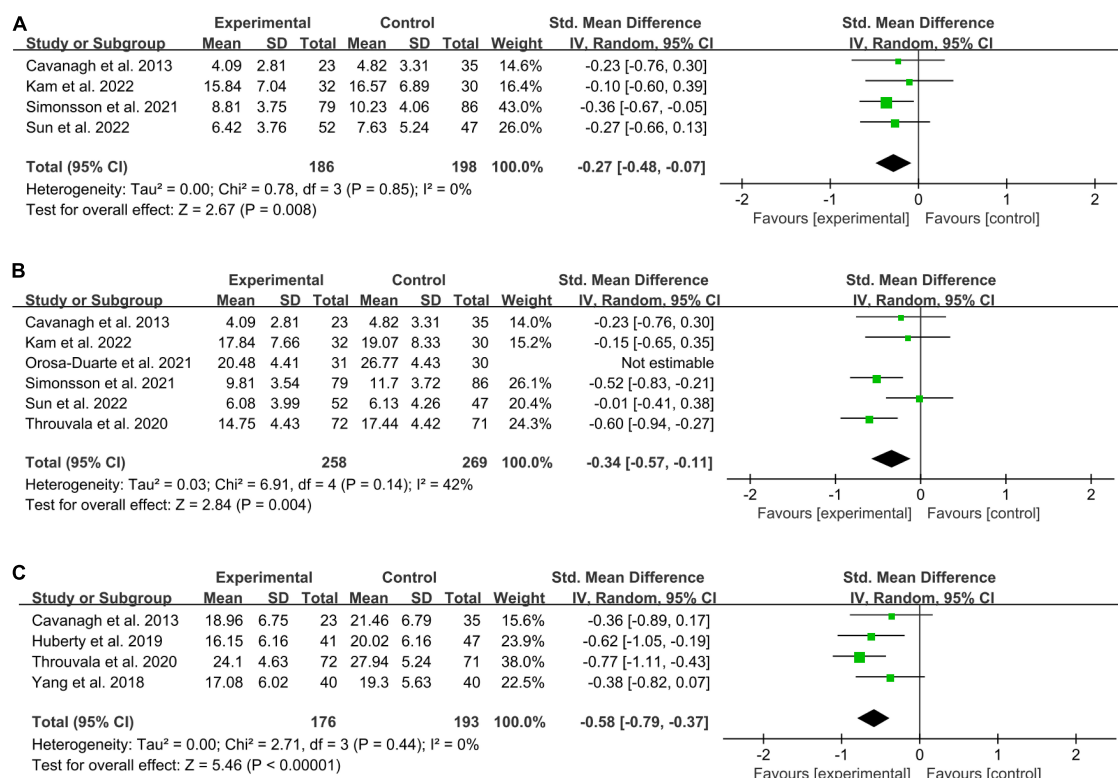


FIGURE 3

Forest plot of meta-analysis for the efficacy of online MBIs on mental health. (A) Depression. (B) Anxiety. (C) Stress.

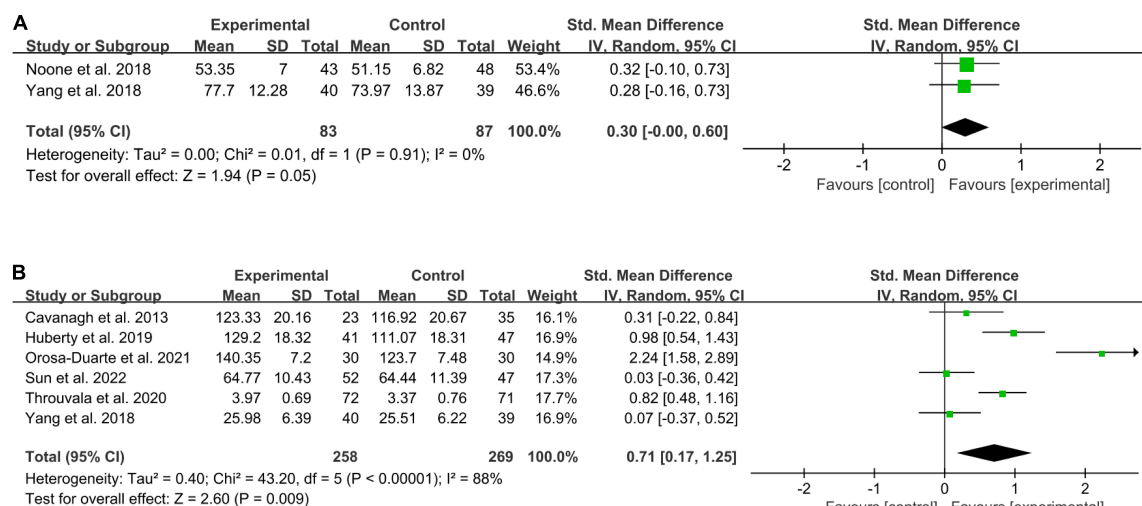


FIGURE 4

Forests plot of meta-analysis for the effect of online MBIs on wellbeing and mindfulness. (A) Wellbeing. (B) Mindfulness.

in these studies also varied. As a result, this meta-analysis is the first to show how online MBIs affect university students' mental health. Concerns about the mental health of university students have grown, and if temporary academic psychological hurdles are not removed, this could result in long-term mental and physical illnesses, even suicidal tendencies. The study's findings could provide evidence for an easy-to-use tool that university students could adopt to manage mental health problems, including depression, anxiety, and stress.

We observed that the effect sizes of online MBIs on depression, anxiety, stress, and mindfulness in this meta-analysis were generally larger for university students than those found for all individuals with physical health conditions (including non-university students) in previous research (Liu et al., 2022). This may be related to university students being more familiar with online and mobile applications and having an advantage in practising online MBIs. Eight of the nine included studies in this review used mobile applications or websites as the delivery modes of the experimental groups.



Although online MBIs were shown to increase wellbeing to some level in the reports of two RCTs (Noone and Hogan, 2018; Yang et al., 2018), a meta-analysis of these two trials in this investigation revealed that there was no statistically significant improvement in wellbeing. Different findings from earlier studies have been found regarding this outcome. Online MBIs have been found to considerably impact wellbeing in one study (Sevilla-Llewellyn-Jones et al., 2018), but their impact on quality of life is modest (Spijkerman et al., 2016). These meta-analyses' contradictory results may be explained by several factors, including how the programme was delivered or samples from different groups and physical health situations (Vollestad et al., 2012). This might be due to the small number of studies that report wellbeing and the significant degree of heterogeneity; as a result, multicenter, high-quality, large-sample research is expected to investigate how online MBIs affect wellbeing.

Additionally, in studies with both a waitlist and an active control group, some outcomes improved more in online MBIs than in these two control groups (Orosa-Duarte et al., 2021), indicating that MBIs are equally effective as or even more effective than other active interventions in alleviating some mental problems.

We still do not fully understand how MBIs affect the human body to enhance mental wellbeing and relieve psychiatric issues. An 8-week mindfulness-based therapy programme resulted in changes in the structure and function of neurons, according to a prior review article (Guendelman et al., 2017). Following MBIs, healthy and unhealthy patients showed enhanced functional activity and structural connectivity in the cingulate cortex, prefrontal cortex, hippocampus, and insula. The amygdala also displayed decreased functional activity and enhanced connection with the prefrontal cortex, resulting in improved emotional control (Gotink et al., 2016). A recent study shows that MBSR reduces the pressure of self-reporting and controls its pain through cognitive reassessment and acceptance. In addition, over time, MBSR enhances brain activity through cognitive reappraisal and acceptance to manage its own (parietal cortex) emotions (Guendelman et al., 2022). These may lead to increased capacity for resilience following MBI.

Online intervention for mental health issues has proliferated and is expected to outperform traditional face-to-face therapies alone in terms of accessibility, acceptance, scalability, and cost-effectiveness (Ferrari et al., 2022). Online therapies aimed at university students' psychological issues may eliminate their worries about stigma, time constraints, and unfamiliarity with the healthcare system (Montagni et al., 2020). Moreover, the high usage of smartphones and familiarity with blended learning modes mean that most university students are well suited for an online digital health support model (Ferrari et al., 2022). Other global factors, like the COVID-19 pandemic, necessitate social distancing and prolonged in-room hours to slow the spread of the virus. An effective online psychological intervention for university students, therefore, seems especially appropriate and necessary.

A previous systematic review (Zhou et al., 2021), including 45 RCTs with 13,291 participants, indicated that online mental health interventions were effective in managing various mental health conditions (such as depression, anxiety, stress, insomnia, and improving quality of life) among youth when compared with control conditions. The current meta-analysis provides enhanced evidence for the efficacy of online mental health intervention. The result affirms the value of existing theory in this area, and we anticipate that it could contribute to the development of practice-oriented guidelines.

One study compared online and face-to-face mindfulness and discovered that both had certain advantages over the other in different indicators (Orosa-Duarte et al., 2021). Although the authors did not delve further into the mechanism at play, it appears that the flexibility of online mindfulness gives it a competitive edge. Nonetheless, more research is necessary to support this observation.

Additionally, this review includes the most traditional and widely used MBI programmes, such as MBSR and MBCT (Zhang et al., 2021), and these interventions were primarily conducted on a psychological level. According to a broad definition, some traditional Chinese Integrative Body-Mind Training (IBMT) regimens, like Tai Chi, Baduanjin, and Qigong, were also included in the category of MBIs (Creswell, 2017). Research has shown that these exercise regimens can benefit practitioners' physical and mental health (Zou et al., 2018; Li et al., 2019; Gong et al., 2022; Lin et al., 2022). Researchers should continue to explore what modifications are necessary for these IBMT programmes to be delivered online for university students.

## 4.2. Strengths and limitations of the review

To the best of our knowledge, this is the first meta-analysis to examine the effectiveness of online MBIs designed specifically for university students with mental health issues. We conducted a comprehensive analysis of the evidence of the included RCTs, which are considered to be the most appropriate and recommended method to evaluate the intervention effect (Kabisch et al., 2011). What is more, the total number of samples included in most meta-analyses was relatively sufficient, and these were distributed in a wide range of geography, covering six countries (China, the USA, Canada, Ireland, the UK, and Spain) on three continents (Europe, America, and Asia), which may reinforce the generalisation of research conclusions.

Despite the apparent positive effects of online MBIs on university students' mental health, a drawback of this framework should be noted.

First, methodological risks or other inadequacies are present in most of the included studies, which limits the strength and feasibility of clinical evidence. One of the most significant drawbacks of most studies is the lack of blinding. Five of the nine studies did not report participant and/or personnel blinding, and one reported that blinding was not used. In addition, only one study reported the adoption of outcome assessment blinding, and one study was considered to have a high risk of attrition bias for reporting partial data loss. Because of these biases, we should be cautious when interpreting the results of this systematic evaluation. Significant heterogeneity in the meta-analysis of this article was found, which may be due to differences in method quality, participants, interventions, and outcome evaluation. Therefore, it is necessary to conduct more rigorous studies with higher standards of trial methodology to assess the effects of online MBIs on the mental health of university students.

Second, in different studies that meet the inclusion criteria, the duration and frequency of online MBIs were significantly different. The duration of the intervention varied from 10 days to 2 months, and the training sessions varied from 4 to 14 times a week, which may have different effects on online MBIs in alleviating anxiety, depression, and stress and improving mindfulness. It was unclear whether the therapeutic effect varied with the intervention length, session, and frequency. Thus, the differences in practice

make it difficult to make specific suggestions on the frequency and duration of practice.

Third, our bibliographic search was restricted to English publications. Additionally, we did not search for unpublished data. Both these aspects may have hindered our ability to identify other relevant trials. This meta-analysis was finally based on nine studies, and the small number of eligible RCTs was a limitation. Because it limits the reliability and validity of statistics, it may explain why the changes in some analysis results do not reach statistical significance. We expect that more rigorously designed and large-scale trials can help us address these shortcomings in the future.

## 5. Conclusion

Based on the available studies, this meta-review shows that online MBIs may effectively improve depression, anxiety, stress, and mindfulness state among university students. Although current research exploring the effectiveness of online MBIs is still in the early stages, we conclude that there is emerging evidence that online MBIs have the potential to improve university students' mental health. In addition, more rigorous RCTs with larger sample sizes are warranted to establish the therapeutic effects of online MBIs on mental health problems (depression, anxiety, and stress) and to improve mindfulness state and wellbeing, particularly among university students.

## Data availability statement

The original contributions presented in this study are included in the article/**Supplementary material**, further inquiries can be directed to the corresponding authors.

## Author contributions

X-GG and L-PW: conceptualization and writing—original draft. X-GG, L-PW, and GR: data curation. X-GG, GR, and A-YZ: formal analysis. X-GG, L-PW, GR, D-NZ, A-YZ, and CL: methodology.

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## Conflict of interest

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

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## Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsyg.2023.1073647/full#supplementary-material>

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# The effect of mindfulness intervention on internet negative news perception and processing: An implicit and explicit approach

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The internet facilitates the formation of the information society while also accelerating the viral spread of negative news and negative emotions, increasing public uncertainty and depression and impeding consensus, especially in the post-pandemic period. Mindfulness intervention, which has a positive effect on attention focus, self-regulation, and subjective wellbeing, is proven to mitigate negative emotional effects, and even alter mind patterns. The study aimed to give insight into the effect of mindfulness in the new media field, concerning trait mindfulness improvement, emotional arousal and regulation, and implicit attitudes from the perspective of intra-personal communication and positive communication. The study conducted a randomized pre-test–post-test control group design, with 3 (condition groups: mindfulness vs. placebo vs. control) × 2 (test times: pre vs. post). Participants who were exposed to negative news coverage with negative emotional arousal received 14 consecutive days of intervention. The results showed that mindfulness training can improve trait mindfulness effectively on the whole, especially in facets of describing, acting awareness, and non-judgment, and mitigate the negative effect from bad information coverage, while mindfulness intervention on mind patterns and expectations on controversial issues still awaited future empirical research. The present study intended to bridge the bonding between positive psychology and new media studies by focusing on individual attention improvement and negative emotion regulation, in the expectation that trait mindfulness can be beneficial in individual infodemic syndromes such as judgment bias and information exhaustion, and avoidance.

## KEYWORDS

mindfulness intervention, global climate change, negative emotions, single category implicit association test (SC-IAT), online negative news

## Introduction

Social media has been credited and foreseen to build the public sphere and social good. While in recent years, it has been evident that the internet also facilitates the viral spread of negative news or bad (mis)information in everyday algorithm practice, this causes network anger and anxiety, forming information and belief echo chambers, impeding consensus, and increasing social polarization (Jamieson and Cappella, 2010; Thorson, 2013; Du and Gregory, 2017). The widespread massive information flow caused by the infodemic (PAHO, 2020) in the



post-pandemic period exacerbates public uncertainty and depression (Zhang et al., 2020; Pine et al., 2021; Yoon et al., 2021).

Climate change has been a most pressing challenge faced by human society; data from 40 countries showed that social media was the main source and channel for the spread of (mis)information on climate change (Newman, 2020). In addition, new media platforms have done some crucial work on the production and reproduction of the meaning of climate change (Carvalho, 2010). A considerable quantity of online media coverage about this controversial issue can be seen around the globe, which has played the primary source of public exposure to information, and uncertainty and echo chamber effects in online discussions have been witnessed in various countries (Heal and Kriström, 2002; Williams et al., 2015).

Research showed that online news on controversial issues such as global climate change has strongly increased politicization and polarization and influenced public belief (Chinn et al., 2020). (Mis)information portrays visuals and texts that are most likely to influence individual emotions, where threats, danger, and doubts are implicated in eliciting negative emotions such as fear, anger, and exhaustion (Feldman and Hart, 2018; PAHO, 2020). It was further shown that negative emotions not only hook public attention (Zeng and Zhu, 2019) but also drive for virally dissemination and lead to the spiral of the evolvement of negative emotions in the network cycle, thus causing individual infodemic syndrome.

As a significant method in positive psychology, mindfulness intervention is proven to eliminate and control negative psychological conditions and mitigate negative impacts. Mindfulness usually refers to a training process of non-judgmental present-moment experience (Kabat-Zinn, 1990; Bishop et al., 2004), with open-minded acceptance of conscious thoughts, bodily feelings, and the environment (Hofmann et al., 2010; Poon and Jiang, 2020). High mindfulness is positively related to attention focus and reallocation (Lindsay and Creswell, 2017), stress alleviation and reduction (Grossman et al., 2004; Goldin and Gross, 2010; Xi et al., 2022), positive emotions and attitudes (Brown and Ryan, 2003; Hülshager et al., 2013; Liu et al., 2022a), as well as subjective wellbeing (Brown and Ryan, 2003; Wallace and Shapiro, 2006; Liu et al., 2020, 2022b). The training breaks cognitive barriers, cultivate emotion regulation and satisfaction, copes with mental fatigue, and exalts current beliefs and future expectations (Langer, 2000; Hülshager et al., 2013; Karelaia and Reb, 2015; Wang et al., 2019; Kudesia et al., 2022). In essence, mindfulness intervention altered the mind patterns from negative to positive, from closeness to openness and flexibility, and from path dependency to creation.

In recent years, empirical studies on mindfulness have flourished in cross-disciplinary research (Academic Mindfulness Interest Group [AMIG], 2006; Good et al., 2015), but the application of mindfulness intervention on infodemic syndrome, where negative emotions are induced by Internet bad information perception and processing, remains unknown. Thus, this study intended to extend the empirical perspective of mindfulness in the new media fields. It focused on the explicit and implicit attitudes changes associated with mindfulness-based stress reduction (MBSR) intervention, hypothesizing that it can reduce the negative effect and improve current tolerance and expectations by using reading materials of negative climate change coverage. Negative emotions and explicit attitudes were measured using questionnaires, and implicit attitudes were measured by behavioral experiments using the single category implicit association test (SC-IAT) cognitive paradigm.

## Materials and methods

### Participants

The experiment initially recruited 81 non-psychology-major participants for mindfulness intervention and experiment. After the exclusion of three participants who failed to meet the previous criteria and 14 who declined successive time training, the study had 64 samples participating in the experiment. Among them, 46 effective participants completed the entire training and experiment, with 16 men and 30 women ranging in age from 18 to 45 years old (shown in Figure 1 and Table 1). The study applied G\*power 3.1 (Faul et al., 2009) to carry out *post hoc* power analysis for the effective sample size (effect size  $f^2 = 0.25$ ,  $\alpha = 0.05$ ,  $1 - \beta = 0.918 > 0.8$ ).

All the participants in the training had no previous experience of regular training (no more than 1 h per week). They met the criteria of no chronic or acute mental or physical disease and no substance use or addictions. The participants were measured with moderate or low scores on the Positive and Negative Affect Scale (PANAS) before the experiment to ensure their normal emotion baselines. The experiment received the approval of the IRB in the Department, and the participants signed the informed consent before the experiment and got awarded after that.

### Procedures

The study conducted a randomized pre-test–post-test control group design, with 3 (condition groups: mindfulness vs. placebo vs. control)  $\times$  2 (test times: pre vs. post). For the three groups, participants first read the same stimulus reading materials, took the pre-test questionnaires to mark the baseline of negative emotional condition, and then received the mindfulness/false/none training intervention for 14 consecutive days. After the training, the participants took the post-test questionnaires to measure the emotional changes and the SC-IAT to assess the implicit attitudes of future expectancies for global climate change.

### Mindfulness training

The participants were randomly assigned to three groups, mindfulness training group, placebo group, and control group. In the mindfulness group, participants received successive 14-day professional MBSR training, 10 min per day in a fixed period. In the placebo group, participants received 14-day completely unrelated intonation practice; the time length was exactly the same as the training group to reduce the influence of the experiment itself. In the control group, the participants received no interventions.

The MBSR training was conducted online due to pandemic restrictions *via* the Tencent Meeting platform with all the participants' face cameras on under their approval to make sure they were in an uninterrupted environment by themselves. The participants were separated into three online chat groups and were restricted from communicating with each other about the training. The three experimenters received professional training and consultancy from the professionals at the psychological counseling center.



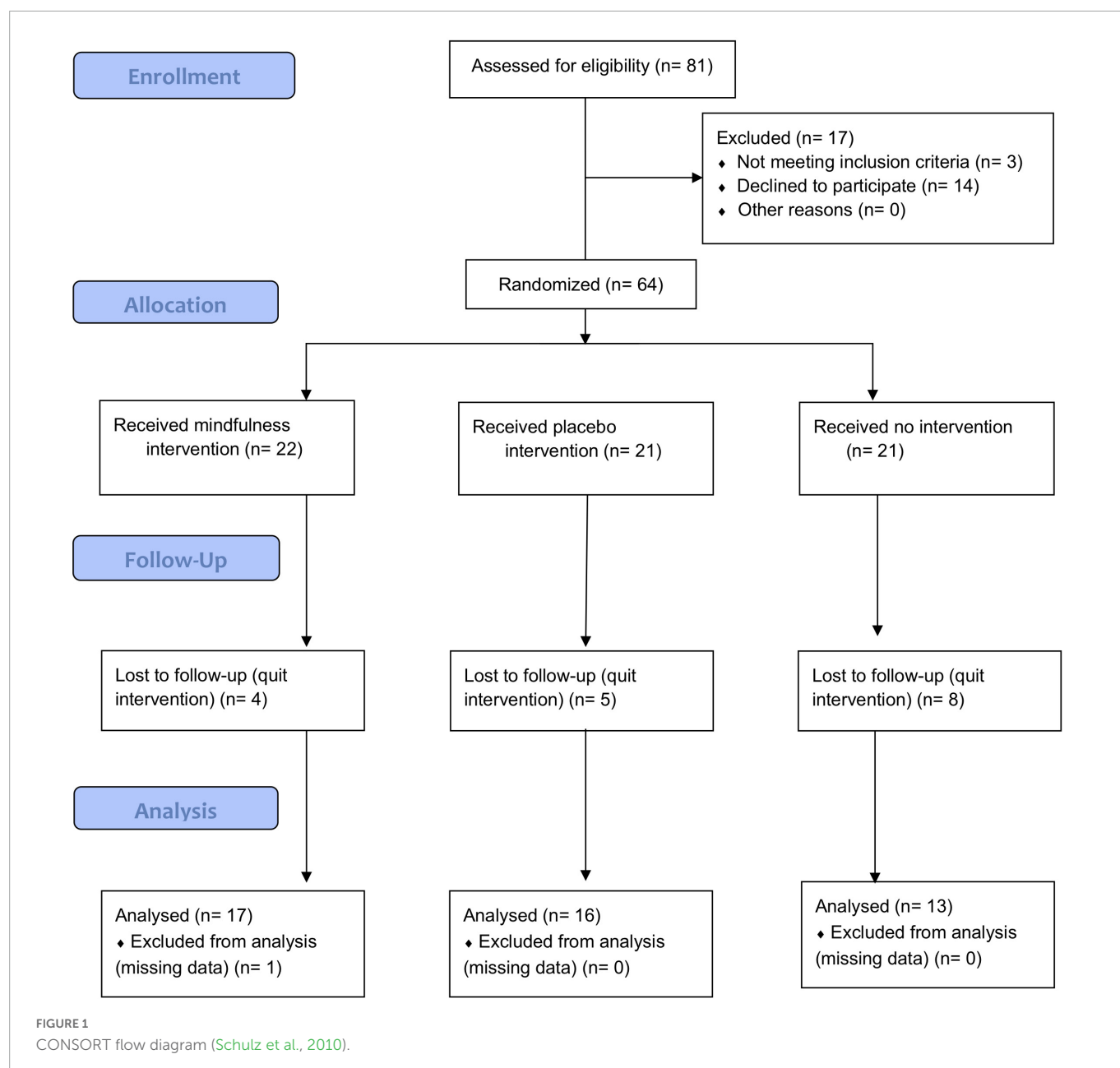


TABLE 1 Demographic variables of participants in three groups.

Variable	Classification	Group A (N = 17)		Group B (N = 16)		Group C (N = 13)	
		Total		Total		Total	
		N	%	N	%	N	%
Gender	Male	6	35.3	7	43.8	3	23.1
	Female	11	64.7	9	56.3	10	76.9
Age	15–18	1	5.9	0		0	
	19–23	15	88.2	5	31.3	10	76.9
	24–28	1	5.9	9	56.3	2	15.4
	29–35	0		2	12.5	0	
	36 or above	0		0		1	7.7
Education level	High school	0		1	6.3	2	15.4
	College or University	7	41.2	6	37.5	10	76.9
	Graduate School	10	58.8	9	56.3	1	7.7

In terms of the mindfulness intervention, the 14-day MBSR training paradigm was used in the study. In previous interdisciplinary studies, the short-period mindfulness training was 56, 30, 14, 10, or 7 days (Kral et al., 2018; Kudesia et al., 2022; Liu et al., 2022). The 14-day training was widely accepted and adopted to reduce social anxiety disorders (Papenfuss et al., 2022) and to enhance bonding through love, openness, and opportunity (Shreffler et al., 2019). The training continued for 10 min each day, with the introduction, breathing training, awareness meditation, body scanning, and the concluding section.

## Stimulus materials

Negative news coverage on global climate change and crisis served as emotional stimulus reading material in this study. The Depression-Anxiety-Stress Scale (DASS) was used for reading material measurement to ensure it would effectively arouse negative emotions. Four pieces adapted from original news were included to avoid single-material bias. The stimulus material was approximately 15,000 words in length, and it took the participants approximately 20 min to read the full text carefully. The same material was used in both the pre-test and post-test of the experiment.

Climate change or global warming issue has long encountered a sensitive “consensus gap” (Cook, 2016; van der Linden, 2022). In some social milieus, the public regard it as controversial or even skeptical of politically laden information dissemination, whereas in another social context, such as among the Chinese public, the situation is more widely accepted (Mou and Ke, 2022). However, there was bad information exploiting and linking it to fatalistic feelings, such as the above sea level or heat stroke caused by climate warming being the suggestion of humans being endangered, causing public fear, anxiety, and depression by repeatedly and virally spreading.

This type of information was referred to as negative news or bad information in the reading materials in this study. There were distinctions among fake news, including misinformation, disinformation, mal-information, and bad information. The first is unintentional false information. The latter three types contain deliberate manipulation, where mal-information is with real news but cherry-picking changes (Adams, 2022), and bad information refers to negative news with true information but harmful objectives (Wardle and Derakhshan, 2017). Bad information or negative news appeals to the uncertainty of the public, resulting in the illusory truth effect in the chain of repeating, rephrasing, and forwarding information (Wang et al., 2016) and even ethical and moral anxieties.

## Questionnaires

In the pre-test and post-test, the Five-Facet Mindfulness Questionnaire (FFMQ), the PANAS, and the Depression-Anxiety-Stress Scale (DASS-21) were applied.

First, trait mindfulness was assessed by the FFMQ, including 39 items representing five factors (Baer et al., 2006): observing items, acting aware items, describing items (such as putting thoughts, beliefs, and expectations into words), non-reacting items (such as watching feelings without getting confused), and non-judging items. A Likert scale ranging from 1 (rarely) to 5 (completely) was used

to measure the degree of self-statement suitable to the participants' conditions. The Chinese-adapted version of FFMQ (Deng et al., 2011) suggested satisfied validity and test-retest reliability ( $r = [0.44-0.74]$ ). The internal consistency in this study was good (Cronbach's  $\alpha = 0.89$ ).

Second, negative emotional arousal, the negative affect (NA) scale in PANAS (Watson et al., 1988) was used to evaluate subjective distress and negative emotions. The items contain negative adjectives, and a Likert scale ranging from 1 (very unlikely) to 5 (very strongly) was used to measure the extent to which the participants experienced the emotions described by these words. The Chinese-adapted version of PANAS (Qiu et al., 2008) suggested satisfied validity (Cronbach's  $\alpha = 0.89$ ) and test-retest reliability ( $r = 0.47$ ). The internal consistency in this study was good (Cronbach's  $\alpha = 0.87$ ).

The DASS-21, which was compiled by the original DASS (Lovibond and Lovibond, 1995), kept the three dimensions of depression-anxiety-stress with seven items each while improving the efficiency of assessing related mood disorder symptoms (Crawford and Henry, 2003). The participants were asked to report how frequently the self-statements they experienced, including depression items (such as no longer having pleasant and comfortable feelings), anxiety items (such as feeling hand tremors), and stress (such as difficulty calming down), with a Likert scale ranging from 0 (none) to 3 (most frequently). The Chinese-adapted version of DASS-21 (Gong et al., 2010) suggested satisfied validity. The internal consistency in this study was good (Cronbach's  $\alpha = 0.95$ ).

## SC-IAT procedure

The SC-IAT was designed to measure the implicit attitudes of a particular category (Karpinski and Steinman, 2006) and proved to have sufficient reliability in many fields (Bluemke and Friese, 2008; Stieger et al., 2010). The test procedure contained two tasks, compatible and incompatible, and four blocks, with 24 trials for practice and 72 trials for the formal test, respectively. Each trial contained 30 stimuli words (shown in Table 2).

In the experiment, words related to global climate change issues were set as target words. There were 21 positive words (e.g., beautiful, optimistic, bright, joy, and happy) and 21 negative words (e.g., ugly, pessimistic, dim, anguish, and upset), which were selected from the Chinese Affective Words System (CAWS). Before the formal experiment, 30 participants were recruited to test the representativeness of 14 target words using a five-point Likert scale, and seven target words ranked top 50% of the total score (e.g., greenhouse, rains, dust, drought, typhoon, heat waves, and the hail). The words recruited in the test were all two-character Chinese words.

TABLE 2 Experiment procedure of SC-IAT.

Block	Trials	Function	“F” key response	“J” key response
1	24	Practice	Positive words + climate word	Negative words
2	72	Test	Positive words + climate word	Negative words
3	24	Practice	Positive words	Negative words + climate word
4	72	Test	Positive words	Negative words + climate word

Each trial contained a 500-ms cross-dot gaze, a 1,500-ms display of words, and an 800-ms empty screen.

In the SC-IAT, the positive association (“target word + positive word”) was in blocks 1 and 2, and the negative association (“target word + negative word”) was in blocks 3 and 4. In positive association tasks, a random sequence of the words and different response ratios of the two keys “F” and “J” on the keypad were applied, where target words, positive words, and negative words were presented in a 7:7:10 ratio so that 58% of correct responses were on the “F” key and 42% of correct responses were on the “J” key. Meanwhile, in the negative association tasks, the presentation ratio of target words, positive words, and negative words was 7:10:7, so 42% of correct answers were on the “F” key and 58% were on the “J” key.

## Results

Repeated-measures ANOVA with the test as a within-subject factor (pre vs. post) and the condition group (mindfulness vs. placebo vs. control) as the between-subject factor was conducted to predict the trait mindfulness and emotional statement. The trait mindfulness and emotional arousal scores ( $M \pm SD$ ) are shown in **Table 3**. The conditions in the pre-test of three groups were taken as the baseline under news reading stimuli.

### Trait mindfulness

The FFMQ results revealed that the impact of the 14 consecutive days of MBSR intervention was valid in the mindfulness training group. As is shown in **Table 4**, the main effect of the condition group was significant [ $F(2, 43) = 4.5, p = 0.02, \eta^2_p = 0.17$ ], and the mindfulness group tended to have a higher score ( $M = 129.91, SD = 2.97$ ) than the control group ( $M = 116.39, SD = 3.40, p < 0.001$ ). In addition, there was a significant interaction effect between group and time [ $F(1, 43) = 3.73, p = 0.03, \eta^2_p = 0.15$ ]; see **Figure 2**. The *post hoc* analysis revealed that after the mindfulness intervention, there were significant differences between the mindfulness group

( $M = 137.71, SD = 3.58$ ) and the control group ( $M = 116.00, SD = 4.10, p < 0.001$ ), as well as the placebo group ( $M = 123.31, SD = 3.69, p = 0.01$ ). The main effect of time [ $F(1, 43) = 2.43, p = 0.13, \eta^2_p = 0.05$ ] was not statistically significant.

Furthermore, the findings of the FFMQ facets varied. First, observing facet, results showed that the interaction effect [ $F(2, 43) = 1.66, p = 0.20, \eta^2_p = 0.07$ ], as well as the main effects of the group [ $F(2, 43) = 1.10, p = 0.34, \eta^2_p = 0.05$ ] and time [ $F(1, 43) = 0.18, p = 0.68, \eta^2_p = 0.00$ ], were not significant.

Second, describing facet, the main effect of the group was significant [ $F(2, 43) = 5.99, p = 0.01, \eta^2_p = 0.22$ ]. The score was significantly higher ( $p = 0.003$ ) in the mindfulness group ( $M = 23.85, SD = 1.01$ ) than in the control group ( $M = 28.15, SD = 0.89$ ). The main effect of time [ $F(1, 43) = 0.15, p = 0.70, \eta^2_p = 0.00$ ] was not significant. The results revealed a significant interaction effect between group and time [ $F(2, 43) = 4.48, p = 0.02, \eta^2_p = 0.17$ ], and the *post hoc* analysis indicated that the score of the post-test ( $M = 26.59, SD = 1.22$ ) was significantly higher than the pre-tests ( $M = 29.71, SD = 1.05$ ) in the mindfulness group ( $p = 0.03$ ).

Third, acting with awareness, there was a significant difference between groups [ $F(2, 43) = 3.53, p = 0.04, \eta^2_p = 0.14$ ], and the score in the mindfulness group was significantly higher ( $M = 28.29, SD = 1.13$ ) than that in the control group ( $M = 24.15, SD = 1.30, p = 0.02$ ) and the placebo group ( $M = 24.88, SD = 1.17, p = 0.04$ ). The interaction effect [ $F(2, 43) = 0.23, p = 0.80, \eta^2_p = 0.01$ ] and the main effect of time [ $F(1, 43) = 0.09, p = 0.76, \eta^2_p = 0.00$ ] were statistically insignificant.

Fourth, the non-judging facet, the main effect of the group [ $F(2, 43) = 3.69, p = 0.03, \eta^2_p = 0.15$ ] and time [ $F(1, 43) = 6.72, p = 0.01, \eta^2_p = 0.14$ ] were both significant. The *post hoc* analysis revealed that the score in the mindfulness group ( $M = 23.68, SD = 0.76$ ) was significantly larger than that in the placebo group ( $M = 20.75, SD = 0.79, p = 0.01$ ). The post-test scored ( $M = 23.34, SD = 0.61$ ) higher than that in the pre-test ( $M = 20.79, SD = 0.74$ ). The interaction effect was not statistically significant [ $F(2, 43) = 1.14, p = 0.33, \eta^2_p = 0.05$ ].

Finally, the facet of non-reactivity, the main effect of time [ $F(1, 43) = 4.57, p = 0.04, \eta^2_p = 0.10$ ] was significant, and the score of post-tests ( $M = 22.31, SD = 0.61$ ) was higher than that in the pre-test

TABLE 3 The trait mindfulness and emotional arousal scores in three condition groups ( $M \pm SD$ ).

	Mindfulness group ( $n = 17$ )		Placebo group ( $n = 16$ )		Control group ( $n = 13$ )	
	Pre	Post	Pre	Post	Pre	Post
Observing	26.94 $\pm$ 4.85	29.29 $\pm$ 4.74	28.56 $\pm$ 5.50	27.63 $\pm$ 4.30	26.31 $\pm$ 4.66	25.92 $\pm$ 5.62
Describing	26.59 $\pm$ 5.77	29.71 $\pm$ 3.62	28.31 $\pm$ 4.24	27.25 $\pm$ 4.65	25.38 $\pm$ 4.82	22.31 $\pm$ 4.70
Acting aware	27.47 $\pm$ 7.32	29.12 $\pm$ 4.09	25.19 $\pm$ 6.43	24.56 $\pm$ 7.58	24.00 $\pm$ 7.22	24.31 $\pm$ 7.51
Non-judging	22.59 $\pm$ 5.66	25.94 $\pm$ 3.42	20.13 $\pm$ 5.01	21.38 $\pm$ 4.30	20.85 $\pm$ 5.55	22.69 $\pm$ 4.55
Non-reacting	19.71 $\pm$ 3.02	23.65 $\pm$ 1.90	22.19 $\pm$ 4.12	22.50 $\pm$ 5.94	20.23 $\pm$ 4.30	20.77 $\pm$ 3.37
FFMQ total score	122.12 $\pm$ 14.74	137.71 $\pm$ 11.62	124.38 $\pm$ 16.63	123.31 $\pm$ 15.43	116.77 $\pm$ 18.97	116.00 $\pm$ 17.44
Negative affect	17.88 $\pm$ 4.64	15.06 $\pm$ 3.80	14.81 $\pm$ 5.11	18.00 $\pm$ 7.93	15.69 $\pm$ 5.59	16.92 $\pm$ 6.05
Stress	13.41 $\pm$ 5.00	10.47 $\pm$ 2.27	14.88 $\pm$ 5.14	15.50 $\pm$ 6.46	13.46 $\pm$ 4.75	13.62 $\pm$ 3.84
Anxiety	11.53 $\pm$ 4.09	10.35 $\pm$ 3.08	13.44 $\pm$ 5.10	13.38 $\pm$ 5.37	12.00 $\pm$ 4.43	11.23 $\pm$ 2.49
Depression	11.47 $\pm$ 3.86	9.24 $\pm$ 2.19	13.44 $\pm$ 5.34	13.38 $\pm$ 5.58	13.00 $\pm$ 5.20	13.00 $\pm$ 4.38
DASS total score	36.41 $\pm$ 12.08	30.47 $\pm$ 7.19	41.75 $\pm$ 14.71	42.25 $\pm$ 16.71	38.46 $\pm$ 13.45	37.85 $\pm$ 9.76

FFMQ, Five-Facet Mindfulness Questionnaire; negative affect was from The PANAS (Positive and Negative Affective Scale); stress, anxiety, and depression were from DASS-21 (Depression Anxiety Stress Scale).

TABLE 4 Statistical results of group and time in FFMQ, PANAS, and DASS-21.

	Main effect of condition group			Main effect of test time			Interaction effect of group × time		
	$F(2, 43)$	$p$	$\eta^2_p$	$F(1, 43)$	$p$	$\eta^2_p$	$F(2, 43)$	$p$	$\eta^2_p$
Observing	1.10	0.34	0.05	0.18	0.68	0.00	1.66	0.20	0.07
Describing	5.99	0.01	0.22	0.15	0.70	0.00	4.48	0.02	0.17
Acting aware	3.53	0.04	0.14	0.09	0.76	0.00	0.23	0.80	0.01
Non-judging	3.69	0.03	0.15	6.72	0.01	0.14	1.14	0.33	0.05
Non-reacting	1.32	0.28	0.06	4.57	0.04	0.10	2.64	0.08	0.11
FFMQ total score	4.5	0.02	0.17	2.43	0.13	0.05	3.73	0.03	0.15
NA negative affect	0.00	0.99	0.00	0.40	0.53	0.01	4.80	0.01	0.18
Stress	3.65	0.03	0.15	0.55	0.46	0.01	1.41	0.25	0.06
Anxiety	2.20	0.12	0.09	0.84	0.37	0.01	0.21	0.81	0.01
Depression	4.65	0.02	0.18	0.61	0.44	0.01	0.60	0.56	0.03
DASS total score	2.06	0.14	0.09	3.21	0.08	0.07	3.36	0.04	0.14

FFMQ, Five-Facet Mindfulness Questionnaire; negative emotion (NA) was from PANAS (Positive and Negative Affective Scale); stress, anxiety, and depression were from DASS-21 (Depression-Anxiety-Stress Scale).

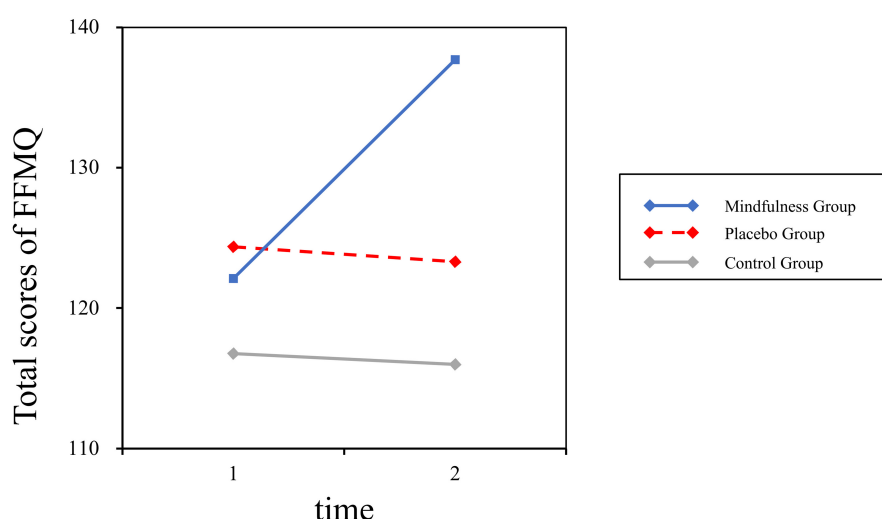


FIGURE 2

Interaction effect of group and time on the FFMQ.

( $M = 20.71$ ,  $SD = 0.57$ ). The main effect of the group [ $F(2, 43) = 1.32$ ,  $p = 0.28$ ,  $\eta^2_p = 0.06$ ] and the interaction effect [ $F(2, 43) = 2.64$ ,  $p = 0.08$ ,  $\eta^2_p = 0.11$ ] were statistically insignificant. Therefore, the effect of MBSR intervention on improving trait mindfulness was proved effective on the whole, especially in facets of describing, acting awareness, and non-judgment.

## Emotional arousal

As for the NA of PANAS, it was shown that the interaction effect of group and time was significant [ $F(2, 43) = 4.80$ ,  $p = 0.01$ ,  $\eta^2_p = 0.18$ ]. The *post hoc* analysis indicated that in the mindfulness group, the negative affect in the post-test ( $M = 15.06$ ,  $SD = 1.49$ ) was significantly ( $p = 0.03$ ) lower than that in the pre-test ( $M = 17.88$ ,  $SD = 1.23$ ), and comparatively, in the placebo group, the negative affect in the post-test ( $M = 18.00$ ,  $SD = 1.53$ ) was moderate significantly ( $p = 0.05$ ) higher than in the pre-test ( $M = 14.81$ ,

$SD = 1.27$ ), which indicated the mindfulness training effectively reduced negative affect of bad information coverage.

For DASS-21, the main effects of condition group [ $F(2, 43) = 2.06$ ,  $p = 0.14$ ,  $\eta^2_p = 0.09$ ] and test time [ $F(1, 43) = 3.21$ ,  $p = 0.08$ ,  $\eta^2_p = 0.07$ ] were not significant. The interaction effect was significant [ $F(2, 43) = 3.36$ ,  $p = 0.04$ ,  $\eta^2_p = 0.14$ ], shown in Figure 3. The *post hoc* analysis showed that in the post-test, the score in the mindfulness group ( $M = 30.47$ ,  $SD = 2.90$ ) was significantly lower ( $p = 0.01$ ) than that in the placebo group ( $M = 42.25$ ,  $SD = 2.99$ ). Furthermore, the score in the mindfulness group was significantly lower than that in the placebo group in both stress ( $p = 0.03$ ) and depression evaluation ( $p = 0.02$ ).

## Implicit attitudes

The primary IAT indicator is the *D*-score, which reflects the difference between the mean response times for compatible and

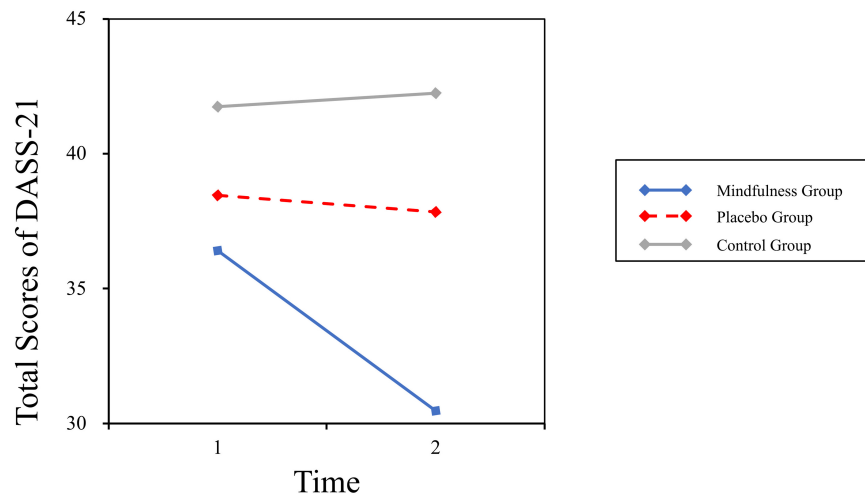


FIGURE 3

Interaction effect of group and time on DASS-21.

incompatible trials (ranging from  $-2$  to  $2$ ). It suggested that the more implicit associations one feels, the quicker categorizing of the compatible pairing (Greenwald et al., 2003). The SC-IAT results showed that the main effect of the condition group was not statistically significant [ $F(2, 43) = 0.30, p = 0.74, \eta^2_p = 0.01$ ], while there was a higher  $D$ -score in the mindfulness group than that in other groups (mindfulness group  $0.39$  vs. placebo group  $0.28$  vs. control group  $0.27$ ). The higher  $D$ -score indicated better positive implicit attitudes in climate change expectations or full awareness and self-regulation for future preparation or confidence. However, it was not statistically significantly proven that mindfulness training altered mind patterns and cognitive bias from negative to positive.

## Conclusion

This study aimed to explore the effect of mindfulness in the new media field from the perspective of positive intra-personal communication by conducting a 14-consecutive-day mindfulness intervention experiment. The hypotheses that MBSR training can considerably improve mindfulness traits, such as attention focus and consciousnesses, as well as mitigate the negative effect of bad information coverage, were proven. While the following hypothesis, that mindfulness intervention can impose a positive impact on current tolerance and future expectations on controversial issues, was not significantly proven in the implicit attitudes test.

The study found that MBSR training improved trait mindfulness effectively in describing, acting aware, and non-judging factors. Furthermore, in congruent with the previous studies, the increase in trait mindfulness also facilitates decreasing subjective distress (Carmody et al., 2008; Shahar et al., 2010; Carpenter et al., 2019) and better recovery following initial reactivity to stressors (Fogarty et al., 2015). In the experiment, the mindfulness training group significantly reduced NA, which indicated that the MBSR intervention could decrease subjective distress and negative emotion caused by reading negative news on global climate change. The underlying mechanism can be that mindfulness practice increases individuals' attention focus and awareness of their emotional states, thus improving attention control and switching, rumination, and emotion regulation

(Chambers et al., 2008; Goldin and Gross, 2010; Hill and Updegraff, 2012).

## Discussion

To this end, mindfulness intervention has proved significant in the perspective of intra-personal communication and positive psychology. Previous studies demonstrated that mindfulness intervention has a potential role in enhancing positive emotions, such as happiness and meaningfulness, inner peace, and subjective wellbeing, such as self-compassion, awareness, self-efficacy, and other positive emotions (Liu et al., 2015, 2022a; Ivtzan et al., 2016). Nonetheless, individual and cultural habitus differences may moderate the effect. For instance, in Confucian culture, the value of introspective awareness, inner peace, and non-judging can be more attached than stimulus-driven pleasures (Wallace and Shapiro, 2006; Chiesa and Malinowski, 2011).

Given the reduced stress and depression after the MBSR training, this study found the practical implications of MBSR training in positive reappraisal and mental resilience in the media environment. Because FFMQ does not imply positive attitudes in general, this finding may help to dispel the misconception about mindfulness as a state of non-doing and relaxation (Huston et al., 2011). According to the broaden-and-build theory (Fredrickson, 2004), the state of mindfulness appears to have a positive valence impact on how we interpret our daily events and could be viewed as the initial phase in the reappraisal process (Garland et al., 2009).

In addition, mindfulness can work on individual mind patterns, which improves information exchange and communication modes between individual and external media environments. Effective intervention can alleviate the individual's need for closeness and gain openness and innovation to the existing cognitive schema (Fiske and Linville, 1980), which was proved to be molded by media news frames and attributions (Entman, 1993; Pan and Kosicki, 2005). In the post-pandemic era, the public is exposed to massive (mis)information, overloaded with mostly negative information and emotion to perceive and



process, causing individuals to lose awareness and judgment bias, leading to information exhaustion and even avoidance. The two components of trait mindfulness, self-regulation and present-moment consciousness (Bishop et al., 2004), can be beneficial in this perspective.

Furthermore, though the hypothesis of implicit attitudes toward the current tolerance and expectation of global climate change remained no different in this experiment, mindfulness training can be a dynamic cognitive process (Kabat-Zinn, 2003; Mikulas, 2011). In a recent study, the trait mindfulness significantly predicted less perceived severity and facilitated the participants to gain self-regulation and protection after the traumatic experience, showing positive confidence about post-pandemic healthy lives (Liu et al., 2022). MBSR intervention may have an influential impact on the not explicit but implicit attitudes toward negative information. Previous studies revealed that mindfulness training focused more on the present status, thus decreasing the capability of imaging the future possibilities and uncertainties in decision-making (Karelaia and Reb, 2015; Yuan et al., 2022) and does not influence rationalized knowledge hiding (Liu et al., 2022c), while other scholars argued that participants increased open-minded behaviors, creative thinking, performance, and metacognitive skills (Guo et al., 2018; Chen et al., 2022; Mitsea et al., 2022). In global climate change issues, in particular, connectedness with nature played a promising mediating role in mindfulness training and climate belief change (Wang et al., 2019). Thus, whether the extent to which MBSR training improved attention focus and regulation can influence attitudes and expectations over a longer period of intervention, such as lifetime self-training, or by a more complex moderation or mediation, such as social and nature connectedness, still awaits future empirical research.

## Limitations and implications

This leads us to the potential limitations and implications of this study. First, while the 14-day training modes successfully cultivate trait mindfulness, and previous studies have shown that there was no significant difference between single brief and long-term mindfulness interventions (Parsons et al., 2020), two facets observing and non-reacting remained unchanged; thus, further studies on 56-day training or longer are being considered. In addition, while online mindfulness and some mobile health applications have been shown to extend the effect in the positive intervention (Liu et al., 2022d), the restriction would be solved by repeated measures analysis, and further offline training exploration would be required.

Second, trait mindfulness, which was measured validly and reliably by FFMQ in previous and present studies, is proven different from state mindfulness, and evoking state mindfulness can predict and increase trait mindfulness in the trajectory of improving psychological positiveness (Vago and Silbersweig, 2012; Kiken et al., 2015), leading to a mediating effect design and test for further experiments.

Third, some studies have indicated the cognitive changes in brain signals such as N2 and P3 amplitudes, and amygdala activity during mindfulness meditation (Atchley et al., 2016; Kral et al., 2018; Klee et al., 2020), which also awaits subsequent cognitive neuroscience and communication research. Moreover,

due to experimental methods and challenging differential attrition in the real-state psychological intervention (Graham and Donaldson, 1993), the external ecological validity of this study remained limited in explaining issues at the media and society levels. Meanwhile, second-generation interventions such as mandala art coloring games and loving-kindness meditation were as well proved to be effective (Liu et al., 2019; Xi et al., 2022) in mindfulness and anxiety reduction. Thus, the MBSR training paradigms need to improve in this permanent-online media society and post-truth infodemic communication environment.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

The studies involving human participants were reviewed and approved by Ethics Review Committee at the School of Journalism and Communication, Beijing Normal University. The patients/participants provided their written informed consent to participate in this study.

## Author contributions

YY, HL, and XL designed the experiment. HL recruited the participants. XL worked on the reading materials. HL, FS, and XL conducted in the mindfulness training. FS collected and analyzed the scales and SC-IAT data. YY and FS wrote the manuscript. All authors participated in this study.

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## Conflict of interest

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

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