Behavioral processes in online identity-related issues

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Behavioral processes in online identity-related issues

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Editorial: Behavioral processes in online identity-related issues

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Editorial on the Research Topic
Behavioral processes in online identity-related issues

The advent of Internet-based new media has introduced a level of anonymity, making it a pivotal space for individuals to construct their identities. As media technologies advance, cyberspace is transitioning from a temporary escape to a new normal. Identity-related issues have emerged as a significant focus in interdisciplinary Internet research. Online identity, a complex social-psychological phenomenon, has garnered widespread attention from researchers across various fields. As we progress into the latter stages of Internet development, bolstered by emerging information technologies, digital media plays a crucial role in shaping identity, influencing online behavior, and guiding individuals to present specific personas. It is necessary to delve into the topics in the context of the behavioral processes in online identity related fields.

At first, privacy protection and information security in online identity construction. In social media, identity construction takes place through activities such as information sharing, self-disclosure, profile setting, and social interaction. These activities, however, can introduce significant privacy and security risks. The rapid dissemination of information heightens uncertainty, as the abstract nature of online identities and the widespread sharing of personal information make it difficult to distinguish between reality and fiction. The asynchronous and transcendent nature of online social interactions blurs the lines between private and public domains. Moreover, the simultaneous demands for justice and occurrences of online violence, such as doxing and online aggression, further threaten privacy and security. "Mindful sharenting" has become a strategy to balance sharing and protecting information, with privacy risks varying based on social context (Walrave et al.). Understanding these behaviors helps elucidate the strategies people use to protect privacy and security. Privacy concerns can inhibit social media participation, manifesting as lurking, fatigue, and self-withdrawal. Developing measurement tools is essential for quantitative research on these psychological manifestations (Chen and Yu). Misinformation is a significant challenge in the new media era, necessitating research into what motivates people to fact-check information and how they assess credibility, with cultural identities playing a notable role (Gottlieb et al.). Therefore, discussions surrounding privacy and information security protection must tackle the inherent advantages and threats that arise from the behavioral processes involved in online identity formation.

Next, identity construction and dynamics in online space. The online realm offers possibility for individuals to explore and express different aspects of their identity. Online interactions, feedback, and experiences can shape and alter an individual's digital identity over time. Social media platforms provide new tools and environments for identity formation and enactment (Bergs et al.). Influencers attract followers by presenting information (Tang et al.), and virtual idol fans actively participate in value co-creation, enhancing interpersonal interactions in online spaces (Wang et al.). This dynamic makes the identification between influencers and their audiences more robust in online space.

Additionally, functional support for specific identity. Online spaces provide and create connection mechanisms that enhance social accessibility for groups. This enables marginalized communities to find support and build connections with like-minded individuals (Xu and Zhang). Consumers can better meet their needs with the help of online information shaped by the consuming interaction model (Zhao et al.), fostering the formation of their identities. Emerging information technologies enhance the functionality of social media, with streaming content providing an immersive and vivid interactive experience, allowing different groups to realize their self-perception on platforms like TikTok (Zhu et al.). In the end, the functional support provided by social media has become an important mechanism for building different types of identities for various social groups across diverse fields.

Addressing the opportunities and challenges presented by identity issues in the virtual world, this Research Topic invites contributions from diverse conceptual and theoretical perspectives. The nine articles featured in this Research Topic delve into the topic from different angles, employing diverse methods including qualitative research, quantitative research, and mixed methods studies. Each approach showcases its unique strengths and insights. The theories employed in these studies span across various disciplines within the humanities and social sciences, highlighting the interdisciplinary nature of this topic. In today's increasingly complex online environment, multi-faceted discussions on online identity issues are of paramount importance. The editing of this Research Topic has been supported by the China National Social Science Fund project "Online Social Anonymity and Privacy Security Protection" (21BSH050). As online media enter the age of AI, there is no doubt that the construction of online identities and related research fields require further expansion and exploration.

Author contributions

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Check for updates

Mindful sharenting: how millennial parents balance between sharing and protecting

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Background: Sharenting, parents' sharing of personal information about children on social media is becoming increasingly controversial. Its potential risks have drawn some parents to engage in mindful sharenting: parents' application of strategies to reduce the potentially negative effects of sharenting, as they are aware of the impact sharenting can have on the child's privacy.

Objective: This study aims to investigate parents' motives for engaging in mindful sharenting, the strategies they implement and how relatives and acquaintances react.

Methods: In-depth interviews were conducted with eight mother–father dyads in Belgium. At least one of both respondents had to be born between 1980 and 2000 (i.e., millennial parents), having a child aged between 0 and 6 years. Conversations were transcribed ad verbatim, coded in Nvivo, and were analyzed thematically.

Results: The reasons leading parents to engage in mindful sharenting were previous negative experiences they encountered or heard of from acquaintances. In addition, parents aimed to safeguard their child's privacy and prevent any misuse of their identity or any other forms of aggression. Furthermore, certain parents wish to grant their children the freedom to choose which media content about them is shared online at a later stage in life. As parents are aware of potential benefits of sharenting, they employ strategies to ensure their child's privacy, while still enjoying the benefits sharenting offers them. These strategies include photographing the child from a distance, the child looking away from the camera, focusing only on a body part, covering the face with an emoticon, blurring the face, or cutting recognizable parts from the photo. However, parents engaging in mindful sharenting are also confronted with questions and negative comments from family members and acquaintances. This makes them feel like they must justify their decision. Moreover, they are sometimes confronted with family members posting identifiable pictures of their child, which leads to privacy turbulence, and parents having to clarify and renegotiate the privacy boundaries concerning image sharing.

Conclusion: Parents deciding to engage in mindful sharenting engage in several strategies to balance between the opportunities sharenting can offer them, the social pressure they experience to post child-related updates, and their objective to protect their child's privacy. However, some parents face criticism, making them feel pressured to justify their decision and having to clearly explain to family members not to make identifiable pictures of their child available online.

1. Introduction

Parenting is a life-changing experience that impacts parents' individual and social life. The joy, questioning, and issues young parents experience are increasingly also shared online. When parents engage in divulging personal information, e.g., photos, videos, status updates concerning their child, they engage in "sharenting", a merge between "sharing" and "parenting" (Brosch, 2018). In general, 82% (U.S.) parents declare to have posted information about their children on social media (Auxier et al., 2020). Other research focused on children's involvement in parents' decision to engage in sharenting. Research has found that 20% of European children's (aged 12–16) parents or carers shared personal information about them on social media without asking (Smahel et al., 2020). However, some studies also found parents reflecting on the consequences of disclosing personal information about their child (Cino and Wartella, 2021; Walrave et al., 2022). Some parents take a critical stance towards sharenting and adapt their behavior by not sharing personal identifiable information of their child or by adopting privacy-protecting strategies when engaging in sharenting (Ammari et al., 2015; Autenrieth, 2018). However, until now, research mainly concentrated on parents' sharenting motives (Latipah et al., 2020), and on adolescents' perception of their parents' motives and behavior (Lipu and Siibak, 2019; Ouvrein and Verswijvel, 2019; Verswijvel et al., 2019; Walrave et al., 2022). Scarce research focused on parents' critical attitude towards sharenting and its influence on their sharenting behavior as a consequence (Davidson-Wall, 2018). The present study therefore strives to tackle this gap in the literature by investigating why, as well as how, parents decide to engage in sharenting while at the same time minimizing sharenting-related risks by exerting privacy-protective strategies. Moreover, as sharenting within an online networked environment makes children's personal information available to online contacts, the recipients can also share this information with a wider audience. Therefore, we also investigate how parents engage in strategies to limit the audience of the sharented content and negotiate the limits of further transmission of the child's personal information with online contacts (e.g., family members) that were granted access. Overall, investigating parents' privacy-protective strategies is relevant as the practice of sharenting contributes to the formation of the child's online identity (Steinberg, 2017). Further, examining parents' boundaries towards sharenting is meaningful as sharenting increasingly has become part of online family communication (Damkjaer, 2018).

1.1. Transition to parenthood

Becoming a parent is considered one of the most difficult adjustment periods (Bartholomew et al., 2012). Although it brings pleasure and affection, parents feel they must perform and meet societal expectations (Collett, 2005). Moreover, caring for the child leaves parents with less time for social contact and leisure activities. As a result, new parents often experience social isolation (Brosch, 2016). Sharenting can contribute to parents' social capital, resources that are built through relationships with others. Social capital is crucial for new parents to adjust to parenthood (Bartholomew et al., 2012). Two forms of social capital can be discerned: bonding and bridging social capital. Bonding social capital exists within networks with strong ties, and involves a high degree of trust, intimacy, and emotional support (Davidson-Wall, 2018). Especially family and close friends provide this form of connective social capital. Bridging social capital occurs within networks of weak ties and is primarily based on gaining new perspectives and information (Putnam, 2000). For example, acquaintances made through social network sites, colleagues, and other individuals met in professional, or leisure activities are responsible for bridging social capital. These ties also include online contacts with other parents who simultaneously or recently went through the transition to parenthood and can thus share useful information with each other. Expectant and new parents find and support each other increasingly on online platforms which can serve as resources for new parents to deal with the high demands of parenting (Bartholomew et al., 2012).

1.2. Conflicting self-presentation

In addition to the need for social support, advice, and belonging, parents turn to social media for self-representation (Blum-Ross and Livingstone, 2017). They do this by presenting themselves on social media based on the personal data they share, and how they present this information online (Holiday et al., 2022). However, parents experience a tension between the presentation of the "individual self," i.e., the parent as an individual, and the "relational self," i.e., the role as a parent exercised with and for their children and family, and in the face of the (online) community they are integrated into (Blum-Ross and Livingstone, 2017). Parents' individual online self-representation is a reflexive practice where every decision regarding one's identity can be seen and can be controlled. These decisions concerning the online image that parents want to portray of themselves can be seen as a form of impression management. Impression management assumes that people have some degree of control over the way in which they are perceived by the public (Leary, 2001). This is usually guided by desires about how one would like to be and how one is expected to be, based on social roles one performs in society (Ouvrein and Verswijvel, 2019). Parenting is one of the social roles which guides one's self-representation (Collett, 2005). By sharing information online about their children, family activities, and how they cope with the challenges of parenthood, parents seek to demonstrate their parenting competencies (Walrave et al., 2022). This is referred to as indirect self-representation, where individuals use others with whom they are closely related, such as in this case their children, to shape their own representation (Ouvrein and Verswijvel, 2019). Parents further engage

in sharenting as they want to share important and mundane moments of their child's life. Parents often illustrate how their child grows and changes physically as well as how it performs in school or spare time related activities (Brosch, 2016). They also emphasize milestones of their child's life, such as birthdays, graduation, family holidays and other common activities (Kumar and Schoenebeck, 2015). Their child's digital visual narrative is created and shared with family members and acquaintances. By doing so, parents chronicle their child's development for current online contacts to view and comment on, but also to cherish these memories for the future. Parents also want to show their pride and highlight important events and accomplishments for their online contacts to witness. They also post these achievements and family moments online to show the role they play as a parent, and to feel supported and validated through the comments and likes they receive (Kumar and Schoenebeck, 2015; Blum-Ross and Livingstone, 2017; Davidson-Wall, 2018; Walrave et al., 2022).

However, by posting personal information about their children, parents also shape the digital presence and identity of their children before they themselves are active on social media (Latipah et al., 2020). This parental impression management of the child is potentially at odds with the child's developmental task to build an autonomous identity (Davidson-Wall, 2018). However, the online identity which parents form for their children through sharenting, may not align with how adolescents want to represent themselves online. Therefore, young people may engage in privacy management strategies, protecting personal information so parents or others may not access and further transmit specific information (Verswijvel et al., 2019; Walrave et al., 2022).

Privacy management strategies and impression management are, however, in a dialectical relationship because the information that is suitable for self-representation may be information that can harm the individual's privacy the most. The trade-off between the two becomes increasingly difficult when individuals share personal information with multiple, asynchronous audiences in online environments, where the boundary between public and private is increasingly blurred (Picone, 2015). According to research, the merging and collapsing of social spheres on social media can cause some conflict in the account of the holder's perception (Binder et al., 2009; Marwick and Boyd, 2011). This tension results from the challenge of concurrently deciding which personal information is suitable to transmit across various social realms. To mitigate risks of personal data disclosure on platforms where different social circles are co-present, users can employ several strategies, such as: the use of privacy settings to differentiate the level of access to one's data between social media contacts, choosing particular communication channels to disclose specific information to specific contacts (e.g., instant messaging apps instead of social network sites), avoiding conflicts of context by not disclosing information and thereby employing self-censorship, or discussing clearly with others not to further transmit the entrusted information (Lampinen et al., 2009; Walrave et al., 2012; Heirman et al., 2016).

1.3. Millennial parents

The potential conflicts between parents' sharenting and adolescents' self-presentation, may be influenced by parents' own online experiences. Parents could have grown up in a period before the development and rise of social media or, by contrast, could have been raised in the public's eye, as their parents engaged in sharenting. More particularly, sharenting may have a different context for millennial parents. These parents were born between 1980 and 2000, have grown up with social media (Latipah et al., 2020), and are therefore referred to as the digital natives (Autenrieth, 2018). As they become parents themselves and raise their children in a digital media culture, they can be stimulated to record and share activities digitally (Putri et al., 2021). Moreover, the creation of photographs and videos has improved tremendously over the years. In the analog era, the number of photographs was limited by the cost of production and the effort involved. Today, most phones include a high-quality camera, allowing parents to capture images of their children anytime, anywhere. This fleeting use is further strengthened by the long-lasting conservations and easy sharing of these images on social media (Prensky, 2001; Autenrieth, 2018). Moreover, today, sharenting is seen as the social norm in this digital age (Blum-Ross and Livingstone, 2017; Siibak and Traks, 2019). New parents are often encouraged to share images and stories of their own experiences as parents and details about their growing-up children (Blum-Ross and Livingstone, 2017). Therefore, managing and controlling the online flow of information related to both parenting and family life constitute a responsibility for parents (Kumar and Schoenebeck, 2015). Parents need to balance between privacy-protective behaviors, as they are the guardians of their children's personal information, the benefits sharenting has to offer them, and how to meet societal expectations (Wagner and Gasche, 2018). Millennial parents' motives to engage in sharenting center around getting affirmation and social support through likes and comments (Robiatul Adawiah and Rachmawati, 2021). This feedback confirms young parents in their competence in taking care of their children. As engaging in sharenting is normative among today's parents, young mothers have been found to indicate their online contacts make snap judgments when they deliberately choose not to engage in sharenting (Siibak and Traks, 2019). Some parents, therefore, indicate that they feel pressured by family and friends to share children's photos online (Ranzini et al., 2020).

1.4. Reactions against sharenting

At the same time, concerns have increasingly been voiced about sharenting's potential drawbacks. These can include both privacy and security risks. For instance, digital kidnapping is a phenomenon where a stranger steals photos of a minor from the Internet and posts these photos as if they were from his own child. Other research has observed how children's photos are plucked from social media platforms and then shared on child abuse image websites (Otero, 2017; Garmendia et al., 2021; Williams-Ceci et al., 2021). Furthermore, through sharenting, parents are forming their children's online identities without their consent (Steinberg, 2017). This can have a negative impact on the development of children's personalities (Verswijvel et al., 2019). Because children are widely portrayed by their parents, they do not have the opportunity to create their own online identity. For some children, the content that parents think is appropriate to share on social media may be sensitive, or some content may lead to negative reactions. As a result, children may face cyberbullying (Robiatul Adawiah and Rachmawati, 2021). Besides, images may stay

online or resurface later in the context of (potential) employers' cybervetting (Walrave et al., 2022). In sum, the choices parents make today may have long-term consequences for their children (Leaver, 2020).

Moreover, through sharenting, children may grow up holding a very different concept of privacy (Davidson-Wall, 2018). It may seem normal for some of them that their personal information is made public online. On the other hand, certain children who are growing up may become increasingly sensitive to their own privacy and the privacy of others when faced with their parents' sharenting. This sensitivity may arise from their firsthand experience of personal information being shared without their involvement in the decision-making process. As potential consequences of sharenting are increasingly discussed and sometimes become apparent for parents and children, sharenting is becoming subject to debate (Autenrieth, 2018). In some countries, awareness raising campaigns are informing parents about the potential drawbacks of sharenting, stimulating them to engage in privacy-protective strategies and, when possible, discuss the sharenting decisions with their child (Diebel, 2022).

1.5. From sharenting to mindful sharenting

Some parents are deliberately choosing not to share information about their child or, when they do, employ strategies to limit the risks of sharenting. Autenrieth (2018) describes this as "anti-sharenting", specific practices to make their child unidentifiable when sharing their pictures online. In the tension between the need to put pictures of their children online while leaving as few visual traces as possible, parents have developed new photo practices. For instance, parents focus on the photographic and spatial context of the image, rather than on the child. These practices allow them to show their children on social media while maintaining some form of anonymity (Davidson-Wall, 2018). In photography, this is also known as the "anti-selfie" (Tifentale and Manovich, 2018). In this type of photograph, the person in the selfie becomes part of a situation rather than being depicted as isolated.

However, we state that the concept anti-sharenting could signal something different than employing strategies to reduce the risks of sharenting, as the prefix "anti" is used to indicate someone is against someone or something (Cambridge Dictionary, 2023). Parents who choose to employ strategies to protect their child's privacy on social media, are still engaging in sharenting and, therefore, not necessarily opposed to it. By adapting the pictures, some parents ensure that their child(ren)'s privacy is not compromised while, at the same time, they can enjoy the benefits of sharenting (Wagner and Gasche, 2018). These parents cannot be seen as opponents of sharenting. Therefore, we propose to coin this behavior as "mindful sharenting", which consists of the application of strategies by parents to reduce the potentially negative effects of sharenting, as these parents are aware of the impact sharenting can have on the child's privacy. Moreover, this well thought-out form of sharenting is further inspired by the characteristics of "mindful parenting" a way of parenting that adheres to the principles of mindfulness (Geurtzen et al., 2015). Mindful parenting is characterized by five key aspects: (1) listening with full attention (paying quality attention and being able to accurately perceive what the child is trying to communicate), (2) nonjudgmental acceptance of the self and the child (appreciating the characteristics of

the child, acknowledging that there will be challenges, mistakes, and unmet expectations, but also setting clear standards for the child's behavior), (3) emotional awareness of oneself and the child (less dismissing and more responding to the emotional need of the child; correctly recognizing own and the child's emotions), (4) parenting in accordance with one's goals and values, and (5) compassion for oneself and one's child (positive affection in the parent–child relationship) (Shorey and Ng, 2021). In relation to mindful parenting, engaging in mindful sharenting can be inspired by specific goals and values that lead to parents' sharenting decisions. In doing so, parents are aware of their motives and purposes for engaging in sharenting as well as the impact sharenting can have on the child and themselves. They consider the potential consequences for their child and, depending on their child's age and agency, the child's own emotions and opinions before engaging in sharenting. In other words, the act of sharing or not information about their child is fuelled by parents' consciousness of their own objectives for engaging in sharenting and its potential impact on their child, now or in later life. Mindful sharenting therefore also includes privacy-mitigating strategies to lower the (short- and/or longer-term) risks of sharenting for their child.

The specific strategies parents can implement reduce the focus on the child and emphasize the photographic and spatial contexts of the images. There are five types of photographic practices that focus on making the child unidentifiable. First is the "disguised child" (Davidson-Wall, 2018), in which attributes such as a scarf or glasses are used to make the child unidentifiable (without specific photo processing). A second way is to photograph the child from a distance to make it less identifiable ("the faraway child") or photographed from behind and in a wider context ("the child from behind"). What also can be done is to photograph a specific body part of the child, such as a hand, or foot ("the parted child"). This will keep the child unrecognizable to unknown viewers. In addition to photographing only a particular body part, one can also choose to photograph the child when it is looking away from the camera. Finally, one can digitally edit the photo by using, among other things, an emoticon to cover the face ("the digitally processed child") (Davidson-Wall, 2018). Beyond the method of taking the photo and editing it, it is also important for some parents to avoid other potential identifying information. For example, some use only the initials of a child or a pseudonym. Parents can also adjust the reach of their social media posts. By using private groups on Facebook or Instagram, stories are shared with a select group of followers. Parents can also decide to share pictures through messaging apps such as WhatsApp or Messenger. Taken together, these strategies are employed by parents to mitigate the disadvantages of sharenting (Ranzini et al., 2020), while enjoying the benefits sharenting offers them (Autenrieth, 2018).

1.6. Communication privacy management theory

Parents' efforts to reflect on sharenting's consequences and, when possible, to include the child in the decision-making process concerning the sharing of information about the child, can be related to the Communication Privacy Management (CPM) theory (Petronio, 2002). In general, CPM theory helps to explain individuals' management of disclosing and protecting personal information (Petronio and Child, 2020). In the case of sharenting, it can shed light

onto how parents, children and family members, as social media users, evaluate their privacy needs and develop rules for social media use (Child and Petronio, 2015) and, in the present context, for engaging in sharenting (related) practices. A key tenet of CPM theory is that individuals believe they own personal information related to them, and have the right to control its dissemination. Ownership is symbolized by metaphorical privacy boundaries, wherein personal information is kept, or where others are brought into the privacy boundary, when they become (authorized) co-owners of the personal information (Child and Petronio, 2015). Applied to sharenting, parents decide which information of their (underage) child is disclosed online and with whom. Recipients become co-owners who, at their turn, control the information's further dissemination. In line with the theory, parents tend to establish rules about privacy boundaries, which the extended circle of family and friends must adhere to, in order to maintain ownership of personal information about the child (Cino and Dalledonne Vandini, 2020).

Parents' privacy rules may be formed through observation (e.g., of other parents' (over)sharenting) or their experience as a child, more particularly, their parents' sharenting practices and how it forged their vision and practices concerning sharenting. The establishment of these privacy rules, and their alignment among individuals, are an ongoing communication process in which there is a trade-off between the risks and benefits of disclosing information about the child (Walrave et al., 2022). Parents can use privacy rules to guide other co-owners of the child's personal information, to manage the access to this information. In sum, privacy boundaries are singular (around personal information of one person) as well as collective (when personal information is co-owned by others (e.g., family members)) (Petronio and Child, 2020). Privacy boundaries are managed through three types of privacy rules. First, privacy boundary linkage rules focus on decisions co-owners make concerning who else can know the personal information (applied to sharenting, parents stating their child's picture may not be transmitted to a specific family member). Privacy boundary permeability rules determine which type of information and how much information can be disseminated outside the set privacy boundary (e.g., adolescents asking their parents not to share pictures of them when they were a child or other pictures that they could find embarrassing). Finally, privacy boundary ownership or control rules determine the rights of co-owners to make their own decisions concerning the further dissemination of information (e.g., parents sharing photos in a private WhatsApp group, and asking its members to first ask them if they want to further transmit pictures to others) (Petronio, 2002; Child and Petronio, 2015; Petronio and Child, 2020). In other words, parents engaging in mindful sharenting may want to control co-owners' further dissemination of the entrusted child-related information. Therefore, they might more explicitly discuss with others the degree, or conditions, of privacy boundary permeability.

Yet, when privacy rules are not made clear, or openly discussed within the couple who raises the child, their family and circle of friends, there is a chance that privacy boundaries will be crossed. This can lead to privacy turbulence, which occurs when there is a violation, intentional or not, of the privacy rules, control or ownership that were established (Petronio, 2002). These privacy violations can affect the core of the relationship between friends or family members (Steuber and McLaren, 2015). In addition to the negative consequences and feelings related to these privacy breaches, it also provides an

opportunity to (re)explain or recalibrate the privacy rules, in order to prevent future privacy turbulence (Petronio and Child, 2020).

As demonstrated above, the process of engaging in sharenting can be situated and explained through CPM theory. Previous research has focused on negotiations between parents and adolescent children (Walrave et al., 2022). However, little is known about the decision-making process of young parents who decide to employ strategies to mitigate the disadvantages or risks of sharenting (Wagner and Gasche, 2018). Therefore, the present study focusses on the following research question: What are the motives of millennial parents (born between 1980 and 2000) with young children (0–6 years) to engage in mindful sharenting? (RQ1).

New parents are encouraged to share photos of their children online. However, the choices parents make, may have long-term consequences for their child(ren) (Leaver, 2015). Parents must thus, in this digital age, balance between privacy-protective behaviors to protect their child(ren) and enjoying the benefits sharenting offers them. The decision of young parents to engage in mindful sharenting may be fuelled by observing sharenting behavior of others or by their own experiences that led parents to discuss and reconsider their sharenting behavior. Therefore, the second research question of this study is: Which situations or observations have led to parents' decision to engage in mindful sharenting? (RQ2).

When they engage in sharenting, parents can employ different strategies to protect their child's online privacy (Autenrieth, 2018). In addition to applying strategies when photos are shot, parents can also choose to avoid sharing identifiable information. They also can limit the reach of these pictures on social media, by using private groups or limiting the reach of their posts through more stricter privacy settings. Moreover, parents can establish explicit and implicit rules to discern what can and cannot be posted online about their child (Ammari et al., 2015). This is not only important for the parents themselves, but also for the extended family so that they can understand and handle these rules (Cino and Dalledonne Vandini, 2020). To further investigate these strategies, this study also focuses on the following research question: What strategies do young parents who engage in mindful sharenting employ to protect their child's online privacy and how do online acquaintances react to it? (RQ3). More particularly, we investigate how parents negotiate with each other and family members the sharing of personal information concerning their child, considering how they engage in their child's privacy protection. In situations where parents' and family members' vision and practices conflict, how do they react when privacy turbulence occurs, and further discuss, or possibly, recalibrate privacy boundaries? (RQ4).

2. Methods

2.1. Participants

Eight semi-structured interviews with mother/father dyads (16 participants in total, mean age: 31) were conducted in Flanders, the Northern part of Belgium, between March and April 2022 (for an overview of the participants, see Table 1). Both the mother and father of the child(ren) were interviewed together to get insight in the mindful sharenting decisions they take as a couple. Participants were recruited through specific parental Facebook groups and acquaintances based on four criteria. At

TABLE 1 Background information of interview participants.

	Pseudonyms	Age	Profession	N of children	Age of children
Couple 1	Anne and Tim	28 and 28	Preschool teacher and forman	1	8 months
Couple 2	Karen and Johan	29 and 30	Speech therapist and insurer	1 (+pregnant)	2 years
Couple 3	Evelien and Frank	30 and 34	Branch manager and warehouseman	1 (+pregnant)	2 years
Couple 4	Lisa and Bruno	29 and 30	PhD Candidate and port worker	1	6 months
Couple 5	Tina and Mats	35 and 33	Actors	1	3 years
Couple 6	Sara and Daan	35 and 37	Officials	2	6 and 4 years
Couple 7	Elise and Joris	29 and 29	Nurse and educator	2	2 years and 5 months
Couple 8	Sanne and Tijs	30 and 30	Occupational therapist and service technician	2	2 years and 2 weeks

least one of both parents needed to be Flemish, had to be born between 1980 and 2000 (i.e., millennial parents), were parent of a child aged between zero and six and said to engage in mindful sharenting which the authors defined as limited and consciously sharing of information about their child(ren) on social media. Since the corona pandemic was not over yet, seven out of eight interviews took place online via Microsoft Teams. Interviews lasted on average 46 min. During the last interviews no new topics emerged from the conversations signalling that data saturation was reached, the point in the data collection when no supplementary insights or topics were identified and indicating that continuing to collect data would be redundant. The collected data captured the diversity, depth and nuances of the issues studied (Hennink and Kaiser, 2022).

2.2. Interview procedure

Interviews were audio recorded and proceeded as follows. First, the interviewer gave a brief introduction of the research topic. Respondents confirmed their voluntary participation and gave their permission to make an audio recording. The interviewer also reminded the couples that they had the right to stop the interview at any time. The participating couples signed a consent form they received along with the information form that explained the objectives of the study and the respondents' rights (in terms of data protection and the right to withdraw from the study). This procedure followed the guidelines of the University of Antwerp. The interview consisted of four parts. After the introduction, the interviewer asked the couples about their parenthood experiences and how they perceive their role as a parent (part 1). Next, participants were probed about their social media usage (part 2). These introductory questions focused on their motives for being active on social media, the changing role of social media before and after pregnancy, and their opinion about sharenting. Next, the interviewer moved to the core of the interview, the couples' mindful sharenting behavior by asking, e.g., why they engage in mindful sharenting and how friends or family members cope with their decision to cautiously share information of their child online (part 3). At the end of the interview, the interviewer asked to show some media content they shared about their child(ren) to illustrate their mindful sharenting behavior (part 4). Finally, the couples were thanked

for participating and reminded that they could contact the interviewer for further information at any time.

2.3. Data analysis

After conducting the interviews, conversations were transcribed ad verbatim and coded as soon as possible in Nvivo12. The coding of the interviews followed an inductive approach and were analyzed thematically in line with the six-phase process (Braun and Clarke, 2012). Before coding, first transcripts were read carefully to verify that data saturation had been reached. Next, one researcher identified every answer that was given by the participants and provided them with a code. Codes referred to different parts of the interview varying from the motives for sharenting to tactics to engage in mindful sharenting. Each answer was coded on sentence level so that more than one code per answer could be used. After coding, all authors read the eight interviews and preliminary findings were discussed. To increase the validity of our study, quotes were selected by the authors to illustrate our findings. All quotes were translated from Dutch into English and were kept as close as possible to the original expression of the participants. To guarantee the anonymity of the participants, this study makes use of pseudonyms. The names of children were changed by the initials of the child.

3. Results

3.1. Context of the decision

The eight couples interviewed all consciously chose to share photos on social media of their children where they are not identifiable. What came back from the interviews was that parents themselves, or someone from their circle of acquaintances, had already experienced negative consequences of sharenting. For example, one couple experienced that a picture of their niece was stolen by a colleague of the grandmother. This person used the photo of the niece on his Christmas card. Another mother was confronted with a fake account of a man in a Facebook group for young mothers. In this group, photos and videos of young children were exchanged.

"In a mom group that I'm in with thousand members, they discovered last year that there was a fake account of a man that

was just there to see the pictures. So that's thousands of moms sharing pictures of their babies, which that guy had access to. These include pictures of children in their diapers, and in their swimming trunks. This makes me think that you cannot protect your child that way" (Mother, couple 8).

A father participating in the study told that, when he was younger and involved in a youth movement, pictures were stolen from the movement's website and found on a child abuse website.

"When I was still in the chiro [Belgian youth organisation], there was someone on our child movement leadership team who pretty much kept the pictures of the kids on a photo website that were shared publicly so that all the parents could access them. Then there was a storm of scandals, as there were photos found on a child porn website in Thailand" (Father, couple 7).

These experiences deliberately made some parents decide to only share photos of their children where they are unrecognizable, or they try to share them selectively (through closed accounts). In addition to the negative experiences, one couple also said they do not share much about themselves online. Therefore, they also rarely share photos of their child. When they do so, they use pictures where their child is unrecognizable. All interviewed couples declared they made this decision before the child was born. Often, one of the parents came up with the idea, and the other partner understood the reasoning behind it and was convinced. The mothers of couple 1 and couple 7 thought it was important that they could still post something occasionally but unrecognizable.

"Yes, for me, that is okay - although we are a couple that is very communicative. If something is put on the table and the other does not agree, we immediately try to find a common ground. We may occasionally share pictures, but then protected" (Mother, couple 1).

Couple 2 and couple 6 initially chose not to share photos. Couple 2 went one step further. They would not even forward photos so that no one could further distribute photos of their child, especially because of negative stories they heard of. Then they loosened these rules.

"Things that happened, stories that we heard from, pictures that really end up in these crazy places. Yeah, that's why we chose that. In the beginning, then made very hard - very strict lines and, afterward, a little less…" (Mother, couple 2).

Some couples who initially decided not to share their child's picture online, changed their decision during the COVID-19 pandemic. In March 2020, the first complete lockdown made physical meetings impossible. As a result, it was difficult for family members and acquaintances to see children of friends and family growing up. Therefore, some parents changed their decision not to post photos on social media to sharing pictures where their child is unrecognizable and forwarding photos in restricted circles.

"Because especially the oldest was born in that lockdown, we do have one private Instagram account that only people can be on, that we allow" (Mother, couple 8).

Some parents try to discuss at an early stage with their family members and friends that they want to oversee which pictures of their child would be shared with whom. As the mother in couple 2 states:

"In the hospital they [family members] were all taking pictures. Then we clearly stated, "this is only for your personal use, OK? Keep it on your mobile phone and do not send it to the rest of the world"" (Mother, couple 2).

All parents chose to engage in mindful sharenting. They find it important to be able to post something from time to time about their children, because this is an important part of their lives. The parents also indicated that they experience social pressure to share pictures of their children on social media. Some parents feel the need to engage in sharenting for affirmation, support, and sharing joyful moments. So, these parents also feel a need to post photos in order to experience these benefits. Nevertheless, these parents are trying to do so in a way their children do not experience any disadvantages.

"I've experienced that a few times. I was so super proud, when our kids do something or so, and thought "oh, too bad we made that decision." I wish I could show it now in all its glory, like "Look, he can do that already!" I still do not regret our decision. You have to think more about "I think this is a very beautiful moment, I want to take a picture of that and how do I take a picture without him being recognizable?"" (Father, couple 7).

Some parents explicitly highlight the difference between their generation and the generation of their parents, aunts and other (older) family members. As our respondents grew up with social media, they explicitly mention that they share less on social media.

"Our mother, her friends, and the aunts of our child, they put everything online, while our generation puts less information online" (Mother, couple 2).

Parents even testify that their parents have difficulties understanding their decision and that some specific arrangements had to be made to give the grandparents the possibility to share photos in their social circle, without putting pressure on the parents' decision.

"Our mum did have some trouble with it, but I think also rather so out of pride. She just wanted to share a lot about her grandchild with her friends. We had to say "Yes, just do not do that in public. Share it in a conversation with one person or so, but just not with too many people at once." We had to explain that occasionally, but then she understood it. She respected that" (Father, couple 7).

3.2. Motives of the decision

The main motive that emerged during the interviews was to protect the privacy of the child. After all, a photograph contains a lot of sensitive information. Furthermore, the photographs can also be shared on child abuse websites, or children may become the target of cyberbullying or other forms of aggression. Some parents also refer

to rapid digital developments related to face recognition and what it may lead to in the future. Parents also state it is not necessary that, so to speak, the whole world sees their child growing up. The most important people see the child growing up in real life. Moreover, some parents do want to prevent their child associating them with taking pictures of them instead of engaging in other interactions.

> "Won't your little one be more used to seeing your smartphone camera instead of yourself as a parent? That they will have the feeling "Oh, you are just looking at me through that little screen." They will not find that attractive, as they are always seeing you with your cell phone in your hand instead of just being busy with them" (Mother, couple 4).

The same mother makes a comparison with other activities, people from a concert audience who are filming instead of enjoying, which makes her similarly question why they are not in the moment.

> "I have the same reservation at concerts or festivals. People who are filming everything. Then I think "just look at what is there, instead of looking through your cell phone." So, I think that lacks authenticity. I really wonder why they do it. Not necessarily in a bad way, but I'm curious about what's behind it, that continuously sharing" (Mother, couple 4).

Some parents make this decision from the start. When they observed some parents sharing ultrasounds of their future child, they found this odd and would not do that. As the following father expressed his doubts about sharing photos of the unborn child.

> "It just does not feel natural to me to do such intimate things like - there's a baby in your belly and it's growing there. It's just on the borderline of having or not having life, you know. It is the essence of our existence. Life is growing inside you, you pass on life. Such a picture of a baby in the belly, then sharing it on the Internet. I find that so intimate" (Father, couple 5).

Furthermore, parents are also aware of the fact that, as soon as a picture is online, they no longer have control over the reach of that photo's audience. Another motive that emerged was that parents want to allow their child to choose what media content they share about themselves on social media. They are convinced it is, in fact, not acceptable to start distributing photos on social media without the child's consent. The child is not asking for its image to be publicly displayed. In this way, parents want to show how important privacy is and that they are aware of the impact sharenting can have on children.

> "We want to give our children the choice, later when they are older, to share images about themselves, if they want to share them" (Mother, couple 6).

Or as another parent points out:

> "If he later wants to be on Instagram, what I will not advise, then he's free to do it. He can put whatever picture he wants online. But I will not stimulate that. I will not, before he can give permission, put him on that. This is for me the most important because he did not ask for it" (Father, couple 5).

Some parents refer explicitly to their responsibility to educate their children concerning the potential risks when they engage in online activities and disclose personal information. Moreover, as one respondent highlights, they as young parents have grown-up with social media.

> "Always stay aware of any activity that is performed on the Internet, as long as they are underage, under 18. Yes, really do pay attention to it. Parental supervision, what are they doing, who are they chatting, texting or calling with. And also, when they are of age 18 that they know they can come to us. The advantage is, we have grown up in this era, so we have seen social media and the digital world evolve" (Father, couple 3).

3.3. Strategies for mindful sharenting

The parents employ several strategies to protect their children's identity as much as possible from the disadvantages of sharenting, while at the same time enjoying the benefits sharenting offers them as parents. The strategies they primarily employ focus on the spatial context rather than on the child (cf. Table 2). The child is photographed from a distance. Or the child is photographed from the back. Half of the parents also posted photos of certain body parts of the child, such as a foot, a hand, or an ear. Furthermore, sometimes an emoji is placed over the child's face. One couple of parents (couple 8) sometimes blurs the face or cuts recognizable parts of the photo.

> "When A. is lying with me, I share a picture of his hand and his ear. You can only see that. For instance, I say that it was a "hang day" because he had his shots. Because I want to share this with people who follow me, but I'm never going to fully portray him" (Mother, couple 8).

One of the couples had a very particular way of sharing photos. They share photos in which their child cannot be seen, but the photos are posted with their child in mind and referring to the child. For example, they post pictures of socks, a toy, or an abstract picture of a baby carriage. This maintains the anonymity of the child while including details that are important to express a situation or refer to the child.

> "Then I do put text with it, in which it is made clear that it is posted with A. in mind or that it does concern her" (Mother, couple 4).

Three couples indicated that the photos were taken spontaneously, and it was decided afterward which ones they were going to share. A parent, showing a picture to make his point, said the following:

> "This photo, for example, is one made where I had to think of other points of view. I would initially think, "I want to pull that so frontal because then you really see he already has his head up really well," but then I start thinking "yeah, we do not want the face on it, which side can I photograph him?," so that it is clear what he is doing, but without showing his face" (Father, couple 7).

The most important rule to keep in mind, according to the parents, is that the child should not be recognizable in the photos

TABLE 2 Mindful sharenting strategies adopted by parents.

	Picture from a distance	Look away from the objective	Focus on a body part	Emoji on the child's face	Shield recognizable body parts	Blur the child's face	Referring to the child without a photo of the child
Couple 1			X	X			
Couple 2	X	X	X	X			
Couple 3		X		X			
Couple 4							X
Couple 5		X	X	X			
Couple 6	X	X					
Couple 7	X	X					
Couple 8	X	X	X		X	X	

or videos posted online. Furthermore, parents also apply other privacy protective measures. For example, some parents started a private WhatsApp group, in which photos of the child are shared with family members and close friends. When parents do not do this through a WhatsApp group, they use another application such as Family Album or Google Photos. These are photo albums shared online, where parents have control over who has access to their child's pictures.

> "Family Album is our alternative to putting photos on social media. Because that is shared with the people that we think are most important. Also, it gets so nicely categorized by month, so you can go back and get an overview of the photos per month and others can comment" (Mother, couple 4). "Then you can scroll back and see when she was a newborn and then go 6 swipes further to see her at 6 months" (Father, couple 4).

One couple even created a private Instagram account for the child on which recognizable photos are shared with family members. Other measures parents apply are that they shield their own accounts as much as possible. Parents find it important that it starts with themselves, that their decision should be in line with their own sharing behavior on social media.

> "We had already set the privacy of our social media profile a little bit stricter, which means that those photos can be more protected" (Mother, couple 2).

Also, one of the parents finds it important that the photos are "acceptable", meaning not nude. Two couples have specific rules for certain grandparents. They are not allowed to post pictures of their grandchildren at all, because the parents feel that the grandparents are not going to understand the consequences. In their opinion, this could compromise the child's privacy. Therefore, they feel it is better that the grandparents just do not share pictures. Then nothing can be posted that would be, in parents' opinion, wrong.

> "We then always asked not to post a photo. My mother in law would not understand the difference and would put anything online. We have the feeling that, maybe that's wrong, but she really does share everything" (Mother, couple 6).

Other parents had to make their viewpoint clear, after a family member already put a picture online, which made the parents react as they were not happy about it. This created privacy turbulence between the family members, leading to clarify and renegotiate the privacy boundary, so the family member would not further post pictures of their child online.

> "My sister-in-law, she was only two or three years in the family. She probably did not get the message well. We had a conversation with her, but when it was already too late (Mother, couple 6). "Yes, I had a conversation with her. I am usually the bad cop, she's [referring to the mother of the child] the good cop. I explained the situation, and she understood and accepted it" (Father, couple 6).

3.4. Reactions of online contacts

Some parents were surprised by the positive reactions they received to their decision to share their children's photos unrecognizable on social media. Because this decision deviated from the norm they observed online, they had rather expected negative reactions. However, sometimes they needed to argue their decision.

> "I receive often – at least in the beginning – the question "Why is K. not visible?." Then I answered "Yes, we have decided to keep him as much as possible from social media. If we post something, then unrecognizable." I then received immediately the reaction "Well I am very proud of my daughter, so I think it is strange that you do this." Then I reacted "Yes, but it is not because I do not do that, that I am not proud of my child" (Mother, couple 1).

> "My parents, for instance, are from another generation. When they see young parents do this, they say "Oh, this is so strange, why are they doing this?" [in a child's photo, putting something on the face of the child]. They are immediately pigeonholing these people. However, I think, there is so much behind this that people do not see. People think do not be ridiculous by putting an emoji", but I think "there is so much more behind this decision", but people do not know that" (Father, couple 5).

Other parents mentioned also they received many questions and reactions as to why they had taken this decision. Comments and questions that came up from family members or friends are for instance: "Why can't we see his face?" "Is something wrong with your child?" but even "Do you have ugly children?" "Isn't that maybe a little excessive?" or "Aren't you proud of your child?". This makes parents feel like they must constantly justify themselves. They then try to explain why they made this decision. They emphasize in these conversations the risks of sharenting regarding privacy, the child's development, and specific risks that could be linked with the disclosure of their child's image online.

> "They ask me personally "why did you do that?". I told them "look, dangers, pedophilia, you name it, on social media" and they said "ah, that's a good idea that you do that." And then I also got responses from other people who did not think it was right for people to post a whole life story of their child online. They also said "yes, that will have an impact on the child when it grows up"" (Father, couple 3).

By explaining their decision, some parents got more understanding for it. However, through these critical comments, parents experienced that sharenting is still considered the social norm, and mindful sharenting less known.

> "I do not think that all the world should know every moment, act that he can and does well - that all the world should know that. I am very proud of my child. The WhatsApp is red hot here [laughter]. That's incredibly common with my family, it's used a lot and we post a lot, absolutely. With very close friends too, but it's not because I choose not to share it publicly for all the world, that I'm not proud of my child. And I find that a pity that you have made a decision and then you get such reactions from people, then I think that we indeed live in a society where that is absolutely possible and where more people do make a conscious choice - but then again you notice on that level, that it is something that is still relatively unknown" (Mother, couple 1).

Some parents highlighted that especially grandparents did not understand their decision and did struggle with the fact that they could not share their joys of a new grandchild with others online. By contrast, parents experienced that among young people, this critical vision on sharenting becomes more established. It is no longer taken for granted that grandparents put pictures of children online without the parents' permission. The respondents experience that more and more young parents are aware of the impact of sharenting, which means that they are more likely to choose to share photos of their children unrecognizable to protect their children from sharenting's potential drawbacks.

> "There are a lot of people that react "oh, I'm going to do that too for my child," and you see they post something about their children, without them being recognizable" (Father, couple 3).

4. Discussion

Until now, research on sharenting has merely looked at parents who engage in sharenting and focused on the motives and perceived consequences of sharing personal information of their children online

(Blum-Ross and Livingstone, 2017; Latipah et al., 2020; Cino, 2021; Cino and Wartella, 2021). Other research studied sharenting from adolescents' perspective by investigating how they perceive their parents' sharenting and how they react to it (Lipu and Siibak, 2019; Verswijvel et al., 2019; Walrave et al., 2022). The present study adds to the literature by focusing on a specific category of parents who engage in, what we have called, mindful sharenting. These parents want to take advantage of some positive aspects of sharenting while, at the same time, minimizing its risks.

As the transition to parenthood is a difficult adjustment period in some adults' lives, engaging in sharenting offers prospective and young parents possibilities to build social capital with peers going through the same stage of life (Blum-Ross and Livingstone, 2017). Building social capital is crucial in helping parents cope with the challenges that parenthood brings (Bartholomew et al., 2012). This important driver for some parents to engage in sharenting is also confirmed by respondents in the present study. As far as parents' motives is concerned to engage in mindful sharenting (RQ1) we found that parents try to balance between the opportunities sharenting can offer them, the social pressure they experience to post news about their child, and their objective to protect their child's privacy. Parents engaging in (mindful) sharenting form their children's online identities without their (underage) children's consent. This can have a negative impact on the development of the personality of their children (Verswijvel et al., 2019). As a result, the parents in this study showed a critical and self-reflective attitude towards sharenting. Moreover, parents were found to engage in mindful sharenting to give their children the opportunity to develop their own online identity.

For the participants, this critical attitude stemmed from the lack of control over sharenting content, concerns regarding the privacy rights of the child and allowing the child the choice to create their own online identity. Parents who engage in mindful sharenting also referred to some negative consequences they observed online, or in their social circles, and ask themselves if parents who post identifiable pictures of their child are enough aware of the risks regarding the privacy of the child, digital security risks such as cyberbullying, or the abuse of pictures on child abuse websites. These potential negative consequences have also been highlighted in previous studies (Steinberg, 2017). These situations and observations were highlighted by parents as a ground for their decision (RQ2).

Mindful sharenting was implemented by adopting several strategies to minimize related risks (RQ3). Parents primarily focused on the photographic and spatial context rather than on the children themselves. For example, the child was photographed from a distance. Other couples post only a body part of the child, such as an ear, a foot, or a hand. Furthermore, the child was also often photographed from behind, when looking away from the camera. There were parents who digitally edited the photos by putting emoticons on the face, blurring the face, or cutting off recognizable parts. Finally, parents tried to regulate the sharenting behavior of relatives by renegotiating their privacy boundaries or asking them not longer to share information of their children on social media to keep control over the child's online identity.

In this digital age, sharenting is seen as the social norm. Some parents' decision to share children unrecognizable on social media is seen as a departure from the current norm (Siibak and Traks, 2019). New parents feel externally and internally encouraged to share the content of their children online (Blum-Ross and Livingstone, 2017). Firstly, parents are internally stimulated to share images that demonstrate their involvement with their child and their parenting

skills. These pictures serve a functional purpose in their self-realization as parents. Secondly, external factors can also play a role in triggering parents to share pictures of their children on social media, showcasing "good parenting," their proficiency in parenting (Thimm, 2023). For instance, the pressure experienced by parents can be related to the mediatization of everyday life, where both ordinary and extraordinary family experiences are expressed as forming part of the family's identity. Social media therefore serve as tools to document life experiences and construct a family chronicle (Thimm and Nehls, 2017). In this context, sharenting can also be viewed as a mode of self-expression driven by parents' inclination for social comparison. By showing positive family moments or their child's accomplishments, some parents aim also to demonstrate their parenting abilities. In some circumstances, these sharenting posts can be seen as a reaction when comparing oneself as a parent to other parents' posts concerning their children and the role they play as a parent (Brosch, 2016).

In this context, the decision to engage in mindful sharenting is not taken lightly. This type of sharenting in which parents consciously choose to employ strategies to limit the disadvantages of sharenting, but allows them to enjoy the benefits it offers them, is a difficult balance they want to strike. Mindful sharenting may thus provide an answer to the privacy-openness paradox (Chalklen et al., 2017). The paradox is between parents' sharing of information about their children on social media to enjoy the benefits of sharenting, and expectations from their relatives and friends, and the privacy and other potential risks they and their children may experience, now or later. Mindful sharenting thus allows parents to enjoy the benefits, but at the same time try to protect their children's privacy. However, their social circle is not always following them in their decision. While some parents feel supported, others face criticism from those around them, such as "Aren't you proud of your child?", "Is something wrong with your child?", "Isn't that maybe a little excessive?". A possible explanation for this contrast between relatives or acquaintances who are supportive or non-supportive for parents' decision, could be differences in privacy concern or their own value for protecting the child's privacy in relation to the benefits of sharing identifiable pictures. Also differences in personal privacy breach experiences could explain why some show understanding for, or explicitly support, the decision of the parents to engage in mindful sharenting, while others do not. Future research could therefore focus on possible differences of online contacts' reactions towards mindful sharenting and find out how this relates to their own privacy concerns, online self-disclosure and related experiences, and how they view possible risks of sharing identifiable pictures of the child. Another possible reason that could be further investigated is related to how relatives react to the privacy boundary determined by the parents. More concretely, parents deciding to publish unidentifiable pictures or restraining online contacts to post or forward child-related pictures may be perceived by online contacts as if they are not allowed into the privacy boundary or withhold their online network—among which friends and relatives—the right to see and share a child's picture.

Furthermore, the criticism faced by parents engaging in mindful sharenting, made them feel they had to justify their decision, leading some parents to explain why they made this choice by emphasizing the disadvantages and risks associated with sharenting when the child is identifiable.

Next to this conflict concerning their decision to engage in mindful sharenting, parents also try to avoid privacy turbulence (RQ4), as some parents explicitly ask grandparents not to share pictures of their grandchildren or to share pictures only in online conversations but not on publicly accessible online accounts. In terms of CPM, parents are setting privacy boundary linkage and boundary permeability rules. As far as privacy boundary control rules are concerned, we observed some parents want to stay in control of the dissemination of their child's personal information. Some parents strictly do not offer grandparents autonomy to decide for themselves, even asking them not to take the initiative to share personal information about their grandchild, as some parents think grandparents do not understand the consequences.

In some cases, parents have found themselves needing to clarify their point of view concerning sharing of pictures of their child when a family member had already put a picture online, causing parents to feel unhappy about the situation. This created privacy turbulence, leading to renegotiations of the privacy boundary, namely that the family member would not share pictures of their child. Some parents try to avoid privacy turbulence by sharing recognizable photos with family members and close friends through private WhatsApp groups, to be able to be more selective about the people who have access to the pictures. A few parents use other applications to share photos with selected recipients (e.g., Google Photos, or a private Instagram account). By sharing the pictures in closed groups and by explicitly telling family members that the pictures may not be further disseminated, parents want to prevent misunderstandings and, in terms of the CPM theory, prevent privacy turbulence.

Notwithstanding the present study's results, several limitations must be acknowledged. Due to the qualitative nature of the study, a limited number of participants were interviewed. The participants were all near or in their 30s. As a result, it was not possible to determine whether ways of engaging in mindful sharenting differed between generations of parents. Future research could examine potential differences in motives and strategies used to engage in (mindful) sharenting. Another limitation of the present study is that both parents were interviewed together. This could have led to social desirability or parent's avoiding some topics to prevent discussions between partners. Future research could interview parents separately and confront their opinions on how the decision was made to engage in mindful sharenting, how strategies to protect the child's privacy were discussed, possible disagreements that emerged during these discussions, and how common decisions were made. Moreover, the present study's findings are based on a limited number of in-depth interviews. The insights of this qualitative research could be further used in follow-up (cross-sectional or longitudinal) survey research to investigate which strategies are employed more or less frequently, how this relates to parents' privacy concerns and other characteristics such as parenting styles. This would offer more insight into correlates and predictors of parents' engagement in mindful sharenting in general, and specific strategies in particular. One of the results of this study is also that some parents who choose mindful sharenting received criticism. Future research could use a longitudinal research design to examine how the way of sharenting evolves, depending on the comments or criticism parents receive. Furthermore, the participants of this study had a Belgian origin. It would therefore be interesting to further investigate whether cultural differences can be observed within or between countries concerning sharenting motives and behaviors, and especially parents' decision to engage in mindful sharenting. Finally, it is worthy to note that this study took place

during the COVID-19 pandemic which made some parents decide to engage in sharenting—although they initially did not—to reach out to their friends and family. In this respect, we believe that studying other circumstances under which parents might turn into sharenting practices for family communication (e.g., when relatives live far away) are relevant to investigate in future research.

5. Conclusion

Previous research on sharenting has primarily focused on parents' motivations and their perceived consequences of sharing personal information about their children on social media, as well as adolescents' perspectives and reactions on their parents' sharenting behavior. The present study contributes to the literature by focusing on parents who engage in mindful sharenting to leverage the benefits of sharenting while minimizing the potential risks. More particularly, parents' motives, the privacy protective strategies they use and how relatives and acquaintances react on their decision were investigated. Parents practicing mindful sharenting demonstrate a critical and self-reflective attitude towards sharenting. They want to protect their child's privacy and avoid that images they post would lead to abuse or aggression, now or later. They are driven by concerns over lack of control, protection of their child's privacy, and allowing their child to shape their own online identity. Parents were sometimes stimulated to take this decision due to their own or acquaintances' previous negative experiences when they engaged in sharenting. Mindful sharenting concretely involves parents engaging in new pictorial practices, focusing on the context of the photographs rather than the children themselves. It also includes photographing the child from a distance, capturing only specific body parts, or using digital editing techniques. These protective strategies, however, lead also to discussions with family members and other online contacts, pushing some parents to justify their decision. Moreover, parents' decision to engage in mindful sharenting is sometimes thwarted by family members who post identifiable pictures as today sharenting has become the social norm, making the decision to engage in mindful sharenting a departure from this norm. In sum, mindful sharenting attempts to strike a delicate balance between reaping the benefits of sharenting while trying to safeguard their child's privacy and minimize risks.

Data availability statement

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

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Iranian scientists and French showers: collaborative fact-checking of identity-salient online information

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In this study, we investigate what leads people to fact-check online information, how they fact-check such information in practice, how fact-checking affects their judgments about the information's credibility, and how each of the above processes is affected by the salience of the information to readers' cultural identities. Eight pairs of adult participants were recruited from diverse cultural backgrounds to participate online in joint fact-checking of suspect Tweets. To examine their collaborative deliberations we developed a novel experimental design and analytical model. Our analyses indicate that the salience of online information to people's cultural identities influences their decision to fact-check it, that fact-checking deliberations are often non-linear and iterative, that collaborative fact-checking leads people to revise their initial judgments about the credibility of online information, and that when online information is highly salient to people's cultural identities, they apply different standards of credibility when fact-checking it. In conclusion, we propose that cultural identity is an important factor in the fact-checking of online information, and that joint fact-checking of online information by people from diverse cultural backgrounds may have significant potential as an educational tool to reduce people's susceptibility to misinformation.

KEYWORDS

fake news, fact-checking, social media, media literacy, identity, opinion change, collaboration, deliberation

1. Introduction

Combating misinformation is one of the greatest societal challenges of our times. In the age of "deepfake," it is almost impossible for the untrained to distinguish fabricated documents, photos, and videos from genuine ones. Even highly educated individuals, including experts in textual analysis, are poor judges of the reliability of online information (Wineburg and McGrew, 2019). Worse still, research indicates that fake stories travel six times faster and further on social media than do factual ones (Vosoughi et al., 2018). A growing body of evidence suggests that misinformation on social media contributes to political polarization (Guess et al., 2019), affects individuals' behavior in areas as diverse as voting, vaccination, and recycling (Lewandowsky et al., 2017), and is often believed long after it has been corrected (Wood and Porter, 2019). The most worrying long-term consequence of misinformation, however, may be its erosion of trust in institutions, media sources, science and expertise (van Der Linden et al., 2020). Repeated

exposure to misinformation increases the tendency to believe fake news (Pennycook et al., 2018), which is associated, in turn, with a propensity to reject information from expert authorities (Uscinski et al., 2020). This rejection of expert authority deprives people of an important method for distinguishing reliable from unreliable information, thereby deepening the initial problem and undermining efforts by policymakers and educators to address it.

In this study, we set out to address this challenge by investigating what leads people to fact-check information on social media and how these processes are affected by the salience of the information to readers' personal and cultural identities. Drawing on research in cultural psychology, cognitive science, and human-computer interaction, we use an experimental but ecologically valid situation – collaborative fact-checking of suspect tweets – to investigate how pairs of participants from diverse cultural backgrounds search jointly for information online to evaluate the credibility of claims disseminated on social media.

2. Scientific background

Efforts to combat misinformation are only just beginning to come to terms with the scope of the problem (Barzilai and Chinn, 2020). A common approach thus far has been to design or expand programs to develop people's generic skills of critical thinking. However, dealing with online information often requires quite different skills to those required to read offline texts — for example "critical ignoring" rather than "close reading" (Kozyreva et al., 2023). Accordingly, many current interventions, which focus on generic critical thinking skills rather than skills specific to online texts, such as critical ignoring and lateral reading, may be not only inadequate but perhaps even misdirected (Wineburg and McGrew, 2019; Ziv and Bene, 2022).

One problem is that, while research has provided insight into the judgments people make about the credibility of online information, few studies have examined in detail the processes by which they arrive at such judgments. To date, much research on the role of the Internet in propagating misinformation has focused on the logical structure and vectors of dissemination of conspiracy theories and fake news (e.g., Vosoughi et al., 2018; Ecker et al., 2022) or the characteristics of credulous readers (e.g., Baptista and Gradim, 2022). Few studies have examined how people deliberate in practice about the credibility of information they encounter online (Bago et al., 2020); and those that have done so have tended to define deliberation operationally as silent thinking performed solo (in a figurative "black box" to which the researcher has no access), often in laboratory settings far removed from the contexts within which people normally encounter online information. This has led to calls for more naturalistic studies (Bago et al., 2022, p. 10).

Particularly lacking are studies that examine how people's identities affect their deliberations about the credibility of online information. Studies of polarization in the consumption and retweeting of online news indicate that people tend to seek out, and to share, news from sources whose political views echo their own (Garimella and Weber, 2017; Jurkowitz et al., 2020). But these studies do not investigate how people assess the credibility of claims they encounter online when the identity of the source is unfamiliar or unclear. Nor do they compare the processes by which people from different cultural groups (e.g., national, ethnic, religious) assess online

claims regarding their own cultural group versus claims regarding other cultural groups.

Previous research indicates that people's cultural identities influence the standards of credibility they use to evaluate claims – a phenomenon known as "epistemic switching" (Gottlieb and Wineburg, 2012). This phenomenon is related to confirmation bias (Tversky and Kahneman, 1974) and cognitive dissonance (Festinger, 1957), in which people process information in ways that maximize its fit with their prior beliefs. However, in epistemic switching, it is not the evaluation of a specific claim that is adapted to cohere with the person's prior beliefs but rather the evaluative criteria themselves (Gottlieb and Wineburg, 2012, p.11). Thus far, research on epistemic switching has been limited to the evaluation of offline textual information (Gottlieb and Wineburg, 2012). No studies to date have investigated whether or how epistemic switching occurs in the evaluation of online information.

Metzger (2007) argued that assessment of the credibility of online information should not be seen as a single evaluative process but rather as a form of dual processing (Chen and Chaiken, 1999), in which internet users' accuracy goals vary depending on their motivation for seeking information. To explore this dual processing model, Metzger (2007) proposed viewing credibility assessment as a three-phase process in which exposure to online information is followed by evaluation, which is followed in turn by judgment. According to this model, it is at the exposure phase that motivations are most relevant, as they determine whether, and to what extent, the individual proceeds to the evaluation phase. However, to the best of our knowledge, this model has not been tested empirically. Research is required, therefore, to determine whether the processes by which people assess the credibility of online information follow the phases hypothesized by Metzger (2007) and to what extent the cultural identities of the assessors and the identity-salience of the information motivate particular kinds of evaluation and judgment.

3. Research questions

The goals of the present study are to explore:

1. What leads people to fact-check online information;
2. How they fact-check in practice;
3. How such fact-checking affects their judgments about the information's credibility; and
4. How the above processes are affected by
   a. the salience of the information to readers' cultural identities; and
   b. collaborative fact-checking with people whose identities differ from their own.

4. Materials and methods

4.1. Methodological approach

To investigate these questions we designed a situation in which pairs of participants collaborate online in selecting specific examples

of online information (in this case, Tweets) that they agree to verify together, and which they then verify by searching on Google.

A short list of six (6) tweets was carefully chosen to be on the cusp of credibility (not too obviously true or false) and to relate in some way to the cultural identities of the participants. By cultural identities, we mean, following Tajfel (1974, p. 69):

> that part of an individual's self-concept which derives from his knowledge of his membership of a social group (or groups) together with the emotional significance attached to that membership.

We use the term cultural identity rather than social identity because we focus here on a particular subset of social identities, namely, gender and nationality. For the purposes of the present study, we defined cultural identity operationally as a person's self-categorization in terms of gender and/or nationality (cf. Phinney and Ong, 2007). For example, tweets were chosen on issues relating to England and France for pairs containing one person from each nationality.

Our research design sought to create an experimental situation in which processes of fact-checking would be:

a) Observable: The design prompted participants to engage in deliberation on the credibility of online information as a form of publicly expressed dialog rather than as a private form of individual thinking.

b) Natural: The design employed the "constructive interaction method" (O'Malley et al., 1985), wherein participants working in pairs are led to communicate their thinking as a 'natural' part of their deliberation. This can be contrasted with individual protocol analysis (Simon and Ericsson, 1984) wherein verbalization can be experienced by participants as an additional "task." Our method aims to produce dialogs that provide rich, qualitative information on (inter)cognitive processes.

c) Ecologically valid: The most common situation for evaluating online information might be individual reading. However, sharing and discussing online information with others (for example, in "retweeting") is also an everyday, and ecologically valid, activity.

d) Related to belief change: To investigate how processes of fact-checking affect belief, we draw on a commonly used method in collaborative learning research (e.g., Simonneaux, 2001; Brocos et al., 2022), whereby participants are asked to state their opinions before and after discussion, with differences then being analyzed in relation to intervening dialog processes.

4.2. Materials

To maximize ecological validity, all six of the Tweets that we presented to participants were ones that we had accessed on Twitter while designing the research. Each Tweet appeared as a screenshot from Twitter and included the name and icon of the source feed on which it appeared, and the time and date on which it was posted.

4.3. Participants

The experimental interaction situation that we developed was as follows: Eight pairs of adult participants were recruited so that they were approximately matched in age and educational background but differed on one or more of the identity criteria gender and nationality. They were invited to participate via Zoom in an online discussion of the credibility of online information, moderated by one of the authors.

Our sampling scheme was purposive: We recruited participants that we believed would have a theoretical bearing on our results. (cf. Patton, 2001). To simplify the definition of participants' cultural identities, we mentioned explicitly when recruiting them that we wanted our sample to include participants from particular national backgrounds and mother tongues, and that we were approaching them as such (e.g., as a French-speaking woman of French origin). We also mentioned to prospective participants that they might be paired with someone from a similar background to their own or from a different background. Our sample of 16 participants included 7 women and 9 men; aged between 30 and 78; from France and England.

We restricted our sample to French and English participants for two reasons: Relevance and clarity. Our research team comprised two English men and one French woman, and research was conducted while the first author, who is English, was a visiting researcher in France. Our interest in exploring the role of cultural identity in fact-checking made nationality a relevant variable to include in our design. Our personal familiarity with differences between English and French culture, and of common stereotypes people from each country have of each other, enabled us to choose tweets that were likely to elicit different reactions from English and French participants. As the analyses below will show, it also enabled us to interpret participants' interactions, whether in English or French, within a broad cultural and intercultural context.

4.4. Procedure

The online interaction comprised four stages.

1. Credibility Assessment: First, each participant completed independently an online questionnaire, in which he or she was asked to assess sequentially the credibility of each of the six tweets on a Likert 7-point scale, from "not credible at all" to "totally credible." After recording their judgments, participants were required to indicate which, if any, of the tweets they would check, and why.

2. Fact-Checking: Next, participants were brought together on Zoom to select two tweets (from the six presented in the first section) that they wished to check together. After selecting the tweets, each participant took turns being the "searcher," i.e., sharing their screen while entering search terms into Google to check the tweet's credibility and discussing the results with their partner. When the participants felt they had reached a conclusion about a given tweet's credibility, they ended their search and each of them entered their conclusions into the online questionnaire.
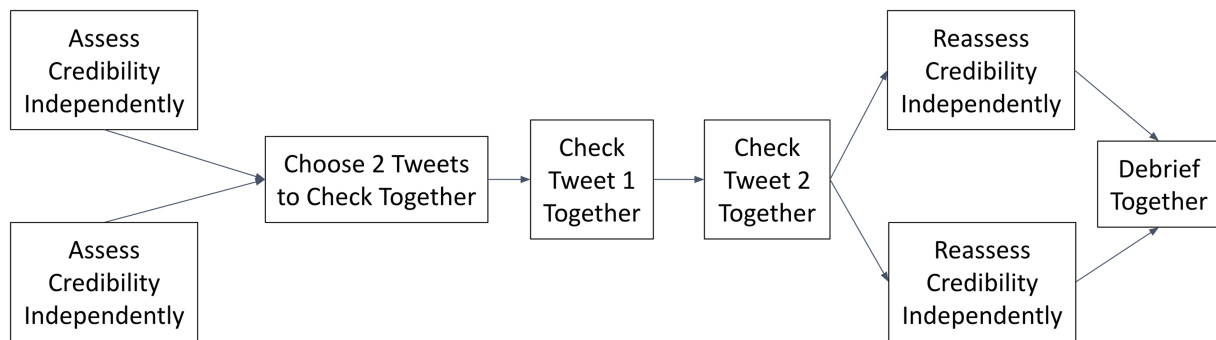
FIGURE 1
The experimental procedure.
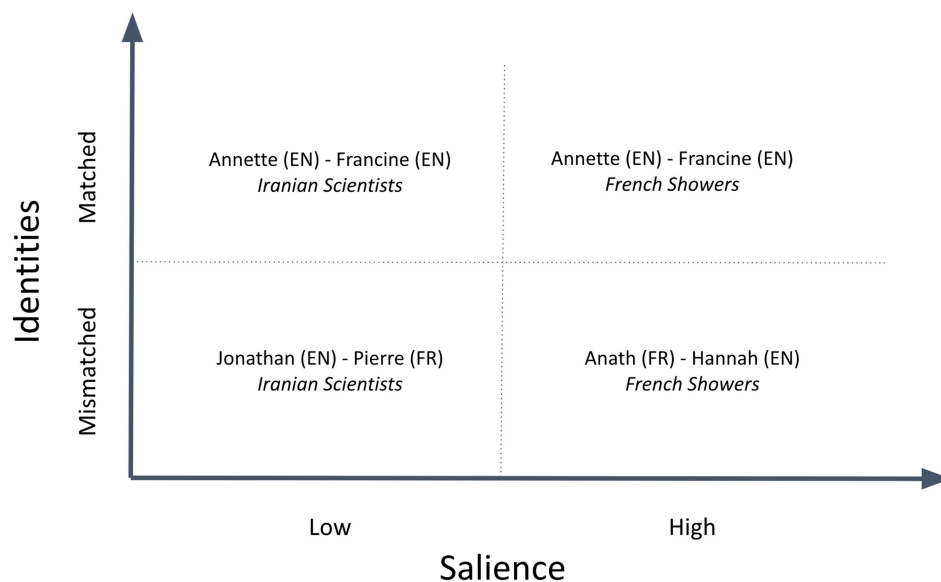
FIGURE 2
2 × 2 experimental design to investigate identity and salience effects, including sample deliberations selected on this basis for detailed analysis.

3. Credibility Reassessment: Then, each participant completed independently, a second time, the online questionnaire, to record their post-deliberation assessments of the credibility of each of the six tweets (i.e., two that they had checked together, and four that they had not checked).

4. Debrief: Finally, the participants were invited by the moderator to comment on their experience and share any general thoughts that occurred to them during the course of the session.

This procedure is summarized in Figure 1.

To investigate the effects of participants' cultural identities on their joint fact-checking deliberations, we used a classic 2 × 2 design to compare the deliberations of participant pairs that were matched for cultural identity (e.g., English-English) with pairs that were mismatched (e.g., English-French); and deliberations in which Tweet content that was of high identity-salience to the participants (e.g., an English-French pair fact-checking a Tweet about how often French people shower) with those in which Tweet content was of low

identity-salience (e.g., an English-French pair fact-checking a Tweet about the percentage of science and engineering graduates in Iran that are women.)

This 2 × 2 design, summarized in Figure 2, includes examples of fact-checking deliberations in each quadrant. We analyze each of these examples in detail in the results section.

4.5. Coding scheme

The Zoom sessions were recorded and transcribed verbatim. Coding categories were derived inductively, using an iterative procedure in which two of the authors each coded a transcript independently and devised a set of categories sufficient to account for fact-checking processes contained therein. After completing their initial coding, the coders met to compare categories and construct a coding scheme on which they could both agree. Each then employed this new coding scheme to code independently a second transcript.

TABLE 1 Coding scheme.

Category	Rule	
Judge	Judging tweet credibility, with or without explicit justification	"The Iranian one sounds fake."
Decide	Statement or reasoning about whether to check the tweet	"Well, I think the Iranian one might be easy to check."
Analyze	Analyzing the form and content of the tweet	"Yeah, so they said only 43% of Frenchies are not showering on a daily basis"
Plan	Discussing how to search, what to search for, what to do next	"I'll try to go straight to the point, otherwise we will look a little more."
Formulate	Discussing which terms to enter into the Google search, etc.	"Open a new Google page on the side and I tell you what to copy paste in there. Yeah."
Search	Action, directions, instructions, discussion regarding the search	"This top one?"
Interpret	Interpreting the results of the search, including comparing sources, claims	"Er, that's about how often do they use a washing machine. That's something different."
Evaluate	Evaluating evidence, sources	"Let us see if they say how many people they have sampled, for instance."
General	General reflections on the activity, online credibility, fact checking	"… things that are politically touchy, you assume some good media has already fact-checked it …"
Other	Not clearly in any of the above categories, anything off-task	"Hmm," "Wow," "Yeah," Etc.
N/A	Ineligible for coding	(Experimenter) "Would you say you have reached a conclusion or is there more that you'd like to check?"

They then met again to compare their results and further refine the coding scheme. After a third iteration the coding scheme was tested formally for inter-coder reliability on four transcripts (i.e., 25% of the total corpus). Inter-coder agreement was high, Cohen's $\kappa = 0.91$. Disagreements were resolved by discussion and the remaining transcripts coded by a single coder.

The coding scheme, with decision rules and examples from the corpus, is presented in Table 1.

5. Results

5.1. The decision to fact-check

What leads people to check online information? Our study provided us with two sources of relevant evidence. First, as noted, participants were asked explicitly in the questionnaire to indicate, independently of each other, which, if any, of the tweets they would check, and why. Second, when deliberating about which two tweets they wanted to check together, participants discussed explicitly reasons for checking, or not checking, particular tweets.

5.1.1. Reasons given in the questionnaire for (not) fact-checking

As can be seen in Figure 3, participants reported that they would indeed want to check several of the tweets presented in the questionnaire. However, on average, they reported being slightly more likely not to check tweets than to check them (56%). The reason participants gave individually for not checking was more often that the tweet wasn't important enough to merit further investigation (30%) than that it was obviously true (10%) or obviously false (20%).

However, as can be seen in Figure 4, some of the tweets were considered more suspect than others. In particular, a majority of participants reported that they'd check the tweets reporting that most science and engineering graduates in Iran are women, and that burkinis are banned in Morocco, because they suspected these

might be fake. In contrast, the tweets claiming that only 43% of French people shower daily, that Britain produces more varieties of cheese than France, and that men are funnier than women, were considered by around half of the participants (50, 44, and 44%, respectively) to be insufficiently important to merit fact-checking. Especially interesting is the finding that only a small minority of participants said the reason they wouldn't check a given tweet was because it was obviously true (10%) or because it was obviously false (20%). In summary, it appears that the decision about whether or not to fact-check a given tweet hangs firstly on whether the reader considers the claim worthy of investigation and secondly on the extent to which the tweet seems true or false.

5.1.2. Reasons given during joint deliberation for (not) fact-checking

During their joint deliberation about which two tweets to check together, participants often cited additional motivations for checking or not checking various tweets. Generally, participants cited specific doubts based on prior knowledge or experience. For example, Jonathan, an English professor of political science tells his interlocutor, Pierre, a French professor of management, that he wants to check the tweet about Iranian scientists because it seems to him both plausible and suspect.

> I would go for the Iranian women one, the reason being that Iran isn't Saudi Arabia, so women do actually have much more of a normal role than they do in the Arab states and the Gulf. Much more of a public role. [IS-JP-6 (Decide)]

Here, and below, utterance numbers appear in square parentheses following each excerpt, alongside initials indicating the Tweet and the participants, and followed in round parentheses by the relevant coding category. For example, in the excerpt above, Utterance 6 in Jonathan and Pierre's deliberation about Iranian Scientists appears as [IS-JP-6 (Decide)].

Pierre concurs, citing his own combination of doubt and readiness to be surprised:
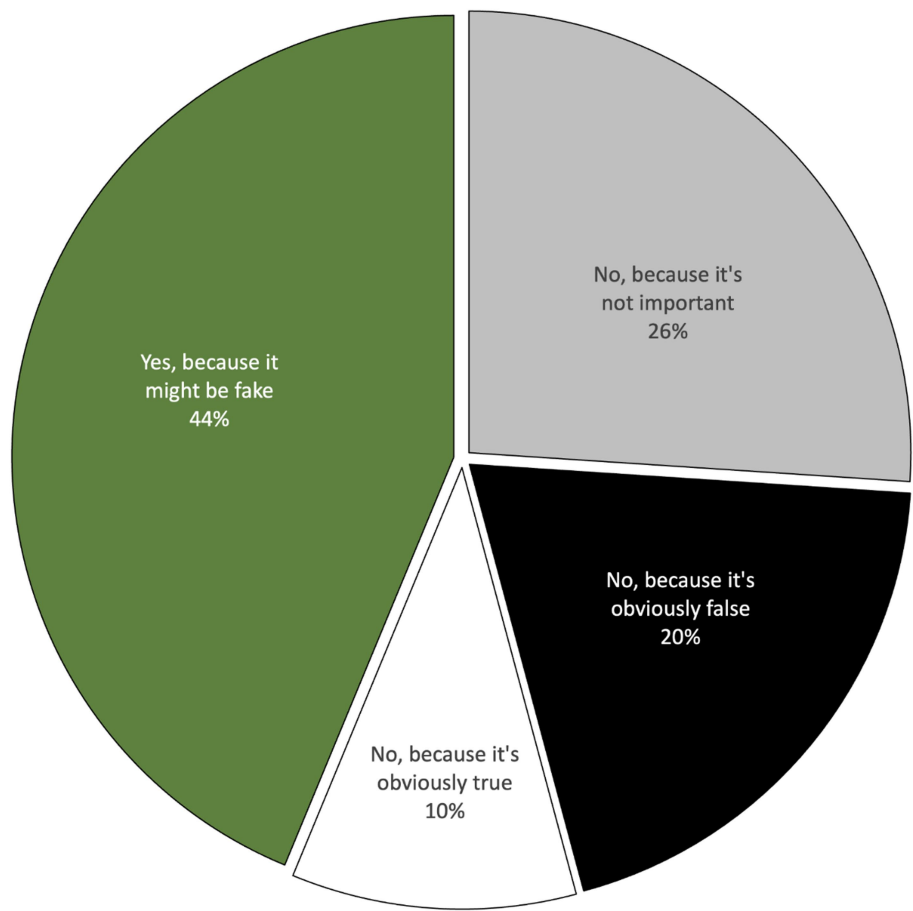
FIGURE 3
Reasons given for (not) fact-checking (Questionnaire).
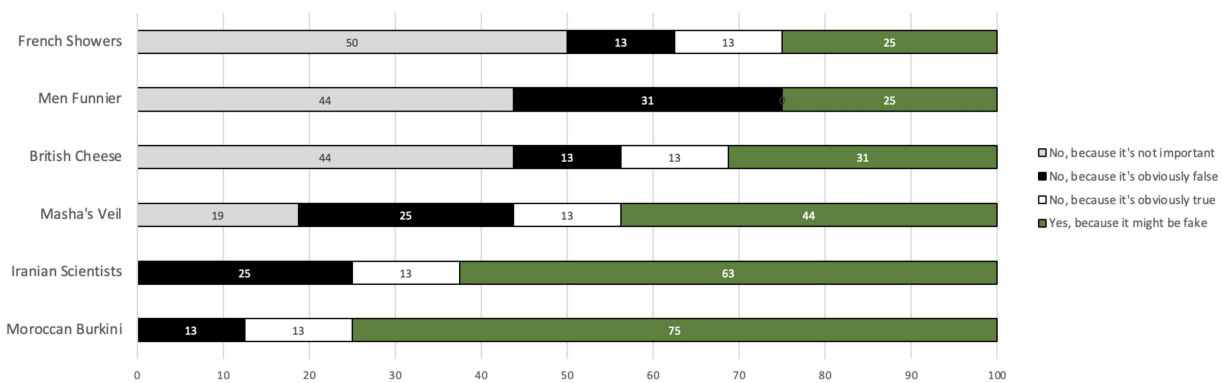
FIGURE 4
Reasons given, by Tweet, for (not) fact-checking (Questionnaire).

> So, I doubt it's true, but I could still believe it might be okay. [IS-JP-7 (Judge)]

However, in some cases, participants decided to check tweets about which they were already firmly convinced. For example, in their questionnaires, English participants, Annette and Francine, each rated the tweet about how often French people shower as totally credible. Nonetheless, they still wanted to check it. Before stating why, both participants launched into a series of derogatory remarks about French cleanliness. Annette starts:

> Stinky French. It's because of that hole in the floor for toileting, all those years ago, I'm sure. [FS-AF-1 (General)]

Francine responds:

> Of course they don't wash. We know they don't wash. [FS-AF-3 (General)]

This sets the (sometimes mildly humorous) tone for the rest of the dialog, which is sprinkled liberally with further comments about "the stinky French." It is as if Annette and Francine chose to check this particular tweet in order to confirm their prior belief that the French are less than meticulous about personal hygiene.

In other pairs, participants chose to fact-check tweets that related to perceived cultural differences between them. For example, Hannah, an English woman, tells Anath, a French woman, that she'd like to check the tweet about how often French people shower:

> Because I feel that's possibly where the English and the French have their most, erm, not our individual interests, but certainly culturally. [FS-AH-11 (Decide)]

Anath agrees, with a hint of self-deprecation (indirectly self-designating as a "Frenchie")

> Yeah, so they said only 43% of Frenchies are not showering on a daily basis. [FS-AH-12 (Analyze)]

Unlike Annette and Francine, Anath and Hannah are unsure initially about the tweet's credibility. In their pre-deliberation questionnaire responses, Anath gives it a score of 3 out of 7, and Hannah a score of 4 out 7. However, Anath adopts an ironic, defensive posture during the deliberation. For example, immediately after her comment above, she adds:

> but who knows what people have corrupted Google to put against French people. [FS-AH-14 (General)]

In summary, our qualitative data from participants' joint deliberations about which tweets to check suggest that at least one reason that people decide that a given piece of online information is worthy of further investigation is that it pertains to their own cultural identity or their prior beliefs about other cultures.

5.2. The checking process

How, in practice, did participants fact-check the tweets they selected?

Our first finding was that, in contrast to Metzger's (2007) linear theoretical model of credibility assessment of online information (see especially Figure 1 in Metzger, 2007, p. 2088), participants did not, in general, reach a judgment about the credibility of what they had read online after reviewing evidence. On the contrary, their review of evidence and deliberations on its quality and relevance was usually sandwiched between two or more credibility judgments. Typically, their joint deliberation began with an initial assessment of the Tweet's credibility, to which they then referred when deciding whether or not to check it. This initial judgment was then updated iteratively over the course of the deliberation until a conclusion was reached.

Similarly, the other elements of fact-checking that we identified in our analysis of participants' deliberations did not generally follow a predictable, unidirectional path. Instead, while all the pairs we studied employed each of the elements, they did not all employ them to the same extent or in the same order. Accordingly, our inductively generated model includes the possibility of multiple pathways and iterations between initial and final credibility judgments.

In other words, the data collected from the joint deliberations of our participants embodied the distinction that Dewey (1902) made between logical and psychological principles of organization (*cf.* Henle, 1962). Theoretically, it may be logical, after deciding to check a Tweet, first, to analyze its form and content to pinpoint precisely what to check; then, to plan how to check it; then, to formulate search terms to input into Google to access relevant evidence; then to interpret the results of the search; then, to evaluate their quality and relevance; and, finally, on the basis of the accumulated evidence, to judge the Tweet's credibility. However, in practice (i.e., from a psychological perspective rather than a logical one), people's deliberations are not generally linear. Their start and end points vary, and they include multiple iterations and revisions.

5.2.1. Analytical model

We represent these multi-directional and iterative features of fact-checking deliberations in the analytical model summarized in Figure 5. As the arrows indicate, it is possible, and sometimes the case, for the direction of deliberation to follow what might be considered the most logical sequence: View, Judge, Decide, Analyze, Plan, Formulate, Search, Interpret, Evaluate, Judge. However, more often, our participants' deliberations included loops and jumps. For example, one common loop was: Plan, Formulate, Search, Interpret, Formulate, Search, Interpret. In such cases, after interpreting the results of their initial search, participants reformulated their search terms to seek out other, additional or more relevant, evidence. Similarly, participants sometimes jumped from Plan to Interpret, as they essentially planned, formulated and searched "with their fingers," typing while talking with their interlocutor about the search terms they were entering into Google, pressing search, silently reading the results – all in a matter of seconds – before interpreting the results of the search.

5.2.2. The shape of deliberations

To explore how this 'canonical' analytic model played out in practice in relation to the content of the Tweet being checked and the cultural identities of participants, we devised a method to represent fact-checking deliberations graphically. This involved plotting the categories of deliberation along the y-axis and the series of utterances comprising the deliberation along the *x*-axis.

To illustrate how such graphic representations can be used to compare and contrast collaborative fact-checking deliberations, we present below a detailed qualitative analysis of two such deliberations – the first short and relatively linear; the second longer and loopier. Both deliberations are from mismatched, English-French pairs; but the first is about a low-salience Tweet (Iranian Scientists) and the second about a high-salience Tweet (French Showers).

5.2.2.1. Jonathan and Pierre on Iranian scientists

As we have seen already, Jonathan and Pierre's deliberation (Figure 6) begins with a preliminary judgment that the Tweet is suspect but might be true, and a joint decision to check it. Next,

FIGURE 5
Dynamic analytic model of collaborative fact checking.
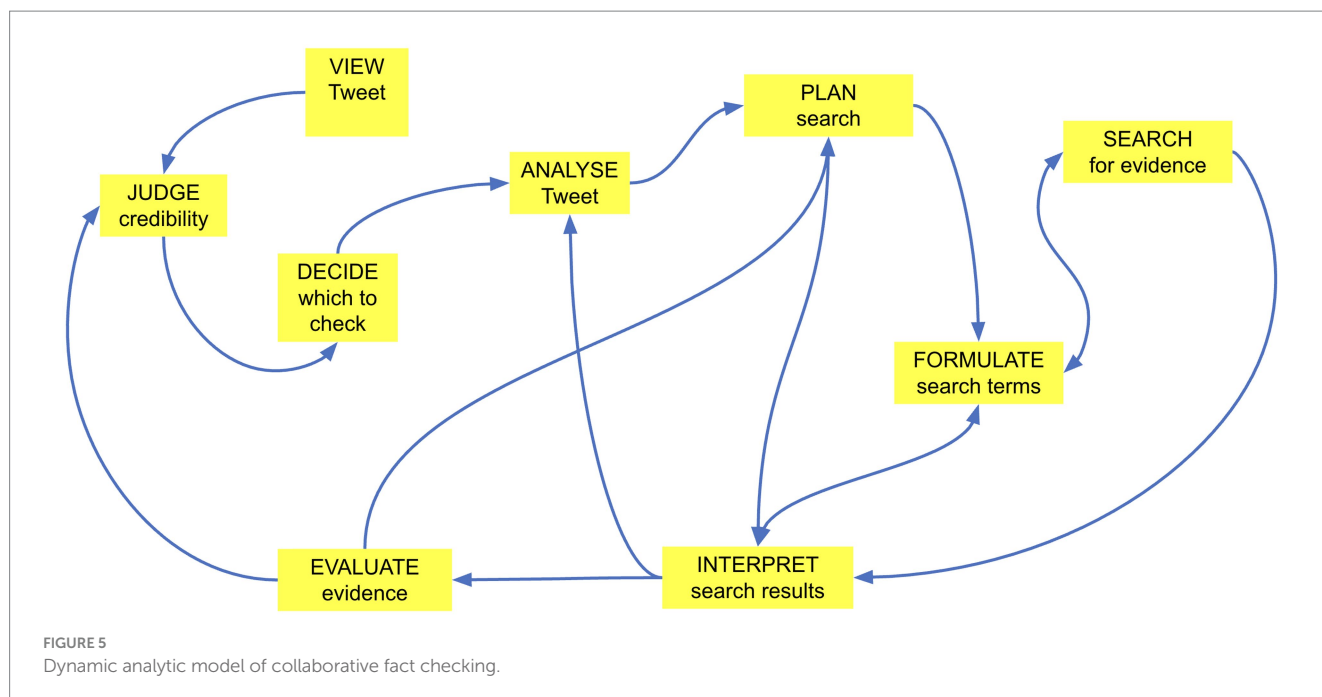
Jonathan, who is the "searcher" in this deliberation, formulates search terms and checks in with Pierre:

> Okay. So I'm gonna put in Iran engineering graduates, men and women. Yes? How's that sound?" [IS-JP-9 (Formulate)]

The search results appear to give a clear and positive answer, at the top of the first page of results provided by Google, which Jonathan reads out loud:

> Forbes says 70% of Iran's science and engineering students are women. [IS-JP-12 (Interpret)]

However, Jonathan does not simply accept the information provided as coming, as it appears, from Forbes. He opens a new tab and checks that the general appearance of the Forbes website corresponds to the page they have just seen:

> Let's see if it really is Forbes … It's definitely from Forbes. [IS-JP-13-16 (Search, Evaluate)]

Next, Jonathan points out that the information from Forbes is corroborated further down the first page of results of his initial Google search by other sites that he considers to be fairly reliable, such as The Hill, Quora and Reddit. Finally, Jonathan evaluates this evidence as being sufficient:

> So I would say, yeah, that would be enough for me. [IS-JP-19 (Judge)]

Pierre concurs:

> After I saw it on Forbes, I don't think that I would have looked much forward. I would have probably stopped here and considered that it's true, even if I am very surprised. [IS-JP-20 (General)]

Figure 6 represents schematically these features of Jonathan and Pierre's deliberation. The deliberation is short, comprising only 21 utterances. Jonathan's initial formulation of search terms yields a "direct hit," whereby the first page of Google results linked to an article in Forbes confirming the Tweet's claim. Jonathan trusts Forbes as a reliable source of information. But to make sure he was not being duped by a site masquerading as Forbes, Jonathan engages in "lateral reading" (Kozyreva et al., 2023), opening a new tab and checking that the format of the Forbes website corresponds to the format of the site they have just viewed.

5.2.2.2. Anath and Hannah on French showers

The shape of Jonathan and Pierre's deliberation about Iranian Scientists (Figure 6) differs markedly from that of Anath and Hannah about French Showers (Figure 7).

First, Anath and Hannah's deliberation is much longer than Jonathan and Pierre's, comprising 147 utterances (vs. Jonathan and Pierre's 21). Second, it contains more iterations, as the pair plan and re-plan their search, formulate new search terms, interpret the results and seek further evidence. Throughout their fact-checking deliberation, Hannah often turns to Anath as a translator and expert on French culture. Their deliberation also contains numerous diversions and 'zoom-outs' as the pair steps back from the specific search to share general thoughts about cultural difference and the relevance of different kinds of evidence.

As we saw earlier, Hannah and Anath's decision to investigate this Tweet is motivated partly by their interest, as a "mismatched" pair, in exploring together a topic that relates to possible differences between English and French culture.

Hannah takes the role of searcher. She begins by formulating search terms: "how often do French people shower," inputting them into Google, and pressing the search button.

Immediately after the results appear on the shared screen, Anath begins to interpret them:
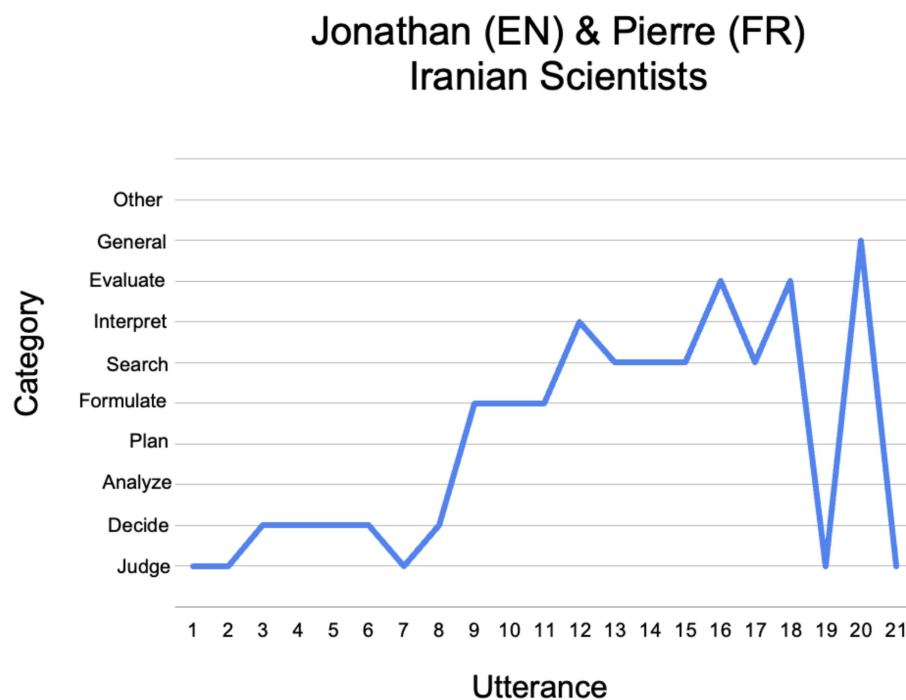
FIGURE 6
Jonathan (EN) and Pierre's (FR) fact-checking deliberation about Iranian scientists.

That's probably the source of that Tweet. [FS-AH-27 (Interpret)]

Then, right away, she seeks to dig a little deeper:

But is there a proper study for that? [FS-AH-28 (Evaluate)]

Hannah then clicks on a link at the bottom of the first page of results from her initial Google search to an article on the Thrillist website titled, "French people do not like to shower, survey shows." The article mentions a study conducted by poll company, BVA, and published in French newspaper, Presse-Océan, showing that "only 57% of the French shower daily."

Hannah asks Anath if she is familiar with the poll company and newspaper. Anath says "no," but comments that Presse-Océan sounds like a local newspaper from the west of France. Hannah then clicks on the link to the newspaper, which (confirming Anath's conjecture) connects to a website named Ouest-France, and an article in French titled, "Les Français restent en moyenne 9 min sous la douche" (which translates as: On average, the French stay under the shower for 9 min).

Anath points out that this does not give the answer they are looking for and instructs Hannah to open a new Google page. She then asks Hannah to copy-paste into Google from the Ouest-France article ("BVA-Doméo-presse régionale, sur les français restent … sous la douche" [English translation: "on the French remaining … under the shower"]). This links to the BVA website, the language of which is French, and which Anath helps Hannah to navigate, acting as her interpreter.

Anath: And that's basically, they are saying, that's the study about French people and what are our habits. And this second one.

Hannah: This top one?

Anath: No, the second … Let's see. And scroll down. Ok, ok so let's see. Scroll down. Yeah, So stop it here, just go a bit further up. They say here as well that only 57% are taking a shower every day. [FS-AH-73-80 (Formulate, Search)]

Having successfully located the source of the 43% statistic cited in the original Tweet, Anath now questions the study's trustworthiness:

So the question. I'm not sure how trustable this study is. I don't know who they are, if it's a big group or not. I have no idea who this BVA is. If you scroll down to the end of the article, let's see if they say how many people they have sampled, for instance. [FS-AH-86-90 (Evaluate, Search, Evaluate)]

Anath then directs Hannah to click on a link titled "sondage" (English translation: opinion poll). This leads to a PowerPoint presentation containing details of how the study was carried out, including the number and age of participants and their representativity of the French population. Scrolling down to look at the error margins, Hannah notes that it's 95% reliable, which leads her and Anath to concur that the study appears to support the Tweet's claim.

Anath: Trustworthy. Given the sampling variety.

Hannah: Yeah, I'd say, if nothing else, it was a serious study. [FS-AH-98-99 (Evaluate)]

Next, Hannah and Anath exchange general remarks about their judgments of the Tweet's credibility in relation to cultural differences between them. Anath admits to a lingering suspicion about the Tweet's credibility whereas Hannah acknowledges that, were she fact-checking alone, it would have been enough for her to see that the Tweet was

Anath (FR) and Hannah's (EN) fact-checking deliberation about French Showers.
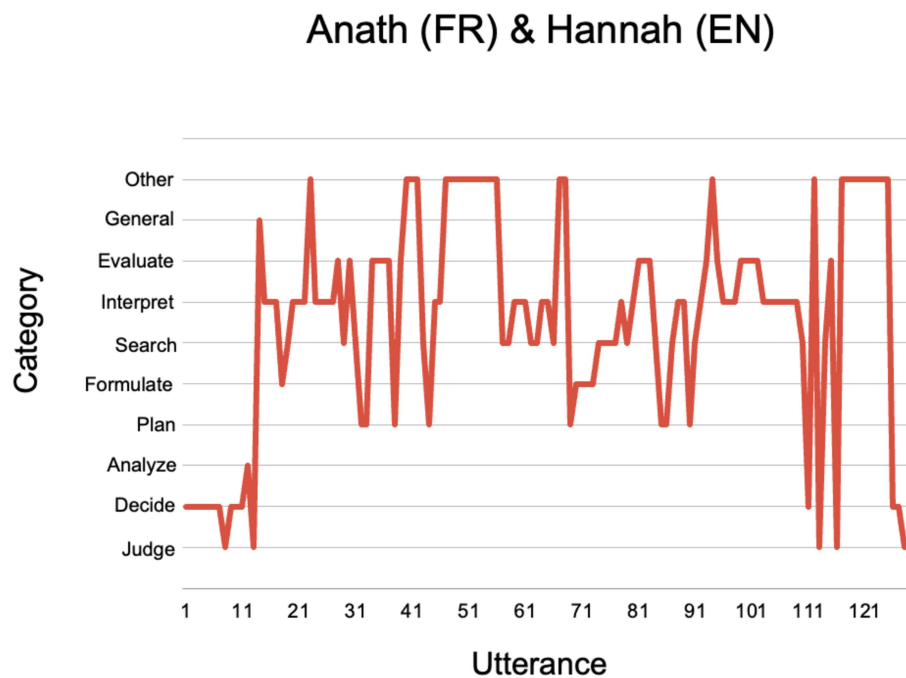
based on a survey, and she would not have dug any deeper into questions of sample size or error margins.

> Hannah: I think in truth if I'd seen that, whether I believed in the survey or whatever itself, I would probably stop and at least think the tweet was based on something.
>
> Anath: I was surprised. I would investigate more. And then when I see the study, unless I go and checkup, who is BVA, I would say maybe they've got some interest in saying that. I would say, like, commercial interests … Otherwise, I would say it's probably a subset of reality; I would tend to believe it.
>
> Hannah: I think the truth is that part of the cultural thing is, my interest in French people showering, to be honest, it's probably slightly less than Anath's. Because she feels something about her belief in it, whereas for me, it's just a figure. [FS-AH-125-131 (Judge, Search, Evaluate, Judge, General)]

Further evidence of Anath's greater stake in the Tweet's credibility, and her corresponding reluctance to take the results of their fact-checking at face value, is her use of irony and self-deprecating humor. During the debrief section of the dialog, Hannah drops off the videoconference due to an internet problem. Echoing her initial defensive posture, Anath jokes: "I hope it's not because of the French smell!"

5.3. Belief change

We have seen that fact-checking deliberations tend to comprise a determinate set of processes (deciding, analyzing, etc) but that the

order in which they appear, the extent to which they are employed, and the number of iterations through which go can vary considerably. But what are the effects of such deliberations on people's judgments of the credibility of the online information with which they were originally presented?

To examine this question, we compared participants' assessments of Tweet credibility before and after deliberation. We calculated the degree of belief change by subtracting participants' post-deliberation credibility ratings from their pre-deliberation ratings. For example, if a participant gave the Iranian Scientists Tweet a credibility rating of 2 prior to deliberation and a rating of 5 after deliberation, the degree of belief change was calculated as 5−2 = +3. Figure 8 presents the degree and direction of belief change for each tweet.

Each participant rated each tweet twice – once before, and once after, deliberation. Therefore, Figure 8 is derived from a total of 96 credibility ratings (2 per tweet, for 6 tweets, from each of 16 participants).

One striking finding is that there is considerable belief change, in both directions, for all but one of the Tweets. The exception was Masha's Veil. This was a Tweet purporting to be from French politician Marine Le Pen's Twitter feed, criticizing a state-run French TV channel for broadcasting a children's cartoon in which the heroine wears a head covering. The Tweet was considered by most participants to be considerably less credible when it was assessed a second time, even though, as can be seen in Figure 9, only 50% of the participants had fact-checked it in the interim.

This suggests that the act of fact-checking may have a general effect on credibility judgments – including about online information that has not itself been checked. In the case of Masha's Veil, the effect was negative, i.e., participants became more skeptical about this

FIGURE 8
Belief change by Tweet.

FIGURE 9
Percent of participants that fact-checked each Tweet.
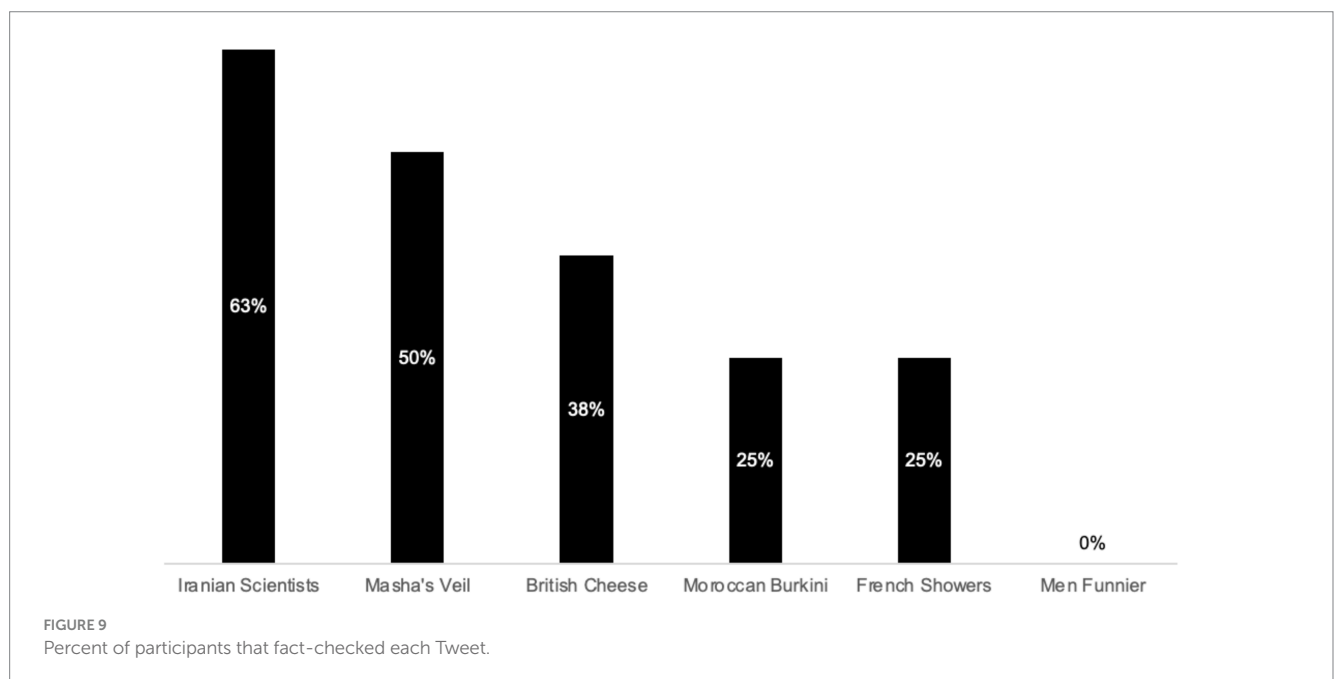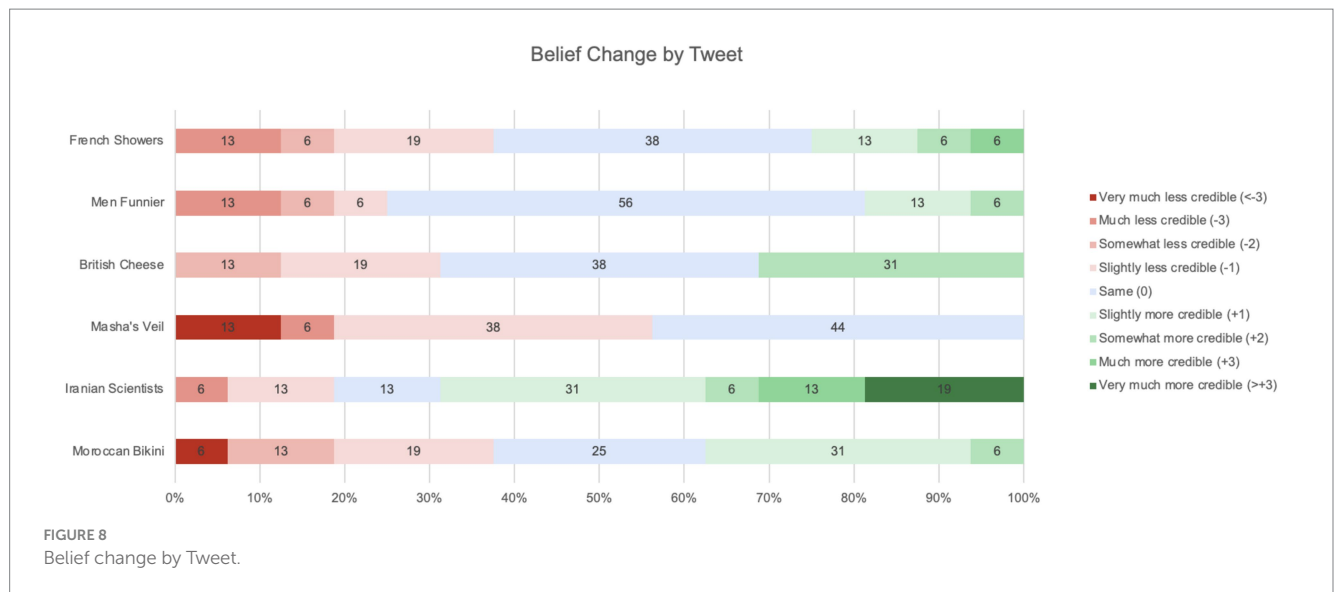
Tweet's credibility, even when it was not one of the Tweets they had checked. With all the other Tweets, the effect was both positive and negative, with some participants becoming more skeptical, and others becoming less so, after deliberation.

Further evidence of this general effect of fact-checking on credibility judgments – even of Tweets that have not themselves been checked – is provided by the Men Funnier Tweet. This Tweet, from the British Broadcasting Corporation's Twitter feed, cited a study claiming to show that men are funnier than women. As can be seen in Figure 8, nearly half the participants changed their assessment of its credibility after fact-checking other tweets, despite the fact that none of them had fact-checked the Men Funnier Tweet itself in the interim (cf. Figure 9).

We expected that belief change would be less pronounced for Tweets about which participants were initially suspicious. In practice,

however, the opposite was true. For example, 75% of participants reported in the questionnaire that they would like to check the Moroccon Burkini Tweet (a Tweet suggesting that Burkinis are prohibited in swimming pools in Morocco) because it might be fake. However, in practice, this was the Tweet with the greatest degree of belief change, with 37% of participants considering it more credible, and 38% of participants considering it less credible, after deliberation.

Similarly, belief change was just as evident, in both directions, for Tweets initially considered insufficiently important to check (such as French Showers) as for Tweets considered suspect and important enough to warrant checking (such as Moroccan Burkini).

As can be seen in Figure 9, the Tweet fact-checked in practice by most participants was Iranian Scientists. It was also a Tweet that most participants picked out in the questionnaire as one they wanted to check because it might be fake. As we saw above in the analysis of

FIGURE 10
Four deliberations compared.
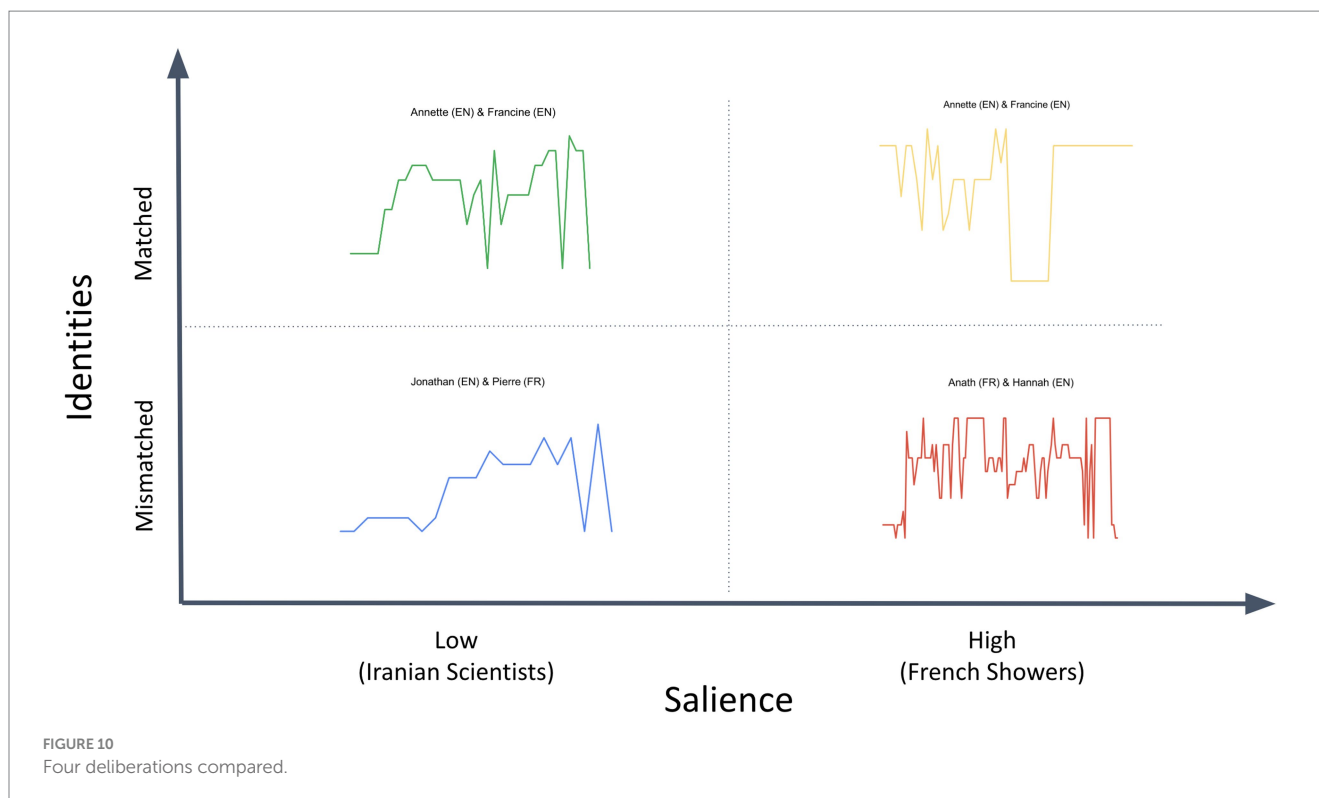
Jonathan and Pierre's fact-checking of this Tweet, evidence supporting its credibility was readily available, with an initial Google search yielding multiple reliable sources that appeared to back it up.

This combination of initial suspicion and subsequent revelation of supporting evidence is the likely explanation for participants' anomalously high degree of positive belief change in relation to the Iranian Scientists Tweet. Indeed, it is possible that participants' experience in relation to this Tweet, namely, of initial suspicions proving unfounded, accounts for at least some of the positive belief change in relation to other Tweets. "If I was overly suspicious about this Tweet," participants may have thought, "perhaps I'm also being overly suspicious about these other Tweets, too."

To summarize the findings of quantitative analyses of all participants' credibility judgments before and after joint fact-checking (presented in Figures 3, 4, 8, 9), fact-checking appears to promote belief change, as a function of the deliberation process. Moreover, the effects of fact-checking appear to extend beyond the particular Tweet checked, affecting credibility judgments about other Tweets, which were not themselves checked.

5.4. The role of identity

How were the processes of deliberation and belief change described above affected by (a) the salience of the information to readers' cultural identities, and (b) collaborative fact-checking with people whose identities differed from their own?

As noted earlier, to investigate these questions, we employed a 2 × 2 design to compare the deliberations of participant pairs that were matched for cultural identity (English-English) with pairs that were mismatched (English-French); and deliberations in which Tweet content was of high identity-salience to the participants (French Showers) with those in which Tweet content was of low identity-salience to participants (Iranian Scientists).

Figure 10 compares the shapes of four deliberations, using this 2 × 2 design. This graphic representation highlights three intriguing points of contrast.

First, when the Tweets are of low salience to the participants (i.e., the green and blue deliberations on the left side of the figure), there is little difference between the deliberations of the matched pair and the mismatched pair. Both deliberations are fairly linear, with few loops or jumps.

Second, when the Tweets are of high salience to the participants (i.e., the yellow and red deliberations on the right side of Figure 10), the deliberations are longer and more iterative, going more rounds before reaching their conclusion.

Third, these effects of high salience are more pronounced for mismatched pairs than for matched pairs. Specifically, as mentioned in our qualitative analysis earlier, the matched pair's high-salience deliberation (Annette and Francine on French Showers) focused primarily on confirming their prior beliefs, with their search for evidence peppered with general, derogatory comments about French hygiene. In contrast, the mismatched pair's deliberation about the same Tweet, included numerous loops and increasingly detailed investigation of the reliability of the sources on which the Tweet was based.

These effects of content salience and interlocutor identity on fact-checking deliberations are further underlined by the belief change data for the four deliberations analyzed in Figure 11.

In the matched cases, salience had no effect on belief change. In contrast, both mismatched pairs exhibited belief change. However the change was much greater in the low salience case (Pierre and Jonathan

FIGURE 11
Belief change data for each of the deliberations analyzed in Figure 10.
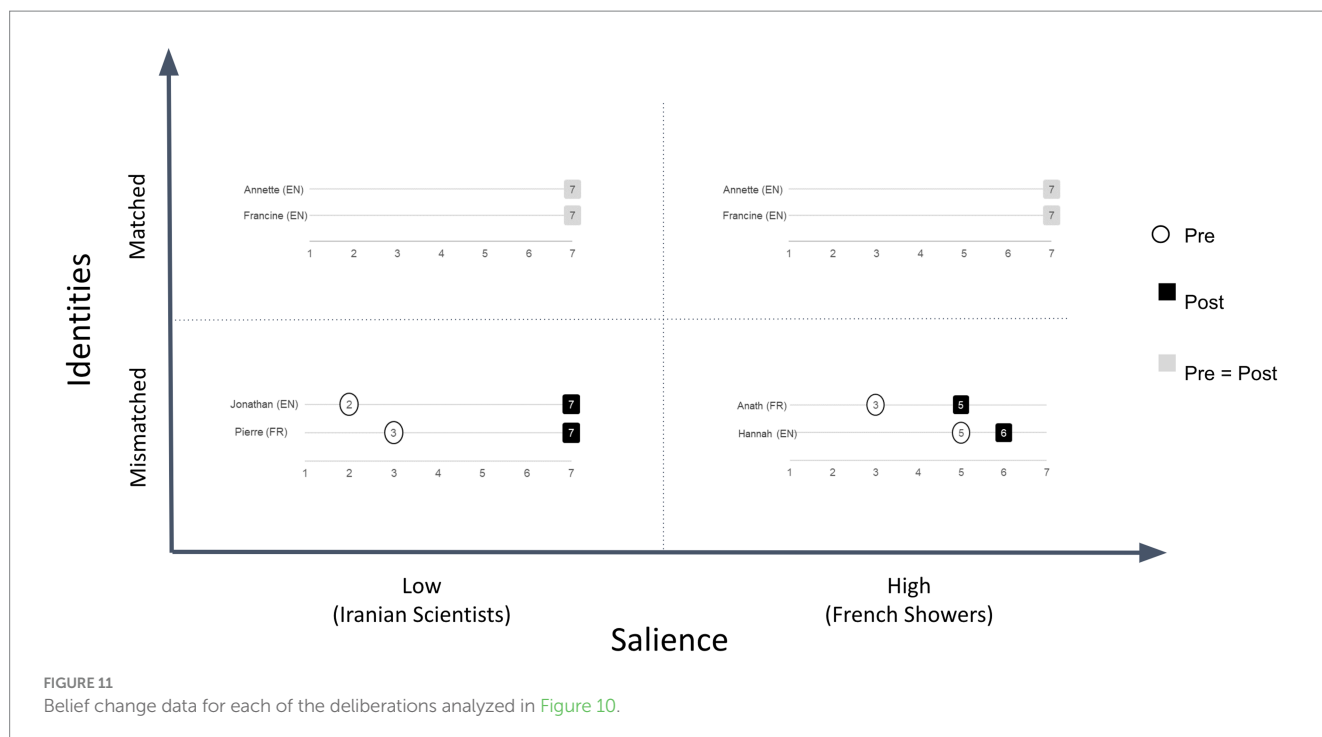
on Iranian Scientists) than in the high salience case (Anath and Hannah on French Showers). Specifically, Jonathan and Pierre's deliberation about the Iranian Scientists Tweet led them to revise significantly their assessments of its credibility: from 3 to 7 in Pierre's case and 2 to 7 in Jonathan's case. However, Anath and Hannah's deliberation about the French Showers Tweet led them to revise their judgments more modestly – from 3 to 5 in Anath's case and from 5 to 6 in Hannah's case.

Taken together, these findings suggest that when the content of online information is of low identity-salience, the identities of the interlocutors have little effect on the deliberation, and belief change is a function primarily of evaluation of relevant evidence. However, when the content is of high-identity salience, the identities of the interlocutors significantly affect the deliberation. Specifically, matched pairs' beliefs remain relatively impervious to the evidence, whereas mismatched pairs' beliefs change in the direction of the evidence, but to a lesser degree than when the content is of low salience.

In summary, the data are suggestive of the hypothesized two-factor model that motivated our 2 × 2 design, namely that identity considerations set limits to fact-checking of online information, but neither replace nor eliminate it.

6. Discussion

6.1. Key findings

Our goals in this study were to investigate what leads people to fact-check online information; how they fact-check in practice; how such fact-checking affects their judgments about the information's credibility; and how the above processes are affected by the salience of the online information to readers' cultural identities and collaborative fact-checking with people whose identities differ from their own.

Within the limits of a case-study approach, our results suggest that people are led to fact-check online information when they perceive that information to be plausible but suspect, i.e., on the cusp of believability but neither obviously true nor obviously false. However, this alone is not sufficient to motivate fact-checking. To make the effort to search for, and evaluate, relevant evidence, people have first to conclude that the information is important enough — in general or personally — to warrant further investigation. If they consider the information suspect but trivial, they are less likely to fact-check it.

One factor that appears to be particularly relevant to people's decisions about whether or not to fact-check online information is the salience of the information to their cultural identities. Whether to confirm stereotypes about relevant "Others," as in Annette and Francine's decision to fact-check a Tweet about how often French people shower, or to defend their own cultural group, as in Anath's decision to fact-check the same Tweet, participants in our study often chose to fact-check Tweets that pertained in some way to their own cultural identities.

These findings should be considered suggestive rather than conclusive. It is likely that participants' interest in issues of cultural difference were exaggerated in our study. After all, we recruited them explicitly to take part in a study of "how people from different backgrounds" assess the credibility of what they read online. Either out of social desirability (i.e., seeking to give the investigators what they want) or simply in response to an experimental situation in which they are invited to deliberate with someone from a different cultural background, they may have been motivated to focus more on issues of cultural identity and cultural difference than they would, had they been left to their own devices. Nevertheless, the fact that such reasons were given for checking some tweets and not others suggests that the presence of identity-salient content is indeed one motivator to fact-check.

With respect to the process by which people fact-check online information, our empirical findings suggest a novel account

(summarized in Figure 5) wherein fact-checking deliberations comprise a determinate set of elements, which are deployed to differing extents, and in differing orders, depending on content and context. This empirically-generated model of online fact-checking differs from previous, theoretical models in at least two, important ways.

First, it posits (*contra* Metzger, 2007) that judgments of the credibility of online information do not occur only at the end of a fact-checking deliberation. Rather, readers make an initial assessment of the information's credibility to decide whether or not it is worthy of further investigation. They then revise this initial assessment iteratively over the course of their deliberation before reaching a final judgment.

Second, these iterations can include loops, in which readers pass several times through the process of planning a search, formulating search terms, and interpreting search results, as they refine their conceptions of relevance and seek more precise forms of evidence. They can also include jumps, wherein readers skip from one element of fact-checking to another, apparently missing out intervening steps. This happened, for example, when some of our participants typed search terms into Google, pressed search, and interpreted the results, all in a matter of seconds, without saying anything about what they were doing while they were doing it.

Pre-post comparisons of participants' assessments of Tweet credibility before and after deliberation indicate that the above fact-checking processes affect credibility judgments and lead to belief change. However, contrary to our expectations, such belief change was not exclusively, or even mostly, toward greater skepticism. For all but one of the Tweets included in the present study, there was movement in both directions following deliberation, with some participants considering Tweets more credible after deliberation and others considering them less credible after deliberation.

Moreover, these belief change effects were not limited to the specific Tweets that participant pairs discussed in practice. Rather, participants' post-deliberation credibility judgments differed from their pre-deliberation judgments even regarding Tweets that they had not discussed. This suggests that fact-checking of online information has a general effect on the tendency to make certain types of credibility judgments, beyond the specific information checked.

Nevertheless, this latter effect may be somewhat exaggerated in the present study due to the fact that the Tweet fact-checked in practice by most participants was Iranian Scientists. This was a Tweet about which most participants (63%) were skeptical prior to deliberation and for which evidence supporting its credibility turned out, in practice, to be readily available. This may have led participants to adopt, following deliberation, a general expectation (or "mindset") that their skepticism about other Tweets, too, might prove unfounded. If so, this might account for some of the positive belief change with respect to the other Tweets that they had not in fact checked. However, this potentially confounding factor is mitigated by the fact that, as noted earlier, many participants (ranging from 25 to 57%, depending on the Tweet) became more skeptical following deliberation, as opposed to less so.

Beyond the above insights into general processes of online fact-checking and their effect on belief change, our findings suggest that the salience of online information to the cultural identities of readers affects systematically both how they fact-check it and the degree to

which such fact-checking leads them to revise their initial judgments of its credibility.

When salience is low (as in the case of the Iranian Scientists Tweet), fact-checking processes are simpler and more linear than when salience is high, and belief change is broadly in accord with the evidence discovered. This pattern appears to apply equally to matched and mismatched pairs.

However, when salience is high, we observe different patterns of fact-checking for matched and mismatched pairs. Specifically, when mismatched pairs fact-check online information of high identity-salience (such as when an English-French pair fact-checks a Tweet about how often French people shower), their deliberations tend to be longer and loopier than deliberations (whether by matched or mismatched pairs) about low salience content (such as Iranian Scientists). They also tend to be longer and loopier than the deliberations of matched pairs about high salience content (such as when an English-English pair fact-checks a Tweet about how often French people shower).

Moreover, these divergent patterns of fact-checking are associated with systematic differences in the extent and direction of belief change. Specifically, when matched pairs fact-check online information of high salience, they tend to confirm their initial beliefs rather than revise them. Mismatched pairs do the opposite: They revise their initial beliefs in the direction of the discovered evidence, even when the object of their fact-checking is of high salience. However, such revisions tend to be smaller than when the object of their fact-checking is of low salience.

Our results suggest that identity may affect fact-checking in several, related ways. First, it affects people's motives to check or not to check a given piece of online information. Second, it affects the standards of credibility people apply to the evidence they discover pertaining to that information. Recall, for example, the suspicions of Anath, a French participant, about the motives of the opinion pollsters, and indeed of Google, when fact-checking the French Showers Tweet. This skepticism contrasted with the readiness of her English search partner, Hannah, to accept the evidence they encountered at face value.

Third, identity constrains belief change. When the online information investigated is of high identity-salience, matched pairs tend to confirm their initial beliefs after fact-checking. Mismatched pairs, on the other hand, tend to revise their belief in the direction of the evidence. But they do so to a lesser extent than occurs when the online information is of low salience.

6.2. Qualifications

While these findings are highly suggestive, they should be interpreted with caution. This was an exploratory study, in which we developed new methods of data collection and analysis to investigate empirically the role of cultural identity in processes of fact-checking.

Our decision to focus on collaborative fact-checking had the advantage of making people's deliberations about the credibility of online information visible (audible). Because they were fact-checking together online, using a shared screen, our participants were required to make their thinking explicit, as they planned their search, formulated terms, and so on. This explicitness included not only the

verbal interactions between them but also their use of the keyboard and their body language (albeit from the shoulder up) as they viewed their screens and considered the material before them.

However, a disadvantage of this focus on collaboration is that it introduces additional factors to the process of fact-checking that may be theoretically extraneous or perhaps even confounding. For example, collaborative interactions are rarely symmetrical. More commonly, one of a pair will do more heavy lifting than the other. Especially in mismatched pairs fact-checking highly salient online information, one participant may have greater knowledge of the context than the other. For example, a French participant in an English-French pair assessing the credibility of a statement attributed to Marine Le Pen might intuit immediately what makes the Tweet more or less credible, while their English search partner is still trying to figure out who Marine Le Pen is.

Language is another source of asymmetry. Depending on the Tweet and the participants, one member of a pair might be searching in their mother tongue while the other is searching, and communicating with their partner, in their second or third language. There are also individual differences between participants. Some people are more garrulous or 'pushy' than others, and tend to talk, or to take the lead in joint activities, more than others do.

Beyond these cultural, linguistic, and personal sources of asymmetry, our design included a further asymmetry in the division of labor between the designated searcher and their partner. By 'owning' the means of production (i.e., the keyboard), the power of the searcher to set the terms of the search and to follow up particular leads by clicking on them was greater, by default, than that of their search partners.

In the present study, we sought to address some of these asymmetries directly. For example, to minimize linguistic asymmetry, we produced English and French versions of the questionnaire, formed pairs that shared at least one common language and enabled them to interact in whichever of the two languages they felt most comfortable. Similarly, to minimize design asymmetry, we had pairs discuss two Tweets and switch roles: One participant being the searcher of the first deliberation, the other switching them out for the second deliberation. In practice, we did not observe any systematic differences between the processes or outcomes of a pair's first deliberation versus their second deliberation. This suggests that, in the present study, which member of the pair "led" the deliberation was not a significant factor in determining the process or outcome of that deliberation.

However, it is not possible in a study of this kind to anticipate and eliminate all forms of asymmetry. Accordingly, it is important to bear in mind when interpreting our findings that collaborative fact-checking is a joint production and that how a participant fact-checked with this particular partner might differ from how they would fact-check with another partner or on their own. Most obviously and importantly, one cannot generalize safely from findings about collaborative fact-checking to conclusions about individual fact-checking.

Some additional qualifications are necessary regarding our operational definitions of cultural identity and identity-salience. Because pairs were free to choose to fact-check any two out of the six tweets presented in the questionnaire, we did not know in advance which dimensions of cultural identity or identity-salience (nationality or gender) would yield the most pertinent data to our investigation. In practice, we did not observe any significant gender effects.

In this context, it is important to remember that the notion of identity-salience is relative rather than absolute. For example, the question of how often French people shower can be assumed to be highly salient to French people. But because French people's alleged poor hygiene is a common cultural stereotype in England, it is also salient to English people – for whom the French (like the Germans and the Irish) are a highly salient "Other." This high identity-salience of the French Showers Tweet for English and French participants can be contrasted with the relatively low identity-salience for these participants of the Iranian Scientists Tweet. The gender distribution of science and engineering graduates in Iran is not an issue of special salience to English and French participants. We hypothesized that it might be more salient to women participants than to men participants. But we did not find any compelling evidence that this was the case in practice.

In future studies, we recommend that contrasts between high and low salience online information be sharpened further by selecting 'hotter' topics, such as ethnic conflicts, border disputes, and so on, about which people from different cultural backgrounds are more likely to diverge.

6.3. Implications

In this study, we developed a novel approach to investigating how people fact-check online information, and devised new methods for analyzing online fact-checking processes. This approach focuses on designing ecologically valid situations in which people engage in collaborative fact-checking. The advantage of this approach is that it makes deliberation visible, and therefore analyzable, as opposed to activity that is presumed to occur silently in individual heads.

A second novelty was our development of an empirical account of how people fact-check online information in practice. This account diverges in intriguing ways from previous, theoretical accounts. For example, rather than credibility judgments coming at the conclusion of a fact-checking process, we found them to occur iteratively over the course of a fact-checking deliberation.

A third novelty of our approach is the introduction of cultural identity – as both a motive and a constraint – in the investigation of fact-checking processes. Our comparisons of fact-checking processes and belief change under conditions of high and low identity-salience, and with pairs matched and mismatched for cultural identity, offer new methodological tools for investigating the role of cultural identity in fact-checking. Moreover, our findings suggest that cultural identity is an important factor in evaluation of online information, and thus warrants further, detailed study. Whereas the present study focused on national identity, future studies would be relevant on other dimensions of cultural identity, such as religion and ethnicity.

Beyond these methodological and theoretical advances, our findings suggest intriguing educational possibilities. If mismatched pairs are able to engage in extended deliberation about identity-salient online information, and to revise their beliefs in the direction of the evidence as a result, joint fact-checking by mismatched pairs may hold potential as a tool for teaching people to think critically about online information, even when that information impinges on their own cultural identities. In these times of misinformation, identity politics and polarization, such tools may be more crucial than ever.

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 approval was not required for the studies involving humans because participants were all legal adults, aged 30 and above, who provided written consent to participation in the study. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

EG: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Validation, Visualization, Writing – original draft, Writing – review & editing. MB: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. FD: Conceptualization, Formal analysis, Methodology,

Validation, Visualization, Writing – original draft, Writing – review & editing.

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 creative behavior of virtual idol fans: a psychological perspective based on MOA theory

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Breakthroughs in digital technology are accelerating the development and commercialization of virtual idols. They are overturning the traditional one-way communication between idols and fans, turning fans into producers and consumers. Therefore, identifying the motivations for fan creation can regulate and guide the creative behavior of fans and turn their creativity into productivity. This paper took "the factors influencing fans' spontaneous participation in creating virtual idols" as the primary research question, took the Motivation Opportunity Ability (MOA) theory as the research framework, used questionnaires as the primary research method, and combined the relevant research on motivation theory and self-determination theory to explore fans' creative behavior from the psychological perspective in depth. The empirical tests revealed that in the motivation dimension, interest motivation, achievement motivation, social motivation, and utility motivation all positively influenced fans' creative behavior; in the opportunity dimension, fans' perceived cost had a significant negative moderating effect on the influence of interest motivation, social motivation, and utility motivation on fans' creative behavior; fans' perceived community atmosphere was substantial. The moderating effect of knowledge and skills on the capability dimension was insignificant. For the virtual idol industry, the future development of the industry could not only focus on IP image creation and content production but also effectively stimulate fans' creative motivation through the creation of an excellent community atmosphere, the provision of targeted creator services, and the reduction of fans' perceived costs in the creation process.

KEYWORDS
creative behavior, virtual idols, fans, MOA theory, psychological perspective

1 Introduction

Under the wave of the digital economy, virtual idols are becoming one of the most imaginative industries. According to the "2022 Research Report on the Development of China's Virtual Human Industry" released by iMedia Research (2022), the number of virtual human-related enterprises has doubled since 2021. The overall market size and core market size driven by virtual idols were 107.49 billion RMB and 6.22 billion RMB, respectively. The growth rate of their market size has exceeded 50% for four consecutive years, and it was expected to reach 640.27 billion RMB and 48.06 billion RMB, respectively, by 2025. The market showed a penetration trend from online channels to offline spaces and from niche circles to mainstream

cultural circles. Virtual idols are aerial images based on digital technology and even a "concept" jointly created by virtual idol production companies and fans. With the support of technology, virtual idols have strong plasticity, incredibly realistic forms, and natural expressions, which not only achieve breakthrough development but also provide more possibilities for fans to participate in creative activities. One of the essential characteristics of virtual idols is "sharing and co-creation and stimulating the creative power of fans is an integral part of the operation and management of virtual idols. Improving the ecology of creators has also become an essential part of the development of virtual idols. Therefore, from the perspective of fan creators, the psychological motivation and external influencing factors of fan participation in virtual idol creation are a new field worth exploring (Edmondson et al., 2004; Titrek and Celik, 2011; Dahling and Ruppel, 2016; Raza et al., 2017; UNCTAD, 2018; Ahmad et al., 2019; Peng et al., 2019; Choi et al., 2021; Malik et al., 2021; Wang et al., 2021; Cui et al., 2022; Schilling et al., 2022).

Virtual idol refers to a virtual character who is usually a singer, actor, idol, etc. It is artificially created using computer graphics like Lil Miquela, Imma, A-Soul, etc. In recent years, there have been many studies on fans' involvement in the production and consumption of idols, but these have not yet been extended to the specific subject of virtual idol fans (Li and Chen, 2018; Zheng and Zhang, 2019; Choi et al., 2021; iMedia Research, 2022; Wang, 2022). However, most of the existing academic studies on fans of virtual idols stop at the cultural study of virtual idols and fans, neglecting to explore the factors influencing fans' spontaneous participation in creation from the perspective of empirical research (Podsakoff et al., 2003; Shalley and Gilson, 2004; Shalley et al., 2009; Shin et al., 2019; Liu et al., 2023; Widodo et al., 2023). Virtual idol fans had significantly more initiative and creative power in the production and consumption of their idols, which made the innovative behavior of virtual idols more and more complex. Therefore, this paper aims to examine in depth the creative behavior of virtual idol fans from a psychological perspective phenomenon to better understand the nature of the virtual idol phenomenon (Wang et al., 2017; Yuan et al., 2019; Gelaidan et al., 2022; Cai et al., 2023; Liang et al., 2023).

The main contribution of this study lies in the following two aspects. In terms of the virtual idol industry, it not only helped to promote the development of virtual idol and fan creation but also provided suggestions and strategies for regulating and promoting fans' creative behavior, ultimately achieving the aim of promoting the healthy and sustainable development of the virtual idol industry. In a theoretical sense, this paper used MOA theory to conduct research, combined self-determination theory and motivation theory to construct a research model of virtual idol fans' creative behavior, and reasonably classified the factors influencing virtual idol fans' creative behavior from three levels: motivation, ability, and opportunity, and finally conducts validation analysis through questionnaire survey method. This broadened the application area and research object of MOA theory to a certain extent (Anaza and Nowlin, 2017; Anwar, 2017; Aljawarneh and Atan, 2018; Liu et al., 2023; Lu et al., 2023).

The paper was structured into the following sections: firstly, a literature review of the relevant research areas; secondly, a description of the research design and the research methods used; a clarification of the findings of this study; and finally, an analysis of the findings and recommendations for the future marketing and management of virtual idols based on the findings. Overall, this paper applied MOA

theory to the study of the factors influencing the creative behavior of virtual idol fans, provided an academic explanation for the spontaneous creative behavior of fans, and explored the factors influencing the creative behavior of virtual idol fans as well as the internal correlation between these factors. Based on the research findings, marketing management suggestions were provided for developing virtual idols, including suggestions for optimizing the design of creative incentives for virtual idol companies and online communities, as well as suggestions for the rational management and guidance of fans' creative behavior.

2 Theoretical background and research hypotheses

2.1 Virtual idols

The rapid development of virtual idols has received widespread attention from scholars at home and abroad, focusing on four aspects: the study of the phenomenon of virtual idol development, critical reflection, business models, and fan culture.

The first was to analyze virtual idols at the phenomenological level and to give a general grasp of the new phenomenon of virtual idols. In his study of "celebrities," Chris (2002) noted the fictionalized images of celebrities and called them "virtual celebrities," whose image-building represented the tastes of the public at the time. Zhao (2017) explained the cultural attributes of virtual idols and unpacked them, arguing that they were a clever blend of technology, idol culture, and music culture, ultimately merging into a vibrant and emerging youth subculture. Most scholars agreed that virtual idols were avatars engaged in performing arts under the development of digital technology. They were "perfect images" constructed by the official and the fans, with fans' at their core.

From a critical and reflective standpoint, studies from this perspective seek to explore the potential pitfalls of the rapid development of virtual idols and reveal the social issues involved. Existing studies have critically considered the development of virtual idols from the perspectives of gender hegemony (Black, 2012; Farrukh et al., 2023), subculture, post-human, semiotics, and consumer culture. Communication scholars mostly affirmed the cultural creativity brought by virtual idols but also remained wary of the possible alienation of cultural symbols, the dissolution of the boundaries between reality and imaginary, gender hegemony, and self-alienation brought about by technological development (He et al., 2020a,b; Liu et al., 2022; Wan et al., 2022).

Many studies explored the development of virtual idols from the perspective of business models. Guga (2015) believed that the success of virtual idols in business models was not only reflected in their progressive technology but also reflected in their characteristics as a combination of enterprise software products, pop stars, behavioral artists, and multimedia art products. Guo and Zhang (2022) analyzed the development of virtual idols and their marketing from the perspective of the fan economy, arguing that fan participation in the creation of virtual idols was the most important feature and advantage of virtual idols, which was conducive to enhancing the stickiness of fans and the commercialization value of idols. In general, the most incredible, most significant economic value and business model innovation of virtual idols was reflected in

the openness of their creation technology and the unique fan co-creation operation model.

At present, related to the studies on the culture and operation model of virtual idols and fans, scholars mainly focused on cultural studies in communication, including theoretical perspectives such as mimetic social interaction (Liberman et al., 2001; Jha and Varkkey, 2018; Khalid et al., 2018; Zhao and Xia, 2019; Zhao and Liu, 2020; Zhang and Wang, 2021; Wang, 2022), participatory culture (Widmer et al., 2012; Wen, 2017; Men et al., 2018; Song, 2019; West et al., 2019), group identity (Zhan, 2019), identity construction and identity (Rhee and Choi, 2016; Li and Chen, 2018; Mitchell et al., 2019; Robbins and Judge, 2019; Zhang and Min, 2019; Nguyen et al., 2022), and emotional labor. From the perspective of mimetic social interaction, identity, the need for social security and the emotion of admiration were the ties that sustain the imitative social interaction between virtual idols and their fans (John, 2006; Zhang et al., 2015; Škerlavaj et al., 2018; Song et al., 2020; Tang et al., 2021). Most scholars noticed the transformation of virtual idol fans from consumers to producers in their analysis of virtual idols and fans and the resulting fan value.

2.2 The creative behavior of idol fans

The study of the creative behavior of fans first began with the subject of real-life icons. As early as the end of the 20th century, John Fiske referred to fans as "excessive readers," arguing that they were not passive recipients, but were not only discerning but also productive, eager to create their own culture by "assembling" and "rewriting" the original texts (Postigo, 2007). With the advent of the Web 2.0 era, the connotations and forms of fan 'participatory culture' have been further expanded. Social media, video sites, and other UGC and PUC platforms have begun to enter the lives of the public, not only accelerating the formation of online communities linked by intriguing ties, but also widening the path of means of text production and circulation, providing fans with a platform to express their views and self-expression. Some studies also confirmed that fans did not just passively receive content, but also spontaneously evaluated it and created based on it (Zheng and Zhang, 2019). In the new media era, scholars have analyzed the drivers of fans' participation in creative behavior, creative characteristics, and the construction and operation of fan creation communities from the perspectives of social psychology (Zhao and Hou, 2018), media economics, semiotics, and group identity and emotional payoff. In short, with the support of media technology, fans transformed from mere consumers to highly engaged producers and consumers, "productive consumers" who participated in original content, secondary re-creation, and even creative integration.

As a new thing, there were few studies on the creative behavior of virtual idol fans. Some studies analyzed the characteristics of virtual idol fans' participation behavior and initially affirmed the high degree of autonomy of fans in the creation of virtual idols, as well as their cultural significance and commercial value, which also guided this study to explore the creative behavior of virtual idol fans (Yang and Peng, 2015; Shang et al., 2019; Park and Lee, 2021; Gelaidan et al., 2022; Wan et al., 2022; Widodo et al., 2023). Some scholars studied the creative motivations of virtual idol fans, mainly through descriptive analysis and qualitative research represented by in-depth interviews (Postigo, 2007; Fan and Zhang, 2015; Zhao and Hou, 2018; Zhan, 2019; Guo and Zhang, 2022; Zhang et al., 2022).

Overall, in the research on virtual idols, in-depth attention was paid to the problems faced by virtual idol fans in their creative practice, and few of them considered the individual motivation variables for fan creators without delving into the psychological motivation and environmental influencing factors of fan creative behavior. Although empirical studies focused on the motivations of fans' creative behavior in the study of "real idols," they did not extend to the emerging subject of virtual idols. Secondly, from the perspective of research methods, the research method for virtual idols was relatively homogeneous, lacking empirical examination of virtual idols and their fan creator groups, and failing to fully reflect the complete picture of fan creators. Finally, from the psychological perspective of the study, multiple factors influenced individuals' spontaneous participation in creation, involving various influences such as personal and environmental factors. Based on this, this study focused on the factors influencing fans' spontaneous participation in virtual idol creation. Quantitative research methods were used to explore the psychological motivation and environmental factors influencing fan creative behavior to help virtual idol companies more accurately understand the psychology and behavior of fan creators when shaping and maintaining virtual idol images.

2.3 Theoretical model

The MOA theoretical model is derived from studies on the motivation of individual information behavior. Based on earlier studies on motivation, MacInnis and Jaworski (1989) extracted and summarized reasonable factors in multiple relevant models and proposed a MOA theoretical model to explain the occurrence of individual behavior. MOA theory includes three pre-variables: Motive, Opportunity, and Ability. Its basic assumption is that motivation will directly impact behavior, and there is a complementary relationship between motivation, opportunity, and ability (Kim et al., 2022; Zhang et al., 2022). In other words, individual motivation will directly affect the final behavior, and ability and opportunity, playing a crucial regulatory role in this process.

MOA theoretical model is open and inclusive, and it does not have a specific list of variables, which provides an effective practical basic framework for analyzing the factors influencing individual behavior. Motivation refers to a kind of motivation that leads an individual to produce a specific behavior, generally expressed as willingness, interest, and the desire to process information. Opportunity is an abstract concept, mainly characterized by timeliness and advantage, which refers to the situation or external driving factors that have an impact on an individual's implementation of a particular behavior (MacInnis and Jaworski, 1989; Binney et al., 2006; Eva et al., 2023). Specific behavior to the knowledge and skills needed for an individual to carry out a particular behavior or task. The relationship between the three factors in the MOA theoretical model can be understood as follows: motivation (M) is the precursor driving force of individual behavior and the direct factor of behavior occurrence; Opportunity (O) is the collection of many factors in the external environment that affect the production of behavior; Ability (A) is the skill that is necessary for the production of behavior. The combination of

ability - opportunity - ability contributes to producing individual-specific behavior.

The MOA theoretical model was first used in the field of advertising and marketing and has now been widely used in the research of information-receiving behavior in the fields of communication and management, such as social marketing (Edmondson, 1999; Baer and Oldham, 2006; Maqbool et al., 2019; Chatterjee et al., 2021; Hwang et al., 2023), knowledge exchange, and knowledge sharing in virtual communities (Tierney and Farmer, 2011; Ghani et al., 2019; He et al., 2021; Wang et al., 2021; Chen et al., 2022), influencing factors of Internet knowledge payment behavior (Sijbom et al., 2017; Shang et al., 2019; Singh, 2019), and travelers' intention to participate in social media (Yang et al., 2019; Ye et al., 2020; Yang et al., 2021), etc. Specifically on the level of users' creative behavior, Fan and Zhang (2015) applied MOA theory to the study of users' participation behavior in Q&A websites. They found that altruistic and reciprocal motives and opportunities provided by the platform, such as perceived ease of use, perceived economy, perceived website image, website atmosphere, as well as users' ability in knowledge transformation and professional knowledge, which is an element related to user participation behavior (Briliana et al., 2015; Yang and Hu, 2019). Yang and Peng (2015) applied the MOA theory to research the driving mechanism of tourist knowledge sharing. They discovered that the three dimensions of motivation-opportunity-ability substantially impact users' creative behavior. The main influencing factors are self-presentation, perceived entertainment, human-computer interaction, perceived interaction, and professional skills.

In general, the MOA theoretical model covers the individual factors and situational factors of behavior, and a large number of different studies have confirmed the applicability of the MOA theoretical model in other disciplines, it is an integrated analytical framework to explain the occurrence of individual behaviors.

This study took the MOA theoretical model as the theoretical framework, combined the research results of motivation theory and self-determination theory, and extracted the factors influencing fan creative behavior at the motivation, opportunity, and ability levels according to the characteristics of virtual idol creation and the characteristics of its fan groups. The self-determination theory holds that each individual has the basic psychological need for self-development, and divides this basic psychological need into autonomy, competence, and relatedness (Deci and Ryan, 2009). Based on the self-determination theory, the internal motivation of fans is divided into three dimensions: interest motivation, achievement motivation, and benefit motivation. Ryan and Deci (2000) pointed out that when individuals are intrinsically motivated, they will act out of intrinsic satisfaction, pleasure or challenge brought by activities, such as hunger, responsibility, altruism, and desire to be appreciated. Motivation theory divides fans' creative motivation into internal motivation and external motivation. In the empirical research of fans' creative behavior, motivation theory, and self-determination theory will provide more in-depth research for the research based on the MOA theoretical model. Specifically, the motivation level included four independent variables: interest motivation, achievement motivation, social motivation, and benefit motivation from the psychological perspective; the opportunity level included two moderating variables, perceived cost, and community atmosphere; and the ability level included the moderating variable of knowledge and skills. Finally, this paper constructed a research model that influenced the creative behavior of virtual idol fans (Figure 1).

2.4 Research hypotheses

This study drew on previous research, used the MOA theoretical model as the basic framework, and combined classical motivation theory research, self-determination theory, and interview data to propose the following research hypotheses.

Motivation refers to whether the individual's subjective will to produce a particular behavior is satisfied, and it is the integration of multiple elements, such as will, interest, and expectation, in the determined behavior. Combined with the above studies on motivation theory and self-determination theory, four secondary variables affecting fans' spontaneous participation in creating virtual idols are extracted from previous studies on fan groups' participation behavior and user creation motivation. Therefore, hypothesis H1 is proposed.

> *H1*: Creative motivation has a significant positive effect on the creative behavior of virtual idol fans. Four sub-variables were included: interest motivation, achievement motivation, social motivation, and benefit motivation.

Previous studies have shown that users' content contribution behavior will be affected by perceived cost. For example, Fan and Zhang (2015) used the concept of "perceived economy" to represent the time and energy spent by users on the website platform and found that perceived economy will affect users' contribution behavior in the dimension of "opportunity." The creation of virtual idol fans is mostly a kind of "free labor," and the fans pursue more non-material benefits in the creation, but the fans need to spend a lot of time and energy or even money into the creation. Therefore, only when the perceived cost of fan creators is small, they are more likely to participate in the creation. In addition, when individuals are engaged in community activities, they are often constrained by the community environment, and good relationship norms and atmosphere help fan creators to participate in the creation of virtual idols for a longer time. The community atmosphere can influence the fan creator's perception of the feasibility of the behavior and the behavior that is likely to be rewarded, supported, and expected. Therefore, hypothesis H2 is put forward.

> *H2*: Creative opportunity has a moderating role in the creative behavior of virtual idol fans. Perceived cost negatively moderates interest motivation, achievement motivation, social motivation, and profit motivation about the innovative behavior of virtual idol fans. The community atmosphere positively mediates the creative behavior of virtual idol fans in terms of interest, achievement, social, and benefit motivation.

In the creation practice of virtual idols and fans, fans' hand-painted creation, video creation, song creation and dance creation of virtual idols all need specific professional knowledge, skills and creative support. Therefore, this study introduces the concept of "knowledge and skills" into the study of fans' creative behavior, regards the innovative knowledge, creative skills, and creativity mastered by fans of virtual idols as fans' knowledge and skills, and holds that fans' assessment of knowledge and skills before participating in the creation of virtual idols significantly affects their final creative behavior, thus putting forward hypothesis H3.
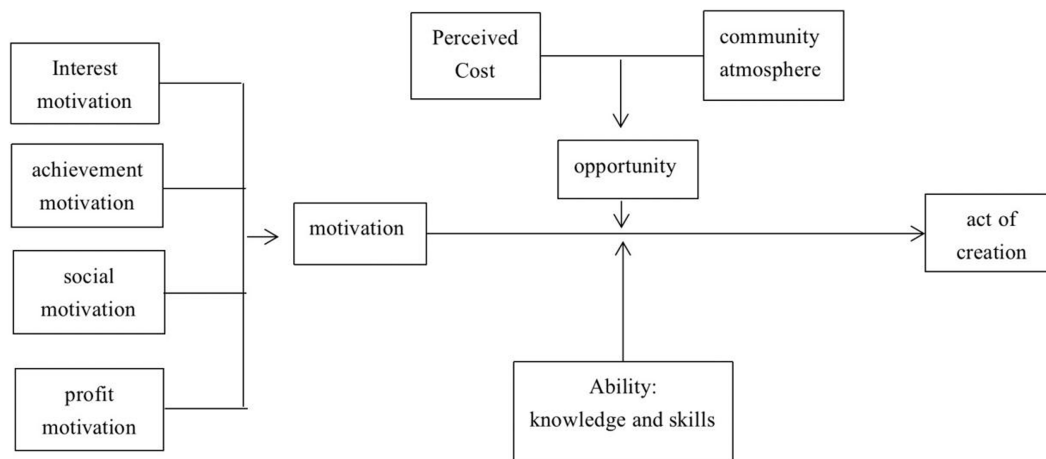
FIGURE 1
Model for studying the creative behavior of virtual idol fans from an MOA perspective.

H3: Creative ability refers explicitly to the positive moderating effect of knowledge skills in interest motivation, achievement motivation, social motivation, and benefit motivation with the creative behavior of virtual idol fans.

3 Materials and methods

3.1 Research methodology

Based on the quantitative research method of social science, this study aimed to comprehensively and deeply understand virtual idol fans' creative behavior and psychological processes. Therefore, the research mainly adopted the questionnaire survey method and the semi-structured interview method as the auxiliary method (Creswell and Clark, 2017).

3.1.1 Semi-structured interview

At the beginning of the research, to obtain a comprehensive understanding of the creative motivation, creative situation, creative form, and other issues of the virtual idol fan creators group, a semi-structured interview method was adopted to conduct exploratory research in advance, and some representative fan creators were selected to conduct one-on-one interviews. Based on the literature study, interview questions were designed with the research purpose, the characteristics of fan creation presented in the virtual idol industry, the creative motivation of fan creators, and the influencing factors in the level of creative opportunity and creative ability were explored. At the same time, the interview results were also used to assist in the design of follow-up questionnaire items.

3.1.2 Questionnaire survey method

The questionnaire survey method, which could quickly and effectively collect data and quantify research results, was widely used in social investigation. Therefore, this study adopted the questionnaire survey method, combining the existing mature scale of relevant variables with the research context and interview results to form a

questionnaire, and conducted network research through the Questionnaire Star platform. The questionnaire survey aimed to test the accuracy and universality of the hypotheses deduced above and found the rules of fans' creative behavior.

3.1.3 Statistical analysis

Based on the data collected from the questionnaire survey, SPSS was used to analyze the data of the valid questionnaire and test the hypotheses. The following statistical analysis methods were mainly used:

- Cronbach's Alpha coefficient was used to analyze the reliability and validity of the scale. The structural validity of the sample data was tested by confirmatory factor analysis.
- Descriptive statistical analysis. This method was used to analyze the relevant variables affecting virtual idol fans' creative behavior and the samples' demographic variables.
- *T*-test was used to analyze and compare the differences between fans of different genders and identities (students and social figures) in multiple dimensions of the motivation to create virtual idols.
- Multiple regression analysis and moderating effect tests were used to verify the research hypotheses and answer research questions.

3.2 Methodology

This study was based on a quantitative social science research method, aiming to gain a comprehensive and in-depth understanding of the creative behavior of virtual idol fans and their inner thoughts from a psychological perspective. Therefore, the research was mainly conducted using a questionnaire-based approach and supplemented by a semi-structured interview method.

At the beginning of the study, to gain a comprehensive understanding of the creative motivations, creative situations, and creative forms of virtual idol fan creators, the semi-structured

interview method was used to conduct an exploratory study, in which some representative fan creators were selected for interviews. Based on the literature research, the interview questions were designed with the purpose of the study and the characteristics of fan creation presented in the virtual idol industry, focusing on the motivation of fan creators and the factors influencing their creative opportunities and creative abilities. The results of the interviews were also used to support the design of the questions in the follow-up questionnaire (Creswell and Creswell, 2017).

As a widely used social survey method, the questionnaire allowed for quick and effective data collection and quantification of research findings. This study used the questionnaire method, combining established scales of relevant variables with the research context, and interview results to form a questionnaire and conduct online research. The objective of the questionnaire survey was to test the accuracy and generalizability of the hypotheses derived in the previous section and to discover patterns in the creative behavior of fans.

Finally, based on the data collected from the questionnaires, the valid questionnaires were analyzed using SPSS to test the hypotheses using the following statistical analysis methods: reliability and validity analysis, descriptive statistical analysis, t-test, and multiple regression analysis and moderated effects tests, as a means of testing the research hypotheses and answering the research questions.

On the one hand, from a theoretical perspective, this study was based on virtual idol enterprises and their online communities. It took the MOA theory as the research framework, combining the research results of motivation theory and self-determination theory to explore the creative behavior of virtual idol fans from a more comprehensive perspective. In addition, at the level of research methodology, this study conducted an in-depth study of the fan creator groups of virtual idols through interviews and questionnaires, breaking away from the single interview method and text analysis method that has been the primary research path in previous studies of the relationship between idols and fans.

3.3 Semi-structured interview design and analysis of interview data

This study adopted a semi-structured interview model to understand the perceptions of virtual idol fan creators about their favorite idols and their creative behavior; and to guide them to

recall their past experiences when participating in the creation of virtual idols, including the reasons for and factors influencing their creation. Secondly, from the current mode of creation of virtual idols, the creation environment and conditions of virtual idol production companies and their related platforms, this paper explored the motivation of fans' creation on the one hand and the opportunities and conditions under which fans were willing to devote their time, energy and money to participate in the creation of virtual idols on their initiative on the other. Finally, based on the interview data, the dimensions of fans' creative motivation and the factors influencing them at the creative opportunities and abilities level were extracted.

Specifically, in the design of the interview outline, the MOA theoretical model was used as the research framework to divide the interviews into four sections. The first part was to explore the interviewees' preferences for virtual idols and their participation in the creation of virtual idols; the second part was to investigate the interviewees' motivation for creation; the third part was to explore the influencing factors affecting the interviewees' participation in creative behavior; and the fourth part was to count the demographic characteristics of the interviewees. At the same time, the interviewees' answers were used as an entry point to encourage users to dig deeper into their creative motivations and experiences to gain a comprehensive understanding of fan creators and enrich the depth and breadth of the interview data. The main questions were designed in Table 1.

This interview adopted a combination of purposive and heterogeneous sampling methods for the survey respondents. In addition, the anime audience had a higher sense of identification with the virtual world and a higher acceptance of, and willingness to watch, virtual idols (Zhao and Hou, 2018). Therefore, this study focused on finding virtual idol fan creators and followed two principles. Firstly, the selected interviewees should have at least one experience of creating their virtual idols; secondly, the selected interviewees should be diversified as possible to obtain a universal perception dimension and consideration logic. According to the above sampling principles, paid interview recruitment posts for fan creators were posted on platforms such as Lofter, Bilibili, Weibo, and so on to find suitable virtual idol fan creators. In the end, a total of 13 interviewees were selected based on the principle of information saturation.

To make the interview data more structured and systematic, this study followed the following three steps to condense and integrate the

TABLE 1 Key question design.

Main interview questions
1. Please briefly describe your favorite virtual idol and discuss your experience of following the star.
2. Please briefly describe virtual idols, including creation time, creation platform, number of works, creation content and form, etc.
3. What are the main reasons for your spontaneous involvement in the creation?
4. What were your biggest expectations when you were involved in the creation? Such as money, emotional expectations, etc., and whether they were met?
5. What was your biggest takeaway from your involvement in creating a virtual idol?
6. What was your first opportunity to get involved in the creation?
7. Have you encountered any difficulties or bottlenecks when you were involved in the creation?
8. What kind of idols/vibes do you think would motivate you to get involved in creation?
9. What conditions/abilities do you think would motivate you to get involved in creation?
10. What do you think of the recent creative solicitation activities sponsored by Henian/Genshin Impact and other officials?
11. Is there anything else you would like to add or ask me about the discussion just now?

TABLE 2 Independent variable — initial measurement items and sources of creative motivation.

Dimension	No.	Measurement issues	Source scale
Interest motivation	IM1	I am often fascinated by my favorite virtual idol	Self-drafted
	IM2	My interest lies in participating in virtual idol creation	Frederick and Ryan (1993)
	IM3	I think participating in virtual idol creation can make me feel happy	
	IM4	I participated in the creation of virtual idols to engage in entertainment and leisure activities in addition to work and study	
Achievement motivation	AM1	I participated in virtual idol creation to make more friends with common interests and hobbies	Kankanhalli et al. (2005); Yang et al. (2019)
	AM2	I participate in virtual idol creation to communicate and share with people with common interests and hobbies	
	AM3	I gained a sense of belonging by participating in virtual idol creation	
Social motivation	SM1	I think participating in virtual idol creation can help me gain recognition from others	Frederick and Ryan (1993)
	SM2	I think participating in virtual idol creation can enhance my sense of value	
	SM3	I think participating in virtual idol creation can enhance my sense of achievement	
Profit motivation	PM1	I participated in the creation of virtual idols to receive certain material rewards	Tang et al. (2012); Park and lee (2021)
	PM2	I participated in virtual idol creation to increase the number of fans and gain profit opportunities	
	PM3	I think participating in virtual idol creation can become my livelihood job	

interview data. Firstly, the interview data was transformed into a "standardized" text to form a formal text. Secondly, according to the purpose of the study, the textual content of the interviews was categorized. The textual expressions related to fans' motivation to participate in creating virtual idols and their influencing factors were selected. The main content of the text was extracted to form the conceptualization results. Thirdly, based on the conceptualization results, the relevant dimensional categories that influenced fans' creative behavior were extracted according to the MOA theoretical research model.

According to the analysis of the interview data, interest motivation was the biggest motivation for fan creators to participate in virtual idol creation, and most interviewees also showed more obvious achievement and social motivation. Although only one interviewee explicitly stated that he wanted to earn money through creation as a career path, the majority of the interviewees also wanted to receive some benefit in return. It expressly said they would be motivated by official or platform "monetary incentive schemes" to participate in creation. Therefore, this study also considered the profit motive as one of the motivations for fans to participate in creative work and included the official/platform incentive scheme in the "community atmosphere" as a moderating factor between the profit motive and creative behavior. It was noteworthy that some respondents indicated that their participation in the creation of virtual idols cost them too much time and money, and they did not achieve the expected rewards, which would reduce the frequency of their subsequent creation; others showed their skills in the creation of virtual idols, which positively contributed to their creative behavior.

3.4 Questionnaire design

In terms of measuring the relevant variables, this study mainly used the Likert Seven Scale to assign and measure the relevant variables. The measurement scales referred to mature scales for domestic and foreign-related variables and were adapted based on

research questions and previous fan creator interviews to fit the research context.

For the scale design of creative motivation, this study mainly drew on the motivation measurement scales for individual behavior both domestically and internationally. It adapted them appropriately based on the research context. In measuring interest motivation and social motivation, based on the theories from Frederick and Ryan (1993), the 'Interest Motivation' and 'Social Motivation' scales were adapted, while the Cronbach's Alpha reliability coefficients of each scale were between 0.81 and 0.91. Unlike general user creative behavior, fans' creation based on virtual idols was mainly based on their love emotions, manifested as their liking and love for their favorite virtual idols. Therefore, based on the analysis of interview results with fan creators, the item "I am often fascinated by my favorite virtual idol" was added to the measurement of interest dimension; In terms of measuring achievement motivation, the Cronbach's Alpha reliability coefficient of each scale was approximately 0.85, based on the "intrinsic benefit" scale of Kankanhalli et al. (2005) and the "achievement motivation" scale of Yang et al. (2019); In the measurement of profit motivation, the primary reference was Tang et al. (2012) and Park and Lee (2021) adapted the "Economic Return Motivation" scale, and the Cronbach's Alpha of each scale was above 0.90 (Table 2).

In terms of measuring perceived cost, referring to Leung and Bai (2013) "Social Media Usage" scale, the perceived cost of fans participating in virtual idol creation was divided into three dimensions: time, money, and energy; In measuring the community atmosphere, referring to Fan's "Website Atmosphere" scale, three items were set to measure fans' perception of virtual idol communities and fan communities (Table 3).

In measuring creative ability, the main reference was Watson and Hewett (2006) and Leung and Bai (2013) on the "Professional Skills" scale. Based on this scale, adjusted it appropriately according to the creative characteristics of fan creators and set four items (Table 4).

In measuring creative behavior, the social media usage scale developed by Cheikh-Ammar and Barki (2016) and the information technology usage behavior scale developed by Davis (1989) was used to measure the creative behavior of virtual idol fans (Table 5).

TABLE 3 Initial measurement questions and sources for the moderating variable-creative opportunity.

Dimension	No.	Measurement issues	Source scale
Perceived cost	PC1	I think it would take too much of my time to be involved in the creation of virtual idols	Leung and Bai (2013)
	PC2	I think it would take too much of my energy to be involved in the creation of a virtual idol	
	PC3	I think it would cost me too much money to be involved in the creation of a virtual idol	
Community atmosphere	CA1	Official/platform/community incentives will motivate me to get involved in virtual idol creation	Fan and Zhang (2015)
	CA2	Official/platform/community incentives will motivate me to participate in virtual idol creation	
	CA3	The success of others in the official/platform/community has motivated me to get involved in the creation of virtual idols	

TABLE 4 Moderating variable-initial measure of creative ability question items and sources.

Dimension	No.	Measurement issues	Source scale
Knowledge skills	OR1	I know about virtual idol creation (graphics, animation, audio and video production, etc.)	Watson and Hewett (2006); Leung and Bai (2013)
	OR2	I am familiar with the performance and use of various virtual idol-creation tools	
	OR3	I think I have the creative power to create virtual idols	
	OR4	I think my creations can enrich the image of virtual idols	

TABLE 5 Initial measurement questions and sources for the dependent.

Dimension	No.	Measurement issues	Source scale
The act of creation	CB1	I would like to be involved in the creation of my favorite virtual idol	Cheikh-Ammar and Barki (2016); Davis (1989)
	CB2	I plan to participate in the creation of my favorite virtual idol	
	CB3	I will keep participating in the creation of my favorite virtual idols as often as possible	
	CB4	I will increase the frequency of my involvement in the creation of my favorite virtual idols	

4 Results

4.1 Hypothesis testing of the independent variable − creative motivation

4.1.1 Correlation analysis

From Table 6, the results of the correlation analysis between the independent variables and the dependent variable all showed significance and all had positive values, indicating a positive correlation and allowing for the next step of regression analysis.

4.1.2 Multiple linear regression analysis

Table 7 showed that interest motivation, achievement motivation, social motivation, and benefit motivation all significantly positively affected the creative behavior of virtual idol fans.

4.2 Hypothesis testing of moderating variables

4.2.1 Hypothesis testing of moderating variables

The results showed that the interaction between interest motivation and perceived cost, between social motivation and perceived cost, and between interest motivation and perceived cost interaction with perceived cost reached significant levels in the creative behavior of virtual idol fans. In contrast, the interaction

between achievement motivation and perceived cost did not have a considerable effect, as shown in Table 8.

Further simple slope analysis revealed that the interaction of perceived cost with interest motivation, social motivation, and benefit motivation all had a significant negative effect on creative behavior (Table 9).

Each sub-variable under the creative motivation dimension was included in the model as the independent variable, creative behavior as the dependent variable, and community atmosphere as the moderating variable for testing. The effect on virtual idol fans' creative behavior was substantial. The results showed that the interaction of social motivation with community atmosphere and interest motivation with community atmosphere significantly affected virtual idol fans' creative behavior. In contrast, the interaction between interest motivation and perceived cost and between achievement motivation and perceived cost did not have a significant effect, as detailed in Table 10.

A specific test was conducted through simple slope analysis, which found that the interaction of social and profit motives in the community atmosphere, significantly positively affected creative behavior (Table 11).

4.2.2 Moderating effects of creative ability

The various sub-variables under the creative motivation dimension were included in the model as independent variables, creative behavior as the dependent variable, and knowledge skills as the moderating

TABLE 6 Results of correlation analysis between variables.

Pearson correlation – standard format							
	Average	Standard deviation	1	2	3	4	5
Interest motivation	4.887	1.276	1				
Achievement motivation	4.804	1.252	0.843**	1			
Social motivation	4.768	1.245	0.853**	0.841**	1		
Profit motive	4.269	1.214	0.522**	0.583**	0.599**	1	
The act of creation	4.682	1.223	0.815**	0.805**	0.797**	0.588**	1

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

TABLE 7 Regression analysis of virtual idol fans' creative motivation on creative behavior.

Results of linear regression analysis ($n = 317$)						
	Non-standardized coefficients		Standardization factor	t	p	VIF
	B	Standard error	Beta			
Constants	0.297	0.156	–	1.898	0.059	–
Interest motivation	0.355	0.060	0.370	5.940	0.000**	4.587
Achievement motivation	0.258	0.060	0.265	4.320	0.000**	4.434
Social motivation	0.175	0.063	0.178	2.797	0.005**	4.810
Profit motive	0.135	0.037	0.134	3.608	0.000**	1.621
R^2	0.736					
Adjustments to R^2	0.732					
F	$F(4,312) = 217.236, p = 0.000$					
D-W values	2.006					
Dependent variable: creative behavior						

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

variable for testing. All four regression analyses showed no interaction effect between creative ability and knowledge skills.

Based on the above tests of moderating effects, the following aggregated model of moderating effects could be synthesized (Figure 2).

The valid sample data recovered from the formal questionnaire, and SPSS software was used to conduct reliability tests, descriptive statistics, mean analyses, t-tests, correlation analyses, regression analyses, and moderating effect tests on the sample data to examine the influence of virtual idol fans' creative motivation on their creative behavior in each dimension and the moderating effects of fans' creative opportunities and creative abilities in creative motivation. The moderating role of fans' creative opportunities and creative abilities in their creative motivation and behavior was examined. Based on the results of the data analysis, the hypotheses presented in the previous paper were validated and summarized. In contrast, the graphs of the moderating effect models were summarized for further discussion of the findings.

5 Conclusions and discussion

Using the MOA theoretical model as a research framework, this study aimed to analyze the factors influencing the content creative behavior of virtual idol fans. Multiple analysis hierarchical regression analysis was used to test the data. It found that the results were satisfactory and could reveal to some extent, the creative behavior of virtual idol fans in real-life situations. The study was translated by the motivation of virtual idol fans to develop, and the role of external factors of opportunity and ability in moderating this process.

Firstly, this paper concluded that creative motivation had a significant positive effect on the creative behavior of virtual idol fans. Combining motivation theory and self-determination theory, this study classified individuals' behaviors into four dimensions: interest motivation, achievement motivation, social motivation, and benefit motivation. In the hypothesis testing, the results of the multiple regression model showed that virtual idol fans' interest motivation, achievement motivation, social motivation, and interest motivation all have a significant positive influence on their creative behavior. In addition, the four dimensions of creative motivation ranked virtual idol fans' motivation as follows: interest motivation > achievement motivation > social motivation > benefit motivation. Specifically, internal motivation was much more powerful than external interest motivation, and interest motivation was the most critical factor driving fans' creative behavior. This was also consistent with the results of the previous interviews with virtual idols, i.e., the constant productivity of fans stems mainly from their obsessions and passions. Fan creators primarily processed out of interest and engaged in virtual

TABLE 8 Tests for moderating effects of perceived costs.

Results of the moderation effect analysis ($n = 317$)				
Model composition	Standard error	t	p	β
Interest motivation	0.036	17.256	0.000**	0.648
Perceived cost	0.036	7.661	0.000**	0.269
Interest motivation * perceived cost	0.020	−2.768	0.006**	−0.090
R²/F	0.719/267.316, $p = 0.000$			
Motivation for achievement	0.039	16.321	0.000**	0.647
Perceived cost	0.038	7.174	0.000**	0.264
Motivation to achieve * perceived cost	0.020	−1.807	0.072	−0.062
R²/F	0.698/241.051, $p = 0.000$			
Social motivation	0.040	15.884	0.000**	0.640
Perceived cost	0.040	6.189	0.000**	0.241
Social motivation* perceived cost	0.021	−2.753	0.006**	−0.092
R²/F	0.678/219.672, $p = 0.000$			
Profit motive	0.051	7.296	0.000**	0.371
Perceived cost	0.052	7.416	0.000**	0.378
Benefit motivation * perceived cost	0.027	−2.163	0.031*	−0.091
R²/F	0.456/87.425, $p = 0.000$			
Dependent variable: creative behavior				

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

TABLE 9 Results of simple slope analysis for perceived cost.

Adjustment variables	Level of adjustment variables	Regression coefficient	Standard error	t	p	95% CI	
Interest motivation	Average	0.621	0.036	17.256	0.000	0.551	0.692
	High level (+1SD)	0.557	0.050	11.179	0.000	0.459	0.655
	Low level (-1SD)	0.685	0.034	19.911	0.000	0.618	0.753
Social motivation	Average	0.629	0.040	15.884	0.000	0.551	0.706
	High level (+1SD)	0.559	0.053	10.628	0.000	0.456	0.663
	Low level (-1SD)	0.698	0.040	17.344	0.000	0.619	0.776
Profit motive	Average	0.373	0.051	7.296	0.000	0.273	0.474
	High level (+1SD)	0.305	0.059	5.156	0.000	0.189	0.421
	Low level (-1SD)	0.442	0.061	7.206	0.000	0.322	0.562

idol creation primarily out of interest and derived pleasure. Achievement motivation was second only to interest motivation in driving fan creative behavior. Fan creators not only gained pleasure from the process of creation but also achieved satisfaction and added value to themselves. The creative behavior of virtual idol fans was not only a form of entertainment, but also a cultural phenomenon and a way of socializing, and fans were also influenced by their social motivations. In the previous interviews, it was also found that some fans were inspired by their community members to start participating in virtual idol creation; others said they made more like-minded friends and fulfilled their personal social needs through their creation. Some even alleviated their loneliness in reality by participating in virtual idol creation. It was for this reason that the understanding and encouragement of the members of a fan community would not only be one of the driving forces behind virtual idol fans' engagement in

creation but also strengthen the fans' sense of intimacy and identity with the group in turn, driving them to participate in creation. It is worth noting that the innovative behavior of virtual idol fans is influenced by intrinsic motivations and, to some extent, external interest motivations. In participating in creation, if fans did not receive the expected benefits in return, their intention to participate was weakened. Other fans said that without an official incentive scheme, they might not be motivated to participate in creative work anymore, or they might no longer be encouraged to participate.

Second, the moderating effect of creative opportunities on the creative behavior of virtual idol fans showed different effects. On the one hand, the perceived cost had a significant negative moderating effect on interest motivation, social motivation, benefit motivation, and creative behavior, respectively. In other words, the higher the perceived cost of fans, the greater the cost of effort, time, and money

TABLE 10 Tests for moderating effects of community atmosphere.

Results of the moderation effect analysis (n = 317)				
Model composition	Standard error	t	p	β
Interest motivation	0.035	20.627	0.000**	0.746
Community atmosphere	0.027	4.866	0.000**	0.186
Interest motivation* community atmosphere	0.019	−1.276	0.203	−0.047
R²/F	0.690/232.091, p = 0.000			
Motivation for achievement	0.037	19.518	0.000**	0.737
Community atmosphere	0.028	4.039	0.000**	0.159
Achievement Motivation* community Atmosphere	0.020	−1.471	0.142	−0.055
R²/F	0.666/207.762, p = 0.000			
Social motivation	0.041	20.013	0.000**	0.831
Community atmosphere	0.030	−0.967	0.334	−0.042
Social motivation* community atmosphere	0.020	2.704	0.007**	0.103
R²/F	0.644/188.346, p = 0.000			
Profit motive	0.052	10.784	0.000**	0.558
Community atmosphere	0.036	2.462	0.014*	0.126
Interest motivation* community atmosphere	0.023	3.426	0.001**	0.157
R²/F	0.389/66.533, p = 0.000			
Dependent variable: creative behavior				

*p < 0.05; **p < 0.01.

TABLE 11 Results of simple slope analysis for community atmosphere.

Adjustment variables	Level of adjustment variables	Regression coefficient	Standard error	t	p	95% CI	
Social motivation	Average	0.817	0.041	20.013	0.000	0.737	0.897
	High level (+1SD)	0.911	0.063	14.577	0.000	0.789	1.034
	Low level (-1SD)	0.722	0.043	16.695	0.000	0.637	0.807
Profit motive	Average	0.562	0.052	10.784	0.000	0.460	0.665
	High level (+1SD)	0.702	0.074	9.474	0.000	0.557	0.848
	Low level (-1SD)	0.422	0.057	7.370	0.000	0.310	0.535

needed to participate in virtual idol creation activities, weakening fans' willingness to participate and their creative behavior. At the same time, the perceived cost of fan creators also changed with time and state of mind. However, perceived cost only negatively moderated interest motivation, social motivation, benefit motivation, and creative behavior, while it did not pass the significance test for achievement motivation. In other words, the negative effect of achievement motivation, which focused more on the internal sense of achievement and self-fulfillment than on the external perceived cost, may be outweighed by the negative effect of perceived cost due to the pursuit of value and identity of virtual idol creation by virtual idol fans. Fans were willing to devote more time and effort to their idols to help them achieve their own goals. Thus, the moderating effect of perceived costs on achievement motivation was relatively small.

On the other hand, the variable of community climate had a positive moderating effect. The results of the hierarchical regression analysis by introducing community atmosphere as a moderating variable for the creation opportunity dimension showed that community atmosphere had a significant positive moderating effect

between social motivation, benefit motivation, and creative behavior. Therefore, a good community atmosphere could promote interaction and cooperation among community members, increase social support and identity, provide more resources and opportunities, and encourage creativity among fans. Taking the more mature Vocaloid virtual idol Luo Tianyi in China as an example, its operating company, Shanghai Huanian Technology, created a good community atmosphere and encouraged fans' creative participation, such as cooperating with the secondary RMB platform Bilibili Program to release the "Vsinger Creation Incentive Program regularly"; on its official website and its virtual idol, the "AI image collection campaign" was published on the official website and the Weibo accounts of virtual idols such as "Yanhe" and "Le Zhengya"; the "Luo Tianyi MMD model creation Contest." Most creation competitions were based on traffic ranking and fan voting, which motivated fans to participate in creation with material benefits that were good and excellent. They also created a good creative community atmosphere for fans and inspired them to create. However, the interaction effect of community atmosphere between interest motivation, achievement motivation, and their creative behavior was
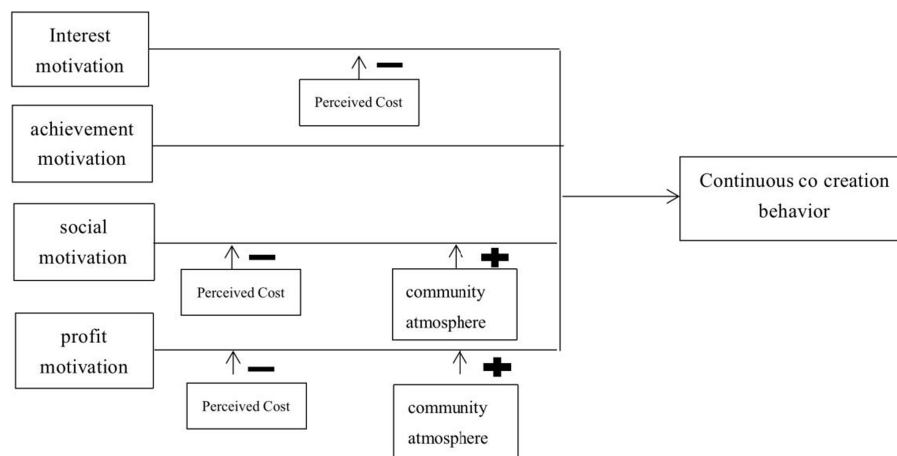
FIGURE 2
Moderating effects model summary.

not significant, indicating that fans' interest motivation and achievement motivation to participate in creative works were relatively little influenced by community atmosphere. Interest motivation and achievement motivation focus more on the intrinsic needs and fulfillment of the individual rather than the external environment and influence of the community. Coupled with the fact that both were also more dependent on individual interests and talents, they were less influenced by the community atmosphere. Therefore, in virtual idol fan communities, community environment moderated different types of motivation and behavioral performance differently.

Finally, moderating the effect of creative ability on the creative behavior of virtual idol fans, a hierarchical regression analysis was conducted to examine the moderating variable of knowledge skills as a dimension of creative ability. Regarding the moderating effect of creative ability on the creative behavior of virtual idol fans, a hierarchical regression analysis was conducted to examine the moderating variable of knowledge skills as a dimension of creative ability. The moderating effect of creative ability on the creative behavior of virtual idol fans, a hierarchical regression analysis was conducted to examine the moderating variable of knowledge skills as a dimension of creative ability. The moderating effect of creative ability on the creative behavior of virtual idol fans, a hierarchical regression analysis was conducted to examine the moderating variable of knowledge skills as a dimension of creative ability. The results showed that the moderating effect of knowledge skills between interest motivation, achievement motivation, social motivation, benefit motivation, and creative behavior was insignificant, i.e., fans' knowledge skills did not moderate their creative motivation and creative behavior. This was at variance with previous studies on consumers' knowledge-sharing behavior in travelers (iQIYI, 2019) and users' contribution behavior in knowledge websites. The reason for this lay in the specificity of the virtual idol fans, who were a typical group expressing their support and love for their idols by creating songs, drawings, and handicrafts. In this process, not all fans had abundant resources, and participating in the creation may take some time and effort, but this did not affect their passion and motivation for creation. It was also found in the interviews that there was greater flexibility in the form of fan participation in virtual idol creation, covering a variety of forms such as homoeroticism, comics, songs,

dance, mashup videos, and cosplay. In general, the specificity of virtual idol fan culture and the flexibility of the forms of their participation in creation lead to a less significant moderating effect of knowledge skills between creative motivation and creative behavior.

5.1 Academic implications

This study opened up a new path for the study of virtual idols and fans, bringing about a unique perspective on the study of fans' participatory creation. In terms of MOA theory research, this study took it as the research framework, which combined the self-determination theory and semi-structured interview results and built a research model of the creative behavior of virtual idol fans. It reasonably divided the influencing factors of virtual idol fans' creative behavior into motivation, ability, and opportunity. Finally, the analysis has been confirmed through a questionnaire survey. This broadened the application field and research object of MOA theory to a certain extent. As far as the object of study was concerned, this study summarizes and tests the comprehensive factors influencing fans' creative behavior through semi-structured interviews and questionnaire surveys from a psychological perspective. This also enriched the research of virtual idol fans to a certain extent, especially the antecedents of virtual idol fans' creative behavior.

5.2 Managerial implications

Through empirical research, this study outlined the portrait of the creators of virtual idol fans, promoted the creative development of virtual idols and fans on the one hand, and provided suggestions and strategies for standardizing and promoting the creative behavior of fans on the other hand, and finally achieved the purpose of promoting the healthy and sustainable development of the virtual idol industry. From the perspective of fans, by exploring the influencing factors of fans' creation, this paper explains the phenomenon of fans' spontaneous participation in the creation of virtual idols, and provides a management basis for the decision-makers and operators behind virtual idols, to promote virtual idol enterprises and related communities to create

excellent creator ecology, designed a reasonable incentive mechanism, and improve fans' sense of participation and experience. At the enterprise level, by mining the influencing factors of fan creation, virtual idol production companies could help them understand the psychology and behavior of fans' creation, provide them with marketing management inspiration, and effectively stimulate the potential creative behavior of fans. In addition, promoting the creation of fans could not only enrich the image and number of works of virtual idols, but also improve their exposure, attract more potential fans, and promote the virtuous circle of the virtual idol industry. On the social level, exploring the factors that influenced the continuous creation of fans, virtual idol enterprises, and related communities could encourage fans to create quality content. This could meet the growing demand for diversified entertainment and help fan creators solve economic problems through reasonable business models. In addition, for the teenagers who occupied the main body of fans of virtual idols, clarifying the psychology and behavior of their participation in the creation could help to provide more targeted guidance.

5.3 Limitations and further research

The study still suffered from shortcomings in terms of the study population, the scope of the study, and its measurement tools. For future research, the scope of the study should be further expanded. On the one hand, the research object could be extended to the current emerging hyper-realistic virtual idols and compared with the virtual idols for a more comprehensively comparative study; on the other hand, the research object could be subdivided to consider in depth whether fan creators have different influences on their creative behavior when facing different favorite objects. In terms of research content, future research could also explore how factors in the environment of the fan creation system interact to influence fans' creative behavior from a broader perspective.

Therefore, future research can expand the study population, the scope, and its measurement tools. Further empirical research could also be conducted on the outcomes of sustained fan involvement in creating virtual idol IPs, as well as the marketing initiatives and support of virtual idol companies. Secondly, the measurement tools should be further researched and refined to find a more suitable scale for virtual fans' creative behavior. Finally, the factors influencing fan creative behavior based on broader theoretical foundations will be explored in depth.

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

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

QW: Conceptualization, Data curation, Supervision, Writing – original draft, Writing – review & editing. SL: Supervision, Writing – original draft, Writing – review & editing. YZ: Data curation, Writing – original draft. LT: Data curation, Writing – review & editing. YW: Data curation, Formal analysis, Investigation, Supervision, Writing – original draft, Writing – review & editing.

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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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Online identity work dynamics of Instagram micro-influencers: an extreme case approach

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Background: Advanced media technologies have become an integral part of people's daily lives, providing them with new tools and environments for the formation and enactment of their identities. To date, the literature acknowledges that media technologies, such as social networking sites, are used to form and enact online identities, and that these platforms can simultaneously pose challenges to individuals' identity work. However, we know little about the precise online identity work strategies that individuals employ in response to the challenges they face over time.

Objective: This paper examines the online identity work dynamics of Instagram micro-influencers, for whom social network sites enable and guide them in forming and enacting their online identities on a daily basis. The study was guided by the following research question: what are the challenges that Instagram micro-influencers perceive online and what are the online identity work strategies that they employ in response to these challenges over time?

Methods: This study employs an extreme case approach to rigorously explore the lives of seven micro-influencers on Instagram. We combine in-depth data from narrative interviews, longitudinal data from online autobiographical narratives revealed through the participants' Instagram timelines, and follow-up interviews.

Results: Our analysis revealed three main themes that highlight the challenges that Instagram micro-influencers face online: (1) amplified social expectations, (2) feelings of inauthenticity, and, as a result thereof, (3) psychological distress. We found that these challenges were viewed as catalysts for their online identity work processes. We identified three key online identity work strategies that the Instagram micro-influencers employed in response over time: (1) experimenting with their online identities, followed by either (2) segmenting between their online and offline identities, or (3) adding identities through online multiplicity.

Conclusion: Our research provides new insights into how individuals may respond to the challenge of managing their online identities over time by engaging in different online identity work strategies. This study highlights the importance of designing online media technologies that enable individuals to cope with online challenges. We emphasize the need to design online spaces for (1) the expression of authentic identities, (2) community building, and (3) online multiplicity.

KEYWORDS

identity, virtual identity, online identity, dynamics, social media, extreme case analysis

1 Introduction

Advanced media technologies are becoming increasingly ubiquitous and integral to people's daily lives, providing new tools and environments for the formation and enactment of their identities (Cover, 2015; Barros et al., 2023). In the current study, we define identity as the "individuals' subjective interpretations of who they are, based on their socio-demographic characteristics, roles, personal attributes, and group memberships" (Caza et al., 2018, p. 889). For example, an individual could define themselves as a female, daughter, introvert, marketeer, gymnast, and mountaineer. Each of the identities an individual holds exists within a network of people who may have particular expectations of the individual (Davis and Jurgenson, 2014). These expectations, in turn, inform the individual's identity work (Brown, 2021), defined as "the cognitive, discursive, physical, and behavioral activities that individuals undertake with the goal of forming, repairing, maintaining, strengthening, revising, or rejecting collective, role, and personal self-meanings" (Caza et al., 2018, p. 895). Consequently, identity work can be considered as a dynamic process in which identities are constantly being confirmed and modified in negotiation with others (Maitlis, 2009; Ramarajan, 2014; Caza et al., 2018; Bataille and Vough, 2022).

Online identity work is then seen as the process of identity work that takes place in virtual worlds, such as on social network sites (SNSs) (Boyd and Ellison, 2007; Cover, 2015; Barros, 2018; Barros et al., 2023). SNSs refer to the set of interactive internet applications that facilitate the creation and sharing of user-generated content (Davis, 2012). The most widely used platforms are Facebook, YouTube, and Instagram, all of which have more than one billion monthly active users worldwide (Statista, 2023). On these platforms, individuals form and enact their online identities in negotiation with others in their social networks (Marwick, 2013; Hafer et al., 2023).

Studies in the fields of communication (e.g., Davis and Jurgenson, 2014) and media technology (Carter and Grover, 2015; Shah and Tewari, 2016; Bishop, 2018) have focused on how media technologies are increasingly used for strategic self-presentational activities, image management, and self-branding (Senft, 2013). Specifically, apps such as Instagram allow individuals to upload pictures and videos of their lives to the platform and share them publicly (Abidin, 2016). In doing so, individuals can explore and create online narratives that further define who they are (Cover, 2015; Gu et al., 2022; Hafer et al., 2023). Given the ability on these platforms to conceal what one does not want to convey, or to accentuate what is important, SNSs allow individuals to present themselves in a socially desirable way (Ellison et al., 2006; Hafer et al., 2023). Specifically, via SNSs, individuals can form and enact identities online that reflect ideal personas. For example, through the presentation of filtered selfies (Halpern et al., 2017), the use of hashtags (Nasrin and Fisher, 2022), or profile pictures (Blanco Ramírez and Palu-ay, 2015).

While scholars in the fields of identity and communication and media technology have acknowledged that media technologies can provide individuals with new environments and tools for (1) exploring their identities (Stanko et al., 2019; Soini and Eräranta, 2023) and (2) publicly and strategically expressing these identities

(Boyd, 2010; Marwick and Boyd, 2011; Bonneau et al., 2023), there is also emerging evidence that further highlights the severe challenges of engaging in online identity work.

First, individuals may experience identity conflicts as social demands from others increase due to the blending of their physical and virtual social networks (Davis and Jurgenson, 2014; Hafer et al., 2023). Specifically, when an individual experiences an inability to maintain and balance the expectations coming from different social contexts, this can trigger tensions between their different identities (i.e., identity conflicts) (Petriglieri, 2011; Ramarajan et al., 2017; Gibson et al., 2021).

Second, it has been argued that there is a greater need for individuals to present their authentic selves on online platforms (Marwick, 2013; Haimson and Hoffmann, 2016; Haimson et al., 2021). Authenticity refers to "the extent to which an individual acts in accord with the true self and it involves owning one's personal experiences, thoughts, emotions, needs, wants, preferences, or beliefs" (Roberts, 2005, p. 699). This means that individuals are required to present a consistent, positive, and "true" self across both their online and offline environments (Haimson et al., 2021). Online authenticity can be understood in two dimensions – a sense of a true self and the expression of a true self online (Lim et al., 2015). The first dimension refers to the degree to which one owns one's personal experiences, i.e., thoughts, values, emotions, and beliefs. The second dimension concerns whether one acts in accordance with one's true self online, that is, whether one expresses online what one thinks and believes (Gardner et al., 2005). However, even though individuals may increasingly strive to present themselves authentically on social media, research suggests that they often feel unable to do so (Haimson et al., 2021), also referred to as the authenticity paradox. Being authentic requires sharing negative experiences online and is therefore only possible at great personal cost (Ibarra, 2015; Haimson et al., 2021). In turn, the feeling that individuals are unable to act in accordance with their true selves on online platforms can lead to severe identity conflicts, which can potentially lead to detrimental mental health issues (Berryman et al., 2018), such as depression (Keles et al., 2020), anxiety (Primack et al., 2017), and burnout (Harren et al., 2021).

While the literature acknowledges that SNSs are used to form and enact identities (Davis, 2012; Cover, 2015; Haimson and Hoffmann, 2016), and can simultaneously pose challenges to online identity work (Davis, 2012; Halpern et al., 2017; Haimson et al., 2021), thus far, we know little about the exact online identity work strategies that individuals employ in response to these challenges. Moreover, identity work studies often take a rather static picture and tend to overlook dynamic elements (i.e., temporal patterns during alternating phases of identity work) (Vantilborgh et al., 2018). This is important as it may advance our understanding of *what* happens, *when* and *how* things happen. This paper explores this further by examining the identity work dynamics of those for whom SNSs enable and guide how they form and enact their online identities on a daily basis: Instagram micro-influencers (Abidin, 2016; Roccapriore and Pollock, 2022). Accordingly, the study was guided by the following research question: what are the challenges that Instagram micro-influencers perceive online and what are the online identity

work strategies they employ in response to these challenges over time?

Overall, our study extends the literature on identity work and online identities in three ways. First, we show that online identity work is a dynamic process that changes over time. In particular, our longitudinal empirical study suggests that individuals initially enter a phase of experimentation in response to the challenges they face online. Here, social media platforms provide a safe liminal space for individuals to freely experiment with desired identities by employing online identity work tactics such as online activation cues and/or online relationship building (Stanko et al., 2019, 2022). Second, our paper contributes by highlighting two different pathways that individuals may choose over time to further cope with the challenges they experience. After a period of experimentation, individuals may either further segment their online and offline identities (Desrochers and Sargent, 2004; Ollier-Malaterre et al., 2013; Dumas and Sanchez-Burks, 2015), or add more identities through online multiplicity (Carter, 2008). Our findings on online multiplicity provide new insights into identity continuity (Wittman, 2019) and may provide answers to the experience of the online authenticity paradox (Haimson et al., 2021). As mentioned earlier, the online authenticity paradox is the experienced difficulty of presenting a consistent and true self across online and offline environments. We find that some individuals, despite feeling inauthentic online, may struggle to change their online identities because these online identities have become entrenched through both sustained social interactions with their followers and the need for online success (Banet-Weiser, 2012; Duffy and Hund, 2015; Abidin, 2016). In turn, adding identities through online multiplicity (Carter, 2008) may provide individuals with an opportunity to present a more consistent, positive, and "true" self without having to discard a certain status that was built within their initial account. Third, and finally, we make a methodological contribution by adopting an extreme case approach (Eisenhardt, 1989), combining narrative interviews with the analysis of online autobiographical narratives revealed through Instagram timelines, and follow-up interviews. The complementary data allowed us to explore the dynamic elements of online identity work by following Instagram micro-influencers over time.

2 Materials and methods

2.1 Research context

Micro-influencers are individuals with a social media presence larger than a "normal" person but smaller than a celebrity, ranging from 1,000 to 100,000 followers (Urwin, 2022). According to research from the Influencer Marketing Hub (2021), there are ~1.21 billion active Instagram influencers, the majority of which are micro-influencers with between 1,000 and 100,000 followers. However, there are also mega-influencers with millions of followers who can earn up to hundreds of thousands of dollars per post. The audience of micro-influencers is smaller but often highly engaged (Urwin, 2022).

Instagram influencers typically aim to influence the behavior and opinions of their followers through their posts and stories, often related to content such as fashion, beauty, fitness, travel, food,

or lifestyle (Roccapriore and Pollock, 2022). In turn, they may be paid by brands to further promote certain products and/or services to their followers. To become a successful Instagram influencer, individuals must build online social communities and present themselves in a likable way to get rewarded in the form of more subscriptions, likes, and viewers (Abidin, 2016; Duffy et al., 2021).

In the world of micro-influencers, "authenticity is currency," as those individuals with a smaller number of followers can have more frequent and genuine interactions with their followers, responding to comments and messages and sharing personal stories (Urwin, 2022). Micro-influencers promote products that are also relevant to their own interests and/or expertise. They aim to build strong relationships and communities around the content they share and "both textually and visually exhibit their personal daily lives to a large number of followers" (Chae, 2018, p. 246). They leverage SNSs to create a sense of self by interacting with followers online (Abidin, 2016; Roccapriore and Pollock, 2022). More broadly, they express different fragments of their evolving identities on social media platforms, selected for specific audiences (Abidin, 2016; Roccapriore and Pollock, 2022; Rüther et al., 2023).

2.2 Sample

In this article, seven Instagram micro-influencers from the Netherlands were selected as extreme cases to explore the phenomenon of online identity work (see Table 1 for the participants' characteristics). Extreme case sampling is a purposive sampling technique that allowed us to gain a deeper understanding of the dynamics of online identity work and the unique characteristics of individuals who actively engage in this process on SNSs (Eisenhardt, 1989; Patton, 1990). Specifically, the rationale behind this sampling strategy is based on three key considerations. First, Instagram micro-influencers have a significantly higher reach and visibility than the average social media user. This allowed us to explore the nuances of online identity work in the context of an audience that is beyond the reach of more typical cases. Second, the public, consistent, and active use of Instagram by micro-influencers allowed us to explore their temporal online identity work. Third, Instagram micro-influencers have high engagement metrics (e.g., likes, comments, and shares on their posts) (Duffy et al., 2021). By studying individuals with high engagement levels, we were able to gain deeper insights into the identity work strategies employed and the reactions to these strategies from an online audience. To conclude, given that Instagram micro-influencers use SNSs to create a sense of self and to perform identity work in a public and consistent way (Carter and Grover, 2015; Piszczek et al., 2016; Barros, 2018; Moser and Ashforth, 2021; Barros et al., 2023), thoroughly examining their lives provided us with an extreme context in which the process of online identity work became highly visible.

Selection criteria included the influencers' level of activity, engagement on Instagram, and their willingness to participate in the study. We aimed for diversity in terms of gender, length of time participants had been active on Instagram, and follower counts. Participants had to have between 1,000 and 100,000 followers and use Instagram consistently and actively. The nature of this

TABLE 1 Participant characteristics.

Pseudonym	Gender	Age	Job title	Number of followers	Number of interviews	Number of posts analyzed
Louise	F	25	Marketing employee	1,300	2	150
Jasper	M	30	Fitness coach	21k	2	1,500
Simon	M	29	Model / DJ / Photographer	5,000	1	280
Luke	M	33	Project manager	18.2k	1	500
Lisa	F	25	Marketing employee	54k	2	640
Carly	F	31	Life coach	45.2k	2	1,900
Dagmar	F	28	Marketing employee	16.8k	2	2,100

population presented challenges in terms of recruitment. That is, they were considered a hard-to-reach sample, as we had difficulty getting responses to participate in this study. Therefore, two potential candidates who met our inclusion criteria were initially recruited through personal contact. The other five candidates were then recruited through snowball sampling, using a referral system through the first two micro-influencers in the sample. While the snowball sampling technique allowed us to overcome the challenges of accessing this sample, it is important to acknowledge that this method may introduce referral bias. That is, the participants were likely to refer other Instagram micro-influencers with whom they shared certain interests. In particular, Instagram micro-influencers in the health and fitness industry were overrepresented in our sample. We took this potential bias into account when interpreting the results.

In addition to referral bias, it is important to acknowledge other potential sources of bias when using Instagram micro-influencers as an extreme case. One source of bias is the influence of the influencer industry. That is, micro-influencers may have unique online identity work motivations and incentives that are more tied to brand collaboration and monetization (Banet-Weiser, 2012; Duffy and Hund, 2015; Abidin, 2016), which may differ from the motivations of more typical Instagram users. Specifically, Instagram micro-influencers are also active online to generate income through sponsorships (Duffy et al., 2021). This financial focus could also lead them to prioritize content that is more marketable, potentially influencing our findings regarding online authenticity and individuals' motivations for engaging in online identity work. Another potential source of bias is that we chose to use a single-site study to examine the dynamics of participants' online identity work. We intentionally chose to study only the participants' Instagram accounts because, on the one hand, Instagram is characterized by storytelling capabilities and a focus on sharing personal moments through mainly visual content, and on the other hand, all the participants were active on Instagram. Only a few of them were also active on TikTok, YouTube, and/or blog accounts. Therefore, findings from the Instagram platform may not be generalizable to other social media platforms, as each platform has unique characteristics and user behaviors – a topic we return to in the limitations section.

That being said, the results of this study should be interpreted in the context of these extreme cases, recognizing that they may not fully represent the more typical Instagram users. Because our focus was on gaining an in-depth and longitudinal understanding of our participants' experiences and behaviors associated with identity work, we immersed ourselves in the lives of these seven cases for whom their identity work processes are exceptionally visible in their online accounts. Although we did not strive for generalizations in these interpretations, the results may be taken to reflect on the experiences and behaviors of other individuals who are also active on SNSs. In conclusion, we respected the ethical concerns related to our (online) data collection procedure (Barros, 2018). We ensured that no private data was used in our article and that participants remained anonymous by using pseudonyms and not referring to any information (e.g., pictures) from the public accounts that could identify them. All participants provided written informed consent for their involvement in the research.

2.3 Data collection: a three-stage process

Data were collected through the use of complementary multi-method data, including (1) narrative interviews, (2) online autobiographical narratives of the participants' Instagram timelines, and (3) follow-up interviews. By combining these three types of data collection, we were able to take a dynamic and temporal perspective.

Stage 1: narrative interviews: First, we conducted narrative interviews, which were audio recorded and transcribed verbatim. The interview protocol started with the question: "Could you tell me more about your youth and how you experienced your upbringing?" Participants were then asked about the different stages of their lives, how they balanced and navigated their work, private, and online lives, the reasons for having started their Instagram accounts, and what opportunities and obstacles they encountered. By telling their life stories, the participants reflected on their identities, the sequence of different life events, and the turning points in their lives that affected their identity work over time. These interviews varied in duration, ranging from 1 h to 1 h and 45 min.

Stage 2: Instagram timelines: Second, the narrative interviews were complemented by an analysis of the timelines of the participants' Instagram accounts. While the narrative interviews provided us with background information about the participants'

lives, they did not provide a "sufficiently faithful and detailed account of their daily practices" of their online identity work *per se* (Latzko-Toth et al., 2016, p. 205). The Instagram accounts of the participants, however, can be considered as powerful autobiographical accounts that can help to construct and share (online) self-narratives (McAdams, 1999). These timelines are well-suited to explore the dynamic elements of the participants' online identity work. The multimodal posts on these accounts included both textual (e.g., captures and hashtags) and visual/audio content (e.g., pictures and videos). We extracted the text of the posts from the accounts and compiled them into a system, along with the engagement metrics (i.e., number of tags, likes, and comments) and date of publication. This resulted in a total of 540 pages of text. Overall, the analysis of the participants' Instagram timelines resulted in an average of 965 (ranging from 150 to 2100) data points (i.e., Instagram posts) per participant.

Stage 3: follow-up interviews: Third, to ensure methodological rigor, follow-up interviews were conducted 2 years after the narrative interviews. Five of the participants agreed to take part. Two participants declined to participate. One participant declined the follow-up interview but did not specify a reason for his withdrawal. The other participant, who initially agreed to the follow-up interview, encountered scheduling difficulties and ultimately expressed an inability to find time for the follow-up interview. The follow-up interviews with the other five participants added to the thickness of the data, as we reflected with them on the last 2 years of their lives. During these interviews, we discussed the patterns we had uncovered in our analysis with the participants, which gave us a space to check our initial interpretations (Latzko-Toth et al., 2016). The time stamps coming from the Instagram accounts were used to enrich the follow-up interviews, as we reflected together with the participants on the changes they made to their online identities over time. These interviews, which ranged in length from 1 h to 1 h and 30 min, were also audio-recorded and transcribed verbatim.

2.4 Data analysis

The data was analyzed using a thematic inductive approach (Braun and Clarke, 2006), taking place in three distinct rounds. Figure 1 presents a data structure diagram that shows the overall data structure of the coding process (Corley and Gioia, 2004) and illustrates how we moved from basic first-order codes to aggregated theoretical dimensions. These coding steps are elaborated below.

First, the data was analyzed in an open and inductive manner. During this phase, we thoroughly read and re-read the narrative interviews, and went through the online textual phrases and hashtags, verbal cues, and visual and/or auditory cues coming from the participants' Instagram accounts. By going through the posts that came from the participants' Instagram accounts, we were able to discover their online identity work in a timely manner. For example, we found that for some of the participants the hashtags they used gradually changed over time (e.g., #fitgirl, #fitsociety changed to #ambitiousgirls, #entrepreneurialgirls and #girlbosses). We documented these changes and monitored how their Instagram profiles had changed over time. The first emergent findings coming

from both the narrative interviews and the Instagram timelines were discussed in the research group in relation to the research question. These first ideas were then reflected upon with the participants during the follow-up interviews.

Second, first-order codes were developed to describe the main themes that we encountered in the data coming from the narrative interviews, Instagram timelines, and the follow-up interviews. These included, for example, "*changing hashtags*," "*portraying a new profile picture*," "*claiming new identity aspects in the account description*," and "*wearing different clothes*." Following our engagement with the literature and discussions in the research team, we continued our coding by grouping our first-order codes into second order themes (e.g., "*experimenting with online identities*").

Third, and finally, the second-order themes were grouped into aggregated theoretical dimensions. This allowed us to better understand the challenges the participants faced in their online identity work and the subsequent identity work strategies they employed in response to these challenges. For example, "*experimenting with online identities*," "*segmenting of online and offline identities*," and "*adding identities through online multiplicity*" resulted in the aggregate dimension of "*online identity work responses*."

In conclusion, this study was guided by a relativistic approach. This means that we acknowledge the subjectivity and contextuality of knowledge and understanding (Creswell and Poth, 2016). To ensure the rigor and trustworthiness of our research, we employed the following quality assurance methods (King and Brooks, 2016). First, efforts were made to engage with our participants over an extended period through email contact and follow-up interviews. This facilitated the development of trust and allowed for a deeper exploration of their online identity work experiences. Second, multiple data sources and methods were used to increase the robustness of our findings (i.e., narrative interviews, Instagram timelines, and follow-up interviews). Third, participants were invited to a follow-up interview to verify and validate our interpretations of their online identity work experiences. Fourth and finally, multiple authors were independently coding the data, and the authors met regularly to actively discuss the themes that emerged inductively. During these discussions, we also engaged in reflexive practices in which we acknowledged our own subjectivity and potential biases, which was key to shaping our interpretations (King and Brooks, 2016).

3 Results

In this section, we will present the themes and subthemes that emerged from our data analysis, with evidence coming from the narrative interviews, the timelines of the participants' Instagram accounts, and the follow-up interviews. We identified three main themes that highlight the challenges that the Instagram micro-influencers encountered online: (1) amplified social expectations, (2) feelings of inauthenticity, and, as a result thereof, (3) psychological distress. We found that these challenges were viewed by the participants as catalysts for their online identity work processes. More specifically, we identified three key online identity work strategies that were employed in response over time: (1)

FIGURE 1
Overview of data structure.
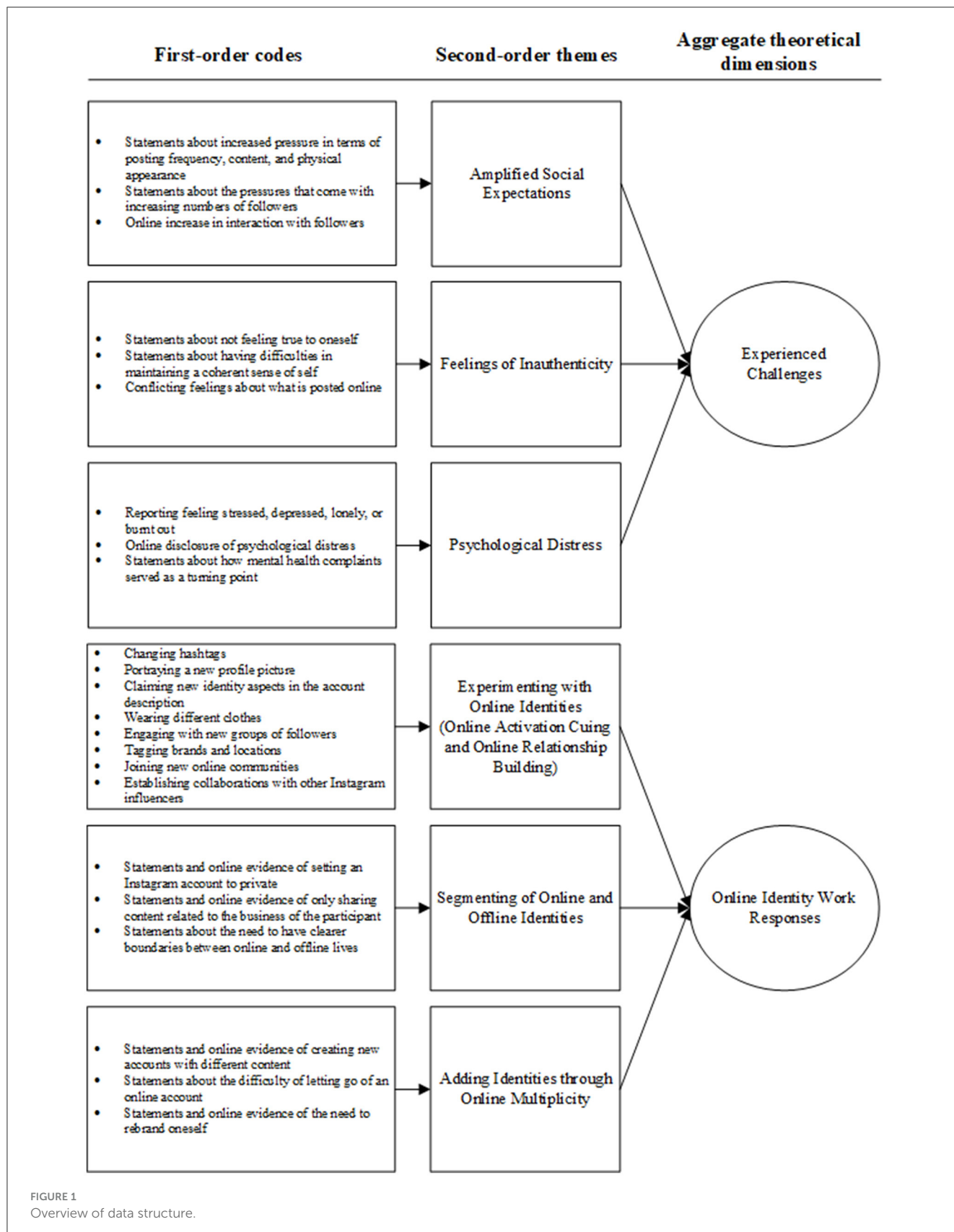
experimenting with their online identities, (2) segmenting of their online and offline identities, and (3) adding identities through online multiplicity. Figure 2 presents our theoretical framework which forms the basis for our results section.

3.1 Experienced challenges

The theme "experienced challenges" is defined by the challenges that participants experienced online. In the interviews, participants shared how they experienced the amplification of social expectations, their feelings of inauthenticity, and, as a result thereof, psychological distress.

3.1.1 Amplified social expectations

In the analysis, it became clear that as the participants engaged more with social media, in due course, all of them started to face challenges stemming from the increased social expectations they experienced. They explained that when they first started using social media, they did it mostly for fun. Over time, however, they described how their growing number of followers led them to experience increased pressure to meet the perceived expectations in terms of posting content more frequently and the type of content they shared online. Louise, for example, described her experience of a significant increase in the number of followers she had, which led to difficulties in meeting the increased social expectations that came with it:

> "Within 3 months, I had like 500 new followers you know? And that also gradually increased the pressure, since you need to deliver content. And then you think, oh, now I have 160 likes and then I had 102… What is wrong? Didn't I use enough hashtags? Does my face look weird? Is my hair okay? I don't know… What do they think of me?" (Louise, narrative interview, 08/11/20)

Similarly, Lisa mentioned that she had gained 10,000 additional followers in a short period of time and explained how she experienced psychological difficulties in balancing the expectations that these followers created. She described how she began to feel severe pressure to perform on her online account, driven by the expectations she perceived for her to produce content production on a regular basis, such as a weekly video or frequent posts.

> "Yeah, I also feel a lot of, uh, pressure to perform. Because I often feel like something is expected of me, like a video every week or content every few days. I don't know, last month I got 10,000 new followers. Yeah, it really shot up, but it also comes with the fact that I get a lot of private messages. I really want to answer them all, I really do, and I want to take my time. But I get 50 new messages every day and they're really long, because they're all people with their own stories who want to lose weight. I think it's really nice and sweet that they want to share that with me and get my opinion or whatever, but I just don't have the time. I don't have the time to respond in detail and it stresses me out, because I want to respond and I want to help these people in my own way (speaks quickly) and I find it very challenging to, yeah, combine and balance that." (Lisa, narrative interview, 08/01/21)

Participants explained how online social expectations were not only about responding and replying to messages, but also about their physical appearance and the content they presented on their timelines. These expectations came from both their followers and potential business relationships:

> "In the world of modeling, there is an increasing focus on, alright, who are you? That becomes more important. So, when I have a modeling job abroad, then I also need to film things around it, show something, those kinds of things. And that is what they find interesting online." (Simon, narrative interview, 08/12/20)

> "It is difficult. Because at a certain moment in time, I made that decision to go into the fitness world. And that means that I always must be fit, I always need to look good." (Jasper, narrative interview, 01/12/20)

> "And then Instagram came along, so you start looking at it and you see all those…, you know, then you start taking those protein shakes. I started exercising even more. Um, then I started sharing about it on my Instagram. Then you enter that world of fit girls. And then, it just gets worse, it just gets more. I was just trying to achieve a perfect version of myself. It was never good enough. I wanted a big bum, but I also wanted to be super skinny. Yeah, when I look back now, I really think I had such a blindfold on! Every time I looked in the mirror, it was not good enough. And when I look at those pictures now, I think: Jesus, why wasn't I good enough, you know?" (Dagmar, narrative interview, 19/03/21)

In general, the participants in the study discussed the gradual increase in social expectations they encountered over time and their efforts to meet these expectations, especially those coming from their followers. A detailed analysis of Carly's Instagram account revealed a gradual change in her content strategy. Initially, she shared only photos of her visits to the gym and her food choices. Over time, however, her content expanded to include detailed descriptions and videos of her workout routines, as well as before-and-after photos that showcased her physical transformation. Concurrent with this shift in content, we saw a significant increase in their follower count and engagement levels. Table 2 provides a visual representation of this growth, showing a significant increase in the number of likes and comments she received on her posts over a period of 4 months. Carly liked and replied to all of her followers' comments. This data example highlights Carly's increased commitment to sharing her personal progress online and engaging with her followers, reflecting her efforts to meet increasing social expectations online.

3.1.2 Feelings of inauthenticity

In describing their experiences with social media over time, six of the participants also shared how they gradually experienced feelings of inauthenticity. These participants articulated the challenge of presenting a consistent and true self online. In her

FIGURE 2
Theoretical framework of the online identity work processes.
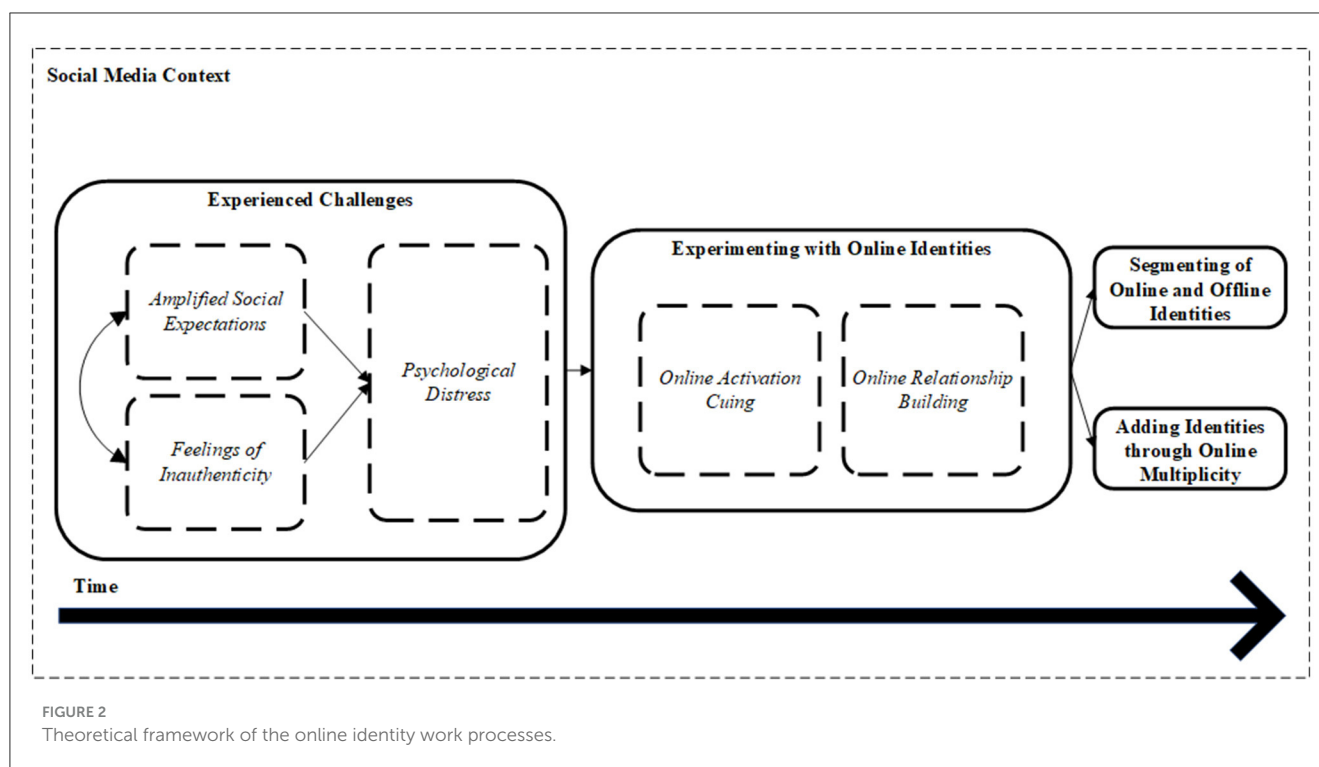
narrative interview, for example, Carly described how her online identity had evolved into an external image that she felt compelled to maintain over time:

> *"Well, I have maintained that (online) image for such a while, that I maybe think that I still am that person. But yes, I now start to doubt a bit. I am a bit stuck in the middle. On the one hand, I really like it, and on the other hand, I question whether that is still the person that I am? You know, you create a certain identity for yourself or so. (…) You think, you must be like that. I think that is it. That I must be like that. And I also somehow don't want to let go of it." (Carly, narrative interview, 26/02/21)*

Strikingly, Dagmar, Louise, Jasper, and Lisa shared similar experiences of feeling increasingly inauthentic as they tried to meet their followers' expectations. They described the difficulty of maintaining a coherent sense of self and presenting a consistent identity across online and offline contexts. Simon, for example, explained:

> *"The most difficult of this life is that like a year ago I was thinking like, okay, but what is really your identity you know? Yes, you are seen as this social guy, and you are often at many places, you are always surrounded with a lot of people, you are a social dude. But yeah, what do you really want yourself? It is often like, you go from one thing to the next, and it all just continues. But then you sometimes stand still, and you think, who am I now and where do I want to be in 5 years?" (Simon, narrative interview, 08/12/20)*

While the participants acknowledged the challenges of maintaining a consistent self across online and offline

environments, our analysis of the Instagram accounts revealed that they persistently posted images and videos that largely conformed to their followers' expectations. For example, Louise, who struggled with an eating disorder in her daily life, maintained her online identity as a food blogger. She explained that she had difficulty sharing her negative experiences on social media:

> *"And to the outside world, I did this by starting my online blog, making my Instagram public. Only smiling, eating, whereas I have an eating disorder. It is not right. But I am keeping up appearances because I don't want other people to know that I am not doing well. That is also why I keep work and private strictly separate. So even if I am sitting here crying on the couch, I still must provide content. So that is very conflicting. Because then I posted a photo of me smiling, and you don't know what's going on behind it. And people think I am really that fun." (Louise, narrative interview, 08/11/20)*

The challenge of presenting a consistent identity across different environments, both online and offline, was further highlighted by our analysis of Louise's Instagram timeline. A month after the narrative interview, in December 2020, her account still presented her as a "food blogger," with predominantly content centered around happiness, food, and wine (Figure 3).

In general, six of the cases revealed an increasing sense of inauthenticity, even though they attempted to maintain a consistent self across their online and offline environments. Despite the participants' struggles, however, our analysis of their Instagram accounts revealed their unwavering commitment to meeting the expectations of their online followers. As a result, many participants described how they experienced increasing psychological distress over time.

TABLE 2 Exemplary posts of Carly over time.

Time →	→
Carly — Fitness and food influencer •••	**Carly** — Fitness and food influencer •••
The essence of fitness is not to surpass others, but to surpass one's past self.	#transformationtuesday. A year ago, I made a lifestyle transformation due to my diabetes and poor eating habits which caused me to feel constantly unwell and fatigued. With a weight loss of 12kg, I feel much better now. While the journey towards a healthier and fitter body can be challenging, it is possible to achieve if you have a strong enough desire. I exercise not because I dislike my body, but because I love it and want to take good care of it since we only have one. I'm grateful for the support from everyone, as many of you motivate and inspire me daily.
87 likes	246 likes
#deadlift #80kg #fitdutchies #fitgirls #love #to #workout	#gymjunkie #fitgirl #eatcleantrainhard #positivethinking #progress #weightloss #Dutch #girlswholift #diabetes #fitdutchie
October 2014 — View all 3 comments	February 2015 — View all 61 comments

Instagram posts designed and reproduced from s.salvador via Freepik (https://www.freepik.com/free-psd/instagram-post-template_5263426.htm#&position=1&from_view=author&uuid=2410d69f-1272-4628-a0b1-836d31b3bb20).

3.1.3 Psychological distress

All participants, except for Luuk, expressed how they experienced psychological distress over time. They explained how the increased social expectations and feelings of inauthenticity threatened their wellbeing, leading to feelings of loneliness, stress symptoms, depressive complaints, and burnout complaints. The following example from Lisa shows how she experienced stress due to the conflict between her online (work) life and her personal life:

> "Well, I am just very stressed. I really want to have an evening to myself, but it just never seems to happen, it never does. And I'm someone who experiences a lot of stress very quickly, because I want to - I only have no stress left when everything on my list is done, but it never happens! It doesn't happen at work, and it doesn't happen in my personal life. Yes, yes, I have a lot of stress. And then I just don't know what to do first, I'm just not relaxed, you know. I just don't know what to do first." (Lisa, narrative interview, 08/01/21)

Like Lisa, Jasper shared how the challenges he faced online led him to experience psychological distress. He explained how he initially resisted the idea of experiencing burnout complaints and continued to try to live up to the expectations of others he felt, even though his body was signaling the need for rest. Ultimately, his decision to work with a psychologist was a turning point in addressing the challenges he was facing:

> "What your body does then, your body starts to sort of put things into perspective, and that's what my body started to do. So, suddenly it went like, yeah, you've had to perform for so long, it's time to take a break. But I didn't deal with it, so I could have sat at home and worked on it, but I never did because I personally didn't really believe in it. I didn't believe in burnout at

all, so I just kept going. But what I started doing is working with a psychologist to process things and understand where things are coming from." (Jasper, follow-up interview, 04/11/22)

Carly, Lisa, and Simon had been open with their followers about their feelings of psychological distress. An example of this is Simon's online disclosure of his struggle with a major depression. This was posted 4 months after his narrative interview, in which he had already discussed the challenges he experienced of maintaining a consistent identity. In this particular social media post (Figure 4), Simon openly shared his personal struggles and engaged with his followers. Similarly, Lisa disclosed that she was seeing a psychologist and told her followers that she wanted to be open about her negative health experiences (Figure 5).

In our data analysis, it became evident that the participants struggled with amplified social expectations and feelings of inauthenticity online, which, in turn, contributed to their experiences of psychological distress. This psychological distress emerged as a catalyst for change:

Louise's breakdown:

> "I am not going to maintain doing this. I notice that I have reached a point and that was only recently, because I started to break down my walls. But that was when I was with my parents and said: 'I can't take this anymore' and I said: 'within 3 months, I won't be here anymore.' Either I fall out mentally within 3 months, or physically. Something must happen right now. Yeah… that." (Louise, narrative interview, 08/11/20)

Carly's turning point:
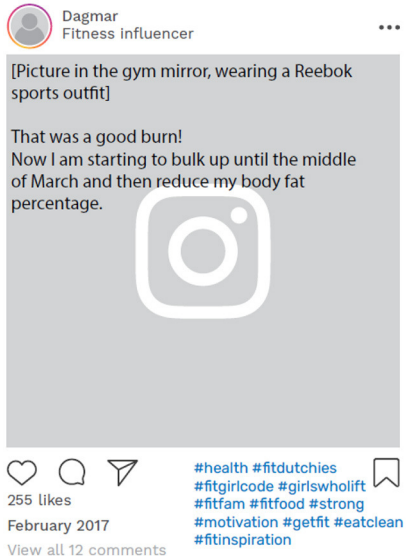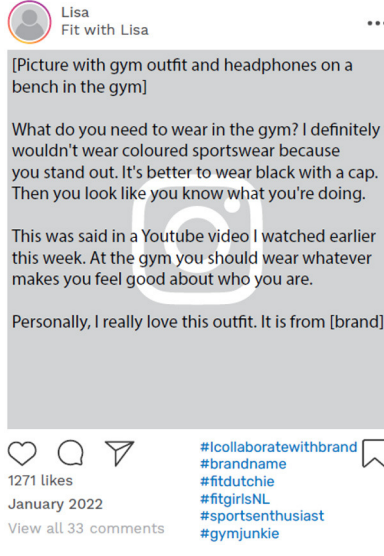
> "At one point I had so many followers that it became overwhelming, and at one point I completely collapsed. It happened during a vacation. I thought things were going well,

FIGURE 3
Example of online data taken from Louise's Instagram account. Instagram posts designed and reproduced from s.salvador via Freepik (https://www. freepik.com/free- psd/instagram- post- template_5263426.htm#&position=1&from_view=author&uuid=2410d69f- 1272- 4628- a0b1- 836d31b3bb20).

but when you're always on, you have a constant level of stress, very high stress. So, we went on vacation, and I thought, 'hey, maybe I should try to do nothing for 5 days,' because we only went to my in-laws for 5 days. But I couldn't even do that. I still wanted to answer messages. Then at one point we went out to dinner, and I just couldn't enjoy it. I realized that I still couldn't really enjoy anything. So, at one point, for no apparent reason, I started crying, and I couldn't stop. I went back to the hotel for a while. I cried all night and wrote down everything I was feeling.

It was mostly the pressure that I felt that I always had to be there for everyone. That was the turning point." (Carly, narrative interview, 26/02/21)

Dagmar's reevaluation:

"Well, I think I was just working less anyway, but not in a way where I was like: "Oh, that's great, now I can be really productive with other things." No, I was just lying on the couch,

FIGURE 4
Example of online data taken from Simon's Instagram account.
Instagram posts designed and reproduced from s.salvador via
Freepik (https://www.freepik.com/free-psd/instagram-post-
template_5263426.htm#&position=1&from_view=author&uuid=
2410d69f-1272-4628-a0b1-836d31b3bb20).

FIGURE 5
Example of online data taken from Lisa's Instagram account.
Instagram posts designed and reproduced from s.salvador via
Freepik (https://www.freepik.com/free-psd/instagram-post-
template_5263426.htm#&position=1&from_view=author&uuid=
2410d69f-1272-4628-a0b1-836d31b3bb20).

and I was already stressed about the smallest things. So, I really realized, okay, this is not making me happy anymore. I also realized that I wasn't finding happiness in the requests that I was getting from followers or the constant need to post. I was kind of done with that for a while. So, yeah, that's when I made the decision to throw it overboard." (Dagmar, follow-up interview, 08/11/22)

These examples highlight the interplay between the amplified social expectations, feelings of inauthenticity, and, as a result thereof, psychological distress. In turn, psychological distress triggered online identity work responses.

3.2 Online identity work responses

The theme of "online identity work responses" is defined by the changes that participants made to their online identities in response to the challenges they faced. The data revealed three different online identity work strategies that were employed in response to the experienced challenges: (1) experimenting with online identities,

(2) segmenting of online and offline identities, and (3) adding identities through online multiplicity.

3.2.1 Experimenting with online identities

The first online identity work strategy we discovered, particularly when analyzing the participants' Instagram accounts, was labeled "experimenting with online identities" and was characterized by a process of experimenting with different identity work tactics online to explore new identities. Our analysis revealed two categories of identity work tactics that the participants used for experimentation: online activation cuing and online relationship building. To illustrate these two tactics of online identity work, we purposefully selected two participants who provided us with a clear temporal example of experimenting with online identities, which we have visualized in Table 3.

3.2.1.1 Online activation cuing

The first category of tactics, the *online activation cuing* tactics, includes how participants experimented with and began to modify their online identities by intentionally using cues and signals to accentuate different facets of their online identities. This involves

TABLE 3 Exemplary posts of the online identity work strategy "experimenting with online identities" over time.

Time	→	→	→
Online activation cuing An online identity work tactic used to cue new online identities. It involves using cues and signals such as clothing, hashtags, profile pictures and account descriptions on online accounts to emphasize certain parts of one's online identity.	**Dagmar** Fitness influencer [Picture in the gym mirror, wearing a Reebok sports outfit] That was a good burn! Now I am starting to bulk up until the middle of March and then reduce my body fat percentage. 255 likes February 2017 View all 12 comments #health #fitdutchies #fitgirlcode #girlswholift #fitfam #fitfood #strong #motivation #getfit #eatclean #fitinspiration	**Dagmar** Female influencer [Picture of mascara] Hello beautiful! It's been a while. So busy with house hunting and other stuff, Sorry! Swipe left to see my amazing Total Temptation look. Can't wait to try the lipcolours! Happy day! 157 likes January 2018 View all 27 comments #totaltemptationlook #bloggersoutfit #blogger #fashion #fashionista #dutchblogger #lifestyle #influencer	**Dagmar** Online Business Coach [Picture dressed in business attire, sitting behind a desk and writing in a notebook] It's not about being as visible as possible or having as many followers as possible. It's more about how you create desire in your followers. You can have thousands of followers, but if you don't engage any of them, you won't make any sales. You get more ideal customers by connecting with your target audience. This can be achieved through strategy, but the other half that we often forget is mindset. Your target audience is a reflection of you. 203 likes August 2022 View all 16 comments #femaleentrepreneur #entrepreneur #contentmarketeer #ambitiousgirls #girlbossnl #dutchgirlboss #businesswoman #businessbabesnl
	Lisa Fit with Lisa [Before and after picture] I began my weight loss journey 1,5 months ago, during which I adopted healthier eating habits, incorporated more exercose into my routine, and stopped drinking alcohol. I am pleased with my progress thus far and am determined to maintain this lifestyle in the new year. 306 likes December 2019 View all 14 comments #weightlossjourney #weightlossgoals #weightlosssupport #weightlossinspiration #obese	**Lisa** Fit with Lisa [Picture with gym outfit and headphones on a bench in the gym] What do you need to wear in the gym? I definitely wouldn't wear coloured sportswear because you stand out. It's better to wear black with a cap. Then you look like you know what you're doing. This was said in a Youtube video I watched earlier this week. At the gym you should wear whatever makes you feel good about who you are. Personally, I really love this outfit. It is from [brand] 1271 likes January 2022 View all 33 comments #Icollaboratewithbrand #brandname #fitdutchie #fitgirlsNL #sportsenthusiast #gymjunkie	**Lisa** TravelwithLisa: Digital Nomad and Entrepreneur [Video on the beach in Spain] 264 likes March 2023 View all 18 comments #traveladdict #digitalnomad #digitalnomadnl #travelblogger #entrepreneur #ambitiousgirls

(Continued)

TABLE 3 (Continued)

	→	→	→
Online relationship building An online identity work tactic that involves creating or strengthening online relationships with others whose online presence also aligns with a desired online identity. This tactic includes joining new online communities, engaging with new groups of followers, and tagging brands and locations.	**Dagmar** Fitness influencer [Picture with four other influencers at a sports event] Together with my blogging and vlogging girls @sportsevent 216 likes October 2016 #health #fitness #fit #fitdutchies #fitgirlcode #fitnessaddict #fitfam #healthy #exercise #fitinspiration View all 29 comments	**Dagmar** Female influencer [Picture with a small mirror and make-up in the hand] A splash here, a splash there... This is not a scene from a porn film or a DIY show, but my daily plastering session for this face of mine. For the first time in my life, I show you my skin without makeup & share the products that really help me now. Check out the link in bio, [Name brand] is one of them and I can give away a tube in collaboration with @namebrand. Follow me on Insta & share your skin story in a comment. 334 likes October 2017 #health #fitness #fitdutchies #blogger #influencer #fashion #fitgirls View all 27 comments	**Dagmar** Online Business Coach [Video together with another influencer while working on a laptop] "Learning to work simpler to achieve a higher goal" is one of the things @nameinfluencer has taught me over the past six months. But she has also been able to develop her business, take it to a higher level and create a better structure. Curious about what I can do for you? Drop me a message in the DM ;) 1684 views July 2022 #femaleentrepreneur #entrepreneur #contentmarketeer #ambitiousgirls #girlbossnl #dutchgirlboss #businesswoman #businessbabesnl View all 22 comments
	Lisa Fit with Lisa [Picture on the website of another influencer] Hello dear all! I often receive questions about how I lost weight and what my story is. A while ago I was approached by @influencer if I wanted to share my story on her account. And now I am featured as fitgirl of the week on her account, fun! It is very personal, so it was difficult for me to put everything on paper. I hope it can inspire or motivate some people. Thank you @influencer! 270 likes April 2020 #fitdutchies #fitgirlsnl #fitdutchgirl #obese #weightlossjourney View all 54 comments	**Lisa** Fit with Lisa [Picture with gym outfit and headphones on a bench in the gym] What do you need to wear in the gym? I definitely wouldn't wear coloured sportswear because you stand out. It's better to wear black with a cap. Then you look like you know what you're doing. This was said in a Youtube video I watched earlier this week. At the gym you should wear whatever makes you feel good about who you are. Personally, I really love this outfit. It is from [brand] 1271 likes January 2022 #Icollaboratewithbrand #brandname #fitdutchie #fitgirlsNL #sportsenthusiast #gymjunkie View all 33 comments	**Lisa** TravelwithLisa: Digital Nomad and Entrepreneur [Video giving a pitch to investors] Today I went to a breakfast for networking! This is also where I got to do an elevator pitch for the first time. What is an elevator pitch? It is a short presentation about yourself in which you tell about yourself and your added value in a maximum of 60 seconds! Tell me, have you ever given an elevator pitch? How did it go? 531 likes April 2022 #femaleentrepreneurs #girlbosses #elevatorpitch #femaleentrepreneur #digitalnomad View all 35 comments

Instagram posts designed and reproduced from s.salvador via Freepik (https://www.freepik.com/free-psd/instagram-post-template_5263426.htm#&position=1&from_view=author&uuid=2410d69f-1272-4628-a0b1-836d31b3bb20).

a variety of actions, including the posting of content that highlights new interests, using specific hashtags, changing profile descriptions and profile pictures, and selecting clothing for online photos. For example, Carly changed her profile description from "Fitness and Food Influencer" to "Manifestation Expert" and shifted her content focus from fitness workouts and food to entrepreneurship and positive thinking. Around 2021, she began to include new hashtags such as #highlysensitiveperson and #lawofattraction in her posts, while gradually decreasing her use of fitness-related cues (e.g., #fitdutchie). Concurrent with these changes, Carly transitioned from predominantly wearing workout clothes to more smart casual outfits. Carly's follow-up interview revealed her sense of relief stemming from experimenting with these online activation cuing tactics and her perception that she was making more progress toward her authenticity online:

> "I started to feel very relieved when I started mindset coaching and making changes to my account. I was on my way to becoming more of my authentic self." (Carly, follow-up interview, 08/12/22)

Another participant, Dagmar, also shifted her content away from fitness and body transformation to share more about her daily life, particularly in relation to fashion and female struggles. She also started using hashtags that were more related to fashion and blogging (Table 3).

3.2.1.2 Online relationship building

The second category of identity work tactics, which we labeled *online relationship building*, refers to the actions that the participants took to build relationships that were more aligned with their personal interests. This involved the deliberate creation of online connections, including followers, fellow Instagram influencers, and sponsors. Within this category of tactics, participants engaged in actions such as liking and providing comments on their followers' responses, tagging brands and locations, using hashtags to join specific online communities, and establishing collaborations with other Instagram influencers. In this way, participants established new online business and personal relationships. Lisa described:

> "You must present yourself online to get collaborations. Right now, I am working on my second book and then I am going to set up an online community. I collaborated on my book with another influencer who is a dietician, so I want that dietician in the online community. People can then join and receive information from someone who has actual knowledge on the topic. They can do live workouts, and they can also ask questions about sports. And I will be there for motivation." (Lisa, follow-up interview, 08/12/22)

Table 3 illustrates the evolving patterns of Carly and Dagmar's online relationship building that better aligned with their desired online identities, that is, being a health and manifestation coach for Carly and being a female entrepreneur for Dagmar. Carly, for example, immersed herself in online communities that reflected her newfound identity, incorporating hashtags such as #ambitiousgirls, #entrepreneurialgirls, and #girlbosses. In 2019,

FIGURE 6
Example of online data taken from Dagmar's Instagram account. Instagram posts designed and reproduced from s.salvador via Freepik (https://www.freepik.com/free-psd/instagram-post-template_5263426.htm#&position=1&from_view=author&uuid=2410d69f-1272-4628-a0b1-836d31b3bb20).

Dagmar underwent an online identity transformation by changing her account description to "Online Business Coach." She also initiated a weekly engagement ritual with her followers, dubbed "Promotional Thursday," where she fostered connections with her followers and encouraged them to tag other entrepreneurs (Figure 6).

Overall, our data analysis revealed that the participants initially employed experimentation tactics, including online activation cuing and online relationship building, to change their social media accounts and explore new desired online identities. Their Instagram accounts allowed them to access new online communities and monitor post analytics, thereby receiving feedback on the changes they made to their accounts and, hence, their online identities.

However, after a period of experimentation with their online identities, our analysis revealed that participants subsequently adopted one of two primary online identity work strategies to further cope with the challenges they faced: (3.2.2.) "segmenting of online and offline identities" and (3.2.3.) "adding identities through online multiplicity."

3.2.2 Segmenting of online and offline identities

In our analysis, we labeled one of the follow-up pathways chosen after the phase of experimentation as "segmenting of online and offline identities." This strategy was employed by Luke, Simon, Jasper, and Louise, who, over the course of 2 years, underwent a process of further segmentation of their online and offline identities. This implies that initially, these participants experimented with online activation cues and online relationship building to gradually change their online identities. Over time, however, our analysis showed that they established clearer boundaries between their online and offline identities in response to the challenges they faced. Analysis of Louise's Instagram account revealed that her account had been set to private since 2022. During our retrospective follow-up interview, she explained:

> "Yes, I now fully let go. I put my profile on private, and then I thought: 'I will just call it quits.' Also, the strategy that I used to have like: first eating, then a picture of myself, then a picture of eating, picture of myself, I just let go of that. And I really thought: 'why do I even edit my pictures?'" (Louise, follow-up interview, 30/09/22)

Similarly, Luke did not share any aspects of his personal life on his Instagram account and only shared posts related to hockey coaching. His posts did not include pictures of himself or stories about who he is. His posts mainly showed different hockey techniques being performed by other people on his team. Simon's account also began to only show pictures of his modeling, photography, and DJ activities. He stopped sharing other aspects of his personal identity online.

3.2.3 Adding identities through online multiplicity

Another follow-up pathway that some participants took over time we labeled "Adding Identities through Online Multiplicity." Paradoxically, the participants who took this pathway described feeling inauthentic in their original online accounts, while at the same time struggling with the reluctance to let go of those accounts. Participants described how, over time, their online identities as displayed on their initial accounts became firmly established, negotiated, and validated by a large group of followers. However, they also recognized that the social expectations imposed by these followers further complicated their decision to let go of their established online identities. This strategy was associated with Carly, Dagmar, and Lisa, who decided to create multiple online identities across different Instagram accounts. Notably, Instagram facilitated a seamless transition between these different accounts by allowing the participants to switch between multiple accounts without having to log out and then log in again for each account separately.

Carly, for example, expressed her doubts about whether her online identity as a fitness influencer really reflected who she was, even though she had maintained it for quite some time. At the same time, she struggled with the idea of letting it go as it had become an integral part of who she was online. After a period of experimentation with her old account, Carly started a new social media account, this time, focused solely on mindset and spirituality. She found that this new account gave her a "clean slate" and allowed her to connect with like-minded individuals. Consequently, she started to feel more authentic again in what she presented online. In her follow-up interview, she described this transition and emphasized her newfound sense of authenticity online:

> "And then I started a new account. And on that one I just posted about mindset and spirituality. And my old account, the one with 45,000 followers, is just kind of stagnant now. Yes, I still post Insta stories, but not as much as I used to. And I noticed that with the new account, I don't know, it just gave me a sort of clean slate. It was completely new, and I could really be myself on there for once. And that might sound strange, because you could do that on your old account too, of course. But I don't know, there were all these people on there who just wanted to see fitness stuff all the time. And yeah, I just didn't feel like doing that anymore." (Carly, follow-up interview, 08/12/22)

When we asked her about the challenges of letting go of her old account, Carly mentioned the persistent urge to maintain it, especially influenced by her considerable number of followers:

> *"It had been in my head for a while to just close the account and create a new one. But every time you just don't do it. Yeah, you still think... Even when you talk to people about it, they always say: 'Yeah, but you've got so many followers, you're not just going to give that up, are you?' And then you start thinking again, oh yeah, maybe I shouldn't do it yet." (Carly, follow-up interview, 08/12/22)*

Dagmar faced a similar dilemma when she decided to change her online account. She explained that it felt like she was throwing away a successful formula that had been well-received by her followers over a long period of time:

> *"I made the decision to throw everything overboard, and to just focus on one-on-one customers. It was difficult because I had to rebrand online. And people of course know me because of my name online, and then I changed that to my normal name. That was a bit difficult, as it also felt like I was throwing something away. Some kind of success formula. But I had to do it. And that decision just gives me so much more peace now." (Dagmar, follow-up interview, 08/11/22)*

Lisa expressed a desire to share her travel experiences but was constrained by the expectations of her existing followers. Consequently, she created a new Instagram account dedicated to her interests in travel and entrepreneurship. This allowed her to build up a new group of followers.

> *"Well, I also started a second Insta [laughs]. Because I didn't have enough to do yet [laughs]. Yeah, because I really like entrepreneurship, traveling, things like that. But I can't share that on my other account, so I started a travel account. It already has 15,000 followers. And I also got my first collaboration with a sponsor." (Lisa, follow-up interview, 08/12/22)*

Lisa used one of her posts on her newly created account to explain the concept of being a social media influencer and to direct her followers to her primary influencer account. This post acted as an invitation to engage with her new content related to travel and entrepreneurship, ultimately fostering a social community around these topics, while directing her audience to her initial influencer account (Figure 7).

In general, some participants decided to add more identities through online identities because this seemed to be the best possible coping response to dealing with experiences of inauthenticity on their initial accounts. It seems apparent that for them, their online identities became firmly embedded in the expectations of their followers, making it difficult to fully disengage from these online identities. In response, they began to create and enact new online identities through different Instagram accounts, actively seeking validation from new audiences to support their evolving online identities while simultaneously lingering on their old accounts.

4 Discussion

In this study, we set out to expand the literature on identity work and online identities by identifying the challenges individuals

perceive online and how they respond to those challenges over time by employing online identity work strategies and tactics. By taking a temporal perspective and rigorously studying seven extreme cases of Instagram micro-influencers using multi-method data, we were able to focus on online identity work dynamics over a longer period of time (Vantilborgh et al., 2018). Our results confirm the idea that online identity work can elicit challenges. We found that the interplay between amplified social expectations (Chae, 2018) and feelings of inauthenticity (Haimson and Hoffmann, 2016; Haimson et al., 2021), can lead to psychological distress (Primack et al., 2017; Berryman et al., 2018; Keles et al., 2020; Harren et al., 2021). Based on our findings, we argue that individuals' online identity work should be viewed as a dynamic process that changes over time. In particular, our empirical work suggests that in response to the challenges individuals may face online, they first enter a phase of experimentation, followed by either a phase of segmentation between online and offline identities, or a phase of adding identities through online multiplicity, i.e., using additional accounts to enact new online identities. Below, we will elaborate on the theoretical implications of our study.

First, our study further revealed how Instagram accounts can be considered as extreme liminal spaces (Stanko et al., 2022) that provide individuals with an environment between fantasy and reality where they can easily experiment with new behaviors and identities. Specifically, in response to the challenges they experienced, the individuals in this study first entered a phase of online experimentation. We suggest that during this phase, individuals can use their social media accounts as an "identity playground" (Stanko et al., 2019, 2022) that can be leveraged to explore desired identities and follower responses (Ibarra, 1999; Ibarra and Barbulescu, 2010). Much in line with the literature on identity play, defined as: "people's engagement in provisional but active trial of possible future selves" (Ibarra and Petriglieri, 2010, p. 11), we found how social media platforms can further help individuals to "freely experiment with the identity in question" (Ibarra and Barbulescu, 2010, p. 13) and gradually make changes to their online identity. We found that they may do this through online activation cuing and/or online relationship building. Identity research already suggested that identity markers, such as dress and other physical artifacts (Bataille and Vough, 2022), and building relationships through community participation (Stryker and Serpe, 1982) can cue the activation of new identities. Our research adds to the literature on identity work and online identities by showing how social media provides an environment where individuals can employ similar tactics to explore new identities on their online accounts. As a result, the online identity that is being experimented with can directly be evaluated by "likes," "reposts," and new "followers." Particularly in the light of engagement analytics, individuals' identity work turns into a visible and measurable process online (Cover, 2015; Duffy et al., 2021).

Second, our results show that after experimenting, participants in this study chose between two different paths over time. They either further segmented their online and offline identities or added more identities through online multiplicity. Consistent with the authenticity paradox (Haimson et al., 2021), our findings showed that there were sometimes discrepancies between the participants' self-perceptions expressed during the interviews and their portrayals on their Instagram timelines (that is, the expression

of a true self online) (Lim et al., 2015). Specifically, in some cases, the Instagram micro-influencers indicated that they had difficulty presenting a consistent self across online and offline contexts (Haimson et al., 2021), which led them to experience psychological distress. As a result, some may cope with the challenges they experience by explicitly creating clearer boundaries between their online and offline identities. Consistent with the literature on boundary work (Desrochers and Sargent, 2004; Ollier-Malaterre et al., 2013; Dumas and Sanchez-Burks, 2015), creating barriers between different identities (e.g., not displaying personal aspects on their online accounts or setting their account to private), may help individuals to reduce the identity conflict they experience. Here, we argue that the context of social media allows individuals to set clear limits on when and how many resources are dedicated to their online and offline identities (Bataille and Vough, 2022). That is, design elements in social media applications, such as privacy settings, help individuals to behaviorally segment different identities, which can help them reduce the identity conflict they experience. In sum, individuals may choose this pathway as it allows them to cope with the challenges they experience (e.g., identity conflicts and psychological distress) by putting clearer barriers between their identities.

However, instead of choosing the pathway of segmenting online and offline identities, some Instagram micro-influencers emphasized that they found it very difficult to cope with the challenges they faced. In particular, the social expectations that followers have online can exacerbate feelings of inauthenticity (Haimson et al., 2021), while at the same time meeting these expectations can further entrench an online identity in social interactions. Moreover, critical media studies have argued that for influencers in particular brand collaboration and monetization are key to their online success (e.g., Banet-Weiser, 2012; Duffy and Hund, 2015; Abidin, 2016). In this context, letting go of entrenched online identities can be a daunting task, despite strong feelings of inauthenticity. Our findings offer new insights by showing how individuals may find an escape from these feelings. Specifically, some individuals may decide to consciously create a new online identity on an alternate account, referred to as "adding identities through online multiplicity." This pathway gives individuals a blank canvas on which they can redefine their online presence, without having to let go of their initial online identity. Our findings on online multiplicity bring forward insights on identity continuity (Wittman, 2019), specifically in online environments. Previous theories in the field of identity work have already explained that individuals often cling to former identities, even after changing roles (Wittman, 2019). Such a "lingering identity," would for example be the musician who is unable to let go of his/her musician identity after experiencing a serious injury (Maitlis, 2009). Regardless of external audience perceptions, the musician would still identify as a musician because he/she would still feel like a musician. However, our findings suggest that individuals may cling to their online identities not necessarily because they still identify themselves as "fit girl," but rather because they experience a strong sense of commitment to their online group of followers or sponsors and the expectations they may have of them (Stryker and Serpe, 1982, 1994). As a result, we argue that it is not a personal desire to hold onto

previous online identities, such as the musician's experience, but rather the entrenchment of online social expectations that makes transitioning to a new online identity or letting go of a previous online identity a challenge. In sum, we add a more thorough consideration of identity continuity in online environments (Wittman, 2019). Specifically, we have seen that online identities may remain "sticky" even when individuals wish to move on. In other words, individuals may find themselves in a battle to make an identity change as they continue to identify themselves by an entrenched online identity, that is cultivated through sustained social interactions with engaged followers and corporate demands from the social media platform (Duffy and Hund, 2015). Here, the online identity work strategy of "adding identities through online multiplicity" may then provide them with an answer to the online authenticity paradox (Haimson et al., 2021), as the creation of a new online identity on a different Instagram account, may help individuals to make an identity change that presents a more consistent, positive, and "true" self without having to discard a certain status that was built within their original account.

This article makes a final methodological contribution to the literature on online identity work (Jäkälä and Berki, 2013; Cover, 2015; Haimson and Hoffmann, 2016; Barros et al., 2023) via our use of online autobiographical narratives revealed through the Instagram timelines of extreme cases (Eisenhardt, 1989). To date, various researchers in the field of identity work have emphasized the need to explore the temporal precedence of identity work to better understand its dynamics (Sveningsson and Alvesson, 2003; Knapp et al., 2013; Bataille and Vough, 2022). Our multi-method data, coming from interviews at two points in time and from Instagram timelines, help us to track online identity work over time. Online stories coming from Instagram timelines can be seen as powerful autobiographical accounts that help individuals to construct and share self-narratives in an online social context (McAdams, 1999; Stanko et al., 2022). Accordingly, we argue that these Instagram timelines are well suited to explore dynamic elements such as temporal patterns during alternating phases of identity stability and change.

4.1 Practical implications

We outline the following elements of online user experience design that can provide individuals with online spaces that can enhance their digital lifestyles.

4.1.1 A space for the expression of authentic identities

To promote the expression of authentic selves in online environments (Haimson and Hoffmann, 2016; Haimson et al., 2021), the design of SNSs could consider certain elements of user experience design. One effective approach may be to configure applications that encourage users to present their true selves, potentially reducing identity conflict. Some SNS, such as BeReal and Everyday, have implemented this approach by encouraging users to share unfiltered moments from their daily lives. In

addition, platforms such as Instagram and TikTok are beginning to adopt similar features in response to the growing trend of online authenticity. Nevertheless, it remains an open question whether these design features can fully challenge the prevailing culture of creating an "ideal online persona" and whether individuals will consistently find it difficult to present their authentic selves online (Duffy and Hund, 2015; Haimson et al., 2021).

4.1.2 A space for community building

Online platforms could be further designed to enhance community building. As explained by earlier scholars, people's self-definitions and personal meanings are co-constructed through interaction with an audience (Goffman, 1959), and individuals are in need of communities where they have a sense of place and belonging (Baumeister and Leary, 1995). Social media can be used to find people with similar interests and join online communities with like-minded people. Some SNSs have already been designed around interest-based communities, such as UNBLND. UNBLND helps to connect strangers and connect them based on their interests and hobbies. As such, it becomes easier for individuals to find, for example, travel buddies, fitness buddies, or cooking buddies. Designed to build communities, apps can further help individuals to feel a sense of belonging, thereby allowing them to further express their authentic selves.

4.1.3 A space for online multiplicity

Finally, online platforms could build in elements of user experience design that allow users to have multiple accounts on one platform, and easily switch between them (Haimson et al., 2021). In this way, users are better able to create boundaries between different online identities, which may help to reduce the conflict they experience. That is, by allowing multiple accounts, individuals can decide when and how many resources to devote to a certain online identity, which may also allow them to present a more coherent and consistent story on a given account. By segmenting different accounts and enabling online multiplicity, individuals can activate different parts of themselves with different interaction partners in different online environments. Although apps such as Instagram and Twitter allow individuals to have multiple accounts, many other apps make it difficult for users to switch between accounts (e.g., TikTok and SnapChat). These SNSs could further integrate features of online multiplicity, which could help individuals to switch between different accounts and to begin to build new online identities with different target audiences that they may perceive as more authentic. However, this design feature raises the question of whether having multiple accounts on a single platform may simultaneously increase the social expectations that are experienced, potentially leading to more psychological distress over time.

4.2 Limitations and future directions

The present study has some limitations, which suggest potential directions for future research. First, a limitation of our study is

that our data was collected exclusively from seven extreme cases of Instagram micro-influencers on a single site (i.e., Instagram). While we believe that this group represents an extreme case for studying online identity work (Eisenhardt, 1989), and that Instagram provided us with a public platform that allowed us to explore visual content related to identity work, we also acknowledge that there is a potential bias in using this group as an extreme case. Aspiring or established influencers may be more aware of how Instagram's algorithm works and, as a result, may consciously tailor their online behavior to satisfy the algorithm, rather than express their authentic identities (Duffy et al., 2021; Haimson et al., 2021). The debate in critical media studies reflects the inherently paradoxical nature of the pursuit of authenticity in online spaces, and its ambivalent relationship with online success, brand collaboration, and monetization strategies (e.g., Boyd, 2010; Banet-Weiser, 2012; Marwick, 2013; Senft, 2013; Duffy and Hund, 2015; Abidin, 2016). Interestingly, our online observations revealed that those posts by Instagram micro-influencers in which they openly shared negative experiences, such as their struggles with mental health, resulted in the highest engagement metrics in terms of likes and comments, thus providing them with "positive quantified indices of visibility" (Duffy et al., 2021, p. 3). This observation raised an important question: does the act of sharing negative experiences truly stem from a desire to be authentic online, or does it serve as a strategic move to satisfy the algorithm and further capture the attention of fans and audiences? Furthermore, it could be argued that perceptions of online authenticity may also vary depending on the type of social media platform one is active on. That is, in this study we focused specifically on Instagram, a platform that is characterized by storytelling capabilities and a focus on sharing personal moments. What is considered authentic on Instagram, may not be the same on platforms like Twitter, blogs, or LinkedIn. Future research could consider expanding the sample to include a broader and more diverse range of social media users, such as young adults, or specifically those who use social media and experience psychological health problems. Additionally, future research could further explore how perceptions of authenticity might vary across platforms, and what identity work strategies are consequently employed on different platforms. Specifically, is there a difference between visual (e.g., Instagram) and text-based (e.g., Twitter) SNSs? To what extent do perceptions of authenticity differ between platforms where content may disappear quickly (e.g., SnapChat and Instagram stories) and those platforms where content may have a longer lifespan (e.g., YouTube or blog accounts)?

Second, to cope with the experienced challenges online we found that some individuals may add more identities through online multiplicity. They did so because they expressed struggling to let go of their online identities, which had been cultivated through sustained social interactions with engaged followers. Future research could explore the long-term effects of employing this strategy. That is, over the last decades, a multitude of studies in the field of multiple identities has examined the effects of multiple identities on health and wellbeing (Ramarajan, 2014). The conclusions of these studies, however, are conflicting. Some researchers take an "expansion" approach and suggest that having multiple identities (i.e., having higher self-complexity)

would provide the individual with more resources and, hence, lead to better wellbeing (e.g., Carter, 2008). Others argue that having to navigate a multitude of identities may deplete time and energy due to more incompatible role behaviors or because of frequent transitions between these multiple identities (Kossek et al., 2012), which may lead to lower wellbeing (for a review see Barnett and Hyde, 2001). Even though online multiplicity was used here as a strategy to deal with experienced challenges, an interesting avenue for future research would be to better understand the long-term psychological consequences of online multiplicity.

Finally, we wish to conclude this section on limitations with a critical reflection on the results of our study and our perhaps "utopian" practical implications. Drawing on critical media studies (e.g., Boyd, 2010; Banet-Weiser, 2012; Marwick, 2013; Senft, 2013; Duffy and Hund, 2015; Abidin, 2016) and critical identity studies (e.g., Thornborrow and Brown, 2009; Brown, 2021; Barros et al., 2023), we would like to emphasize that SNSs are a product of a neoliberal capitalist society (Mukherjee and Banet-Weiser, 2012; Duffy et al., 2021). Therefore, SNSs are primarily designed with profit in mind. This profit motive is, in turn, the enemy of wide and sustained change. In particular, SNSs are powered by a neoliberal ethos of self-commodification (Duffy et al., 2021), and designed to encourage users to create and share content that can be monetized through advertising and data analytics (Mukherjee and Banet-Weiser, 2012). The algorithms are designed to keep the users engaged and to generate more interactions to provide more data for the platform (Bishop, 2018). Instagram micro-influencers in particular are highly susceptible to these normative and algorithmic controls (Barros et al., 2023), given that their online success is tied to metric success (Duffy et al., 2021). A number of studies in this vein have focused on how content creators, such as Instagram influencers, adapt their online brand (i.e., their online identity) to changes in the broader culture (e.g., Duffy et al., 2021), also referred to as consumerist identities (Banet-Weiser, 2012). Interestingly, in this study, for example, we saw that participants' online identities were closely aligned with societal trends in health and fitness, but slowly transformed to online identities that were more aligned with what the newspapers refer to as "spirituality and manifestation trends" (Haupt, 2021; Agg, 2022). These changes may be necessary for them to adapt their online brand to meet the needs of the online system and, in doing so, remain visible and successful (Duffy et al., 2021). Moreover, in line with critical media studies, we argue that algorithmic content creation can create echo chambers (i.e., online spaces in which individuals are primarily exposed to ideas, opinions, beliefs, or information that align with their existing beliefs and identities) that can further inhibit the authentic expression of the self. In these online echo chambers, individuals are exposed to content that consistently reinforces the beliefs and identities that they initially created online. The consistent reinforcement of beliefs and identities could potentially lead to what we call "sticky" identities in this paper; those identities that are difficult to let go of.

In closing, we call for additional critical insight into the complex interplay between the design of social media platforms within a neoliberal capitalist context, and the influence of this profit-driven design on online identity work. If we are committed to building a mental health friendly online world, we need to start working to change the profit motives of these online platforms. That is, as long as these platforms are designed with the idea of profit maximization in mind, the identity demands that these platforms impose on individuals will always perpetuate the challenges that individuals face online. In particular, echo chambers and algorithmic content curation may make it particularly difficult for individuals to explore and question their own beliefs and identities, possibly limiting the inherently dynamic process of identity work (Maitlis, 2009; Ramarajan, 2014; Caza et al., 2018; Bataille and Vough, 2022) and leading to mental health problems in the long run.

5 Conclusion

With the development of advanced media technologies, such as SNSs, individuals' identity work increasingly takes place online. While it could be argued that our sample of Instagram micro-influencers is "extreme" and "atypical" for studying online identity work, we contend that many people today experience similar challenges online and may cope with these challenges in comparable ways to the participants in this study. In particular, we expect that more recent groups of young individuals may have similar experiences, as it has been demonstrated that early adolescents are increasingly influenced by advanced media technologies, such as TikTok and SnapChat (Mittmann et al., 2022). Overall, we hope that this paper can spark interest in conducting further research on online identity work strategies in response to the challenges that individuals may face online.

Data availability statement

The datasets presented in this article are not readily available because only excerpts/posts that have been used to underline the themes have been anonymized and included in the article. The rest of the dataset currently includes identifiable data. Requests to access the datasets should be directed to YB, bergs.y@buas.nl.

Ethics statement

The studies involving humans were approved by the Research Ethics Committee Nyenrode Business Universiteit. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

YB: Conceptualization, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. PP: Conceptualization, Formal analysis, Supervision, Writing – review & editing. XL: Conceptualization, Formal analysis, Methodology, Supervision,

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Measuring users' psychological self-withdrawal on mobile social media: the development of a context dependent instrument

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Introduction: MSM users have many concerns when disclosing information, such as role conflicts and privacy risks, which can result in nondisclosure. We call these negative feelings associated with MSM use "psychological self-withdrawal" (PSW).

Methods: Using a mixed-methods design, this study develops and validates an instrument for measuring PSW in the WeChat context, based on focus-group interviews (seven participants), one-on-one interviews (eight participants), and a survey of 1200 WeChat users.

Results: The result shows that PSW measure is a four-item instrument designed to measure PSW in the WeChat context. The results of two exploratory factor analysis pilot tests ($n = 91$ and $n = 81$) and a final confirmatory factor analysis test ($n = 1200$) indicate that the PSW measure has good internal consistency ($\alpha = 0.839$), factorial validity, and a single-factor structure.

Discussion: The study defines PSW as "users' series of negative feelings when using WeChat" and develops and validates an PSW measurement, using focus groups, interviews, and a survey. A four-item PSW with acceptable reliability and validity was finally developed.

1 Introduction

Many users are now connected via mobile social media (MSM), which is defined as "a set of connectivity-enabled mobile applications that facilitate interaction and the co-creation, exchange, and publication of information" (Hoehle et al., 2015; Wong et al., 2022). The number of social media users has been on the rise and has reached one billion (Hew et al., 2019). With the increasing penetration of mobile phones, there is expected to be a more significant rise in MSM use in the future (Apaolaza et al., 2019).

However, increased use does not necessarily bring higher participation. Following its extraordinary growth in terms of use and diffusion, MSM has recently seen a decline in active users (Cao and Sun, 2018). Pressures such as social media exhaustion have led users

to develop various coping behaviors, such as reducing posting frequency (You and Liu, 2022), using social media discontinuously (Fu et al., 2020), or deleting social media accounts (Lee, 2021), exhibiting certain forms of self-withdrawal (Ritchie, 2018). The phenomenon can be observed on many platforms. For example, Facebook, the world's largest social networking site, has seen a shrinking user base in recent years (Cao and Sun, 2018). Similar to Facebook in the US, WeChat, China's most popular social networking site (Chen et al., 2021), has also experienced a slowdown in user growth (Zhou and Tian, 2023).

Although some people still maintain their engagement on MSM, their use styles are often passive. Today, not all MSM users are willing to actively update their statuses, make comments, or engage in other forms of direct exchange. Many users just browse and observe content posted by others without any attempts to interact socially with other users (Liu et al., 2022). Such passive use behaviors involve features such as neglect and avoidance (Li et al., 2022). Viewed from the perspectives of the stressor–strain–outcome model, self-discrepancy theory, the affective response model, uses and gratifications theory, social cognitive theory, and the stimuli–organism–response framework, these passive use behaviors can be understood as motivated by negative psychological experiences, such as privacy concerns and social overload.

Passive use behavior can threaten the development of platform enterprises. It is commonly acknowledged that market value depends highly on benign interactions among active users (Carah and Shaul, 2016), and the decreased use of social networks could lead to financial losses for platform-based enterprises (Choi et al., 2015). This emphasizes the need for platform enterprises to better understand the concept of "psychological self-withdrawal" (PSW), which pertains to users' uncomfortable feelings and passive engagement behaviors when using MSM.

A number of studies have focused on the SW phenomenon. From a user-behavior perspective, definitions and scales have been developed to understand and measure SW. These definitions have been widely used, and the measures have been validated, highlighting their suitability for measuring SW behavior in the MSM context. SW has been defined as the "active retention of information" (Dienlin and Metzger, 2016), which can be manifested in various ways, such as using privacy protection software or privacy settings (Meier et al., 2020), reducing public disclosure, or withholding certain information (Ritchie, 2018). However, according to stimuli–organism–response theory, behavior can be stimulated by psychological factors. Hence, existing definitions and measures of SW ignore the psychological perspective. Moreover, although researchers have found that users typically vacillate between self-disclosure and SW (Ma et al., 2021), neither the concept of PSW on MSM nor its measurement has been adequately addressed (Dienlin and Metzger, 2016), especially for acquaintance MSM platforms such as WeChat. This study, therefore, aims to fill gaps in MSM research by addressing the research questions that follow:

> *RQ1*: How do we define psychological self-withdrawal on WeChat?

> *RQ2*: How can we measure users' psychological self-withdrawal on WeChat?

PSW on WeChat cannot be adequately examined without considering its connection to MSM use. Although there are many definitions of SW across different research areas and some measures

of its construct, little has been done to define PSW and formalize its measurement in the MSM context, especially for WeChat, which is an acquaintance social networking platform. The few MSM researchers who have attempted to define SW often simply describe it as withholding information or deleting posts (e.g., Dienlin and Metzger, 2016; Chen, 2018), and the limited studies that attempted to measure SW often utilized scales with only physical-based items (e.g., Andreassen et al., 2012; Meier et al., 2020), ignoring SW's psychological dimension. Thus, there is a need to further define SW in the psychological dimension and develop the related measurement items for the WeChat context. In this paper, we define PSW and develop a measurement instrument for PSW in the WeChat context using mixed methods from a psychology perspective instead of a behavior perspective. In the following, we first discuss MSM-related concepts and review SW research as the theoretical basis for developing the concept of PSW in the WeChat context. Second, we take PSW as a theoretical variable and develop its measurement items using a focus group with seven participants and interviews with eight WeChat users. Third, we use a study involving 1,200 WeChat users to empirically evaluate PSW. Lastly, we discuss the results, limitations, and future research directions.

2 Literature review

2.1 MSM and WeChat

According to Ju et al. (2021), MSM refers to "a set of platform-based media technologies that enable communication, interaction, and user-generated content creation and sharing," and it encompasses two types of mobile applications: mobile social networking sites (e.g., Facebook and Twitter) and instant messaging apps (e.g., Facebook Messenger, WeChat, and WhatsApp). In order to adapt to the research context of this article, we define MSM as "a platform supported by a set of media technologies." Thus, for this study, we regard WeChat as an MSM platform.

The difference between WeChat and other MSM applications is that WeChat is a strong-tie social platform (Chen et al., 2019) while applications such as Twitter are weak-tie social platforms (Valenzuela et al., 2018). Thus, WeChat has the characteristics of a social networking platform for acquaintances. In Twitter's communication space, the "imagined audiences" can include strangers and even celebrities (Lee, 2013). While WeChat is more private and exclusive, more relationship focused, and less visible (Xu and Zhang, 2022), the imagined audiences can be friends, colleagues, and family members. WeChat has a relatively rigorous friending mechanism in which people can only add friends by scanning a private QR code or using a certain account ID, which means most WeChat friends are likely in some way connected offline (Pang, 2020). Most studies focus on weak-relationship MSM platforms such as Facebook and Twitter (Kim, 2023), ignoring strong-relationship MSMs such as WeChat (Ma et al., 2020). This is why we conducted this study based on the WeChat context.

WeChat (or *Weixin* in Chinese), launched in January 2011 by Tencent, is one of the most widely used MSMs among young people in China (Pang, 2020). It is an instant messaging and social networking platform that enables interactive exchange through mobile devices (Xu et al., 2015). People use WeChat to maintain or promote relations with acquaintances (Chen et al., 2021) by sending messages, making video or voice calls, and posting content (e.g., text, pictures, and

videos) through "Moment," exclusively to a single WeChat friend, or to a WeChat group. WeChat users can leave comments or simply click the "like" button on other users' posts. It offers users a private platform on which only people admitted to one's friend list can read one's posts and comment on them (Pang, 2018). Thus, WeChat is considered a "must-have MSM app" in China (Zhang et al., 2021), and as of June 2022, it had 1.299 billion active users (Hong et al., 2023).

Given the characteristics of WeChat's acquaintance network, users' PSW might become more obvious on this platform. In the context of WeChat, people's attitudes toward friends and their participation behavior can vary based on the strength of their *guanxi* network with other members (Shao and Pan, 2019). For example, users might disclose more freely to those they have strong ties with since they have long-established emotional attachments. Meanwhile, they might be more cautious about disclosing to those they have weak ties with since there is weaker trust. As the number of WeChat friends increases—especially the number of "weakly related" contacts—users begin to passively browse the "moments" of their contacts without actively interacting (Teng et al., 2022). Thus, MSM platform operators face the challenge of how to increase user activity and self-disclosure behavior (Ma et al., 2020) and reduce SW behavior.

2.2 Passive MSM use

Various environmental and social stimuli on MSM can produce different feelings in users, thus leading to different use styles. One dominant approach is to dichotomize MSM use into active and passive (Meier and Krause, 2022). Burke et al. (2010) were the first to propose this idea (Valkenburg et al., 2022). According to Yin et al. (2022), passive use is the most frequent pattern of MSM use.

Passive use refers to "monitoring the online life of other users without engaging in direct exchanges with them (e.g., scrolling through news feeds or looking at other users' profiles)" (Verduyn et al., 2020). Passive users engage with MSM mainly to browse, monitor, and observe ongoing discussions (Dang, 2020) and to consume information.

Passive MSM use can lead to many negative outcomes. Many studies have found that passive social media use can be related to the feelings of envy (Kashian, 2022), low self-esteem, and other mental health issues; it can trigger an increased social comparison tendency (Ellison et al., 2020) and negatively affect well-being (Yue et al., 2022). If users believe their information on MSM is being recorded, leaked, or spread, they might adopt passive use behavior to protect personal privacy (Teng et al., 2022). For example, they might develop discontinuous use behavior, such as taking short breaks, performing information-control activities, or suspending use (Fan et al., 2020).

2.3 Theorizing PSW on MSM

Definitions of SW are often context oriented, varying across different situations. In the psychological and behavioral sciences, SW is often considered a specific behavior for coping with stressful situations, such as unwanted social interaction (Evans et al., 2000) and negative experiences (Elison et al., 2006). In organizational management research, SW is mostly limited to work withdrawal and job withdrawal. It is regarded as a way of coping with unfavorable experiences and attitudes in the workplace (Kim et al., 2019) and can involve avoiding or denying communication or

cooperation (Xu et al., 2022). Pan (2018) divided withdrawal at work into psychological withdrawal behavior and physical withdrawal behavior; the former refers to remaining physically present at work while mentally escaping from it (Bashir et al., 2019). In addiction research, SW pays more attention to individuals' subjective feelings than their objective behaviors. It can include negative emotions (Liu et al., 2021), negative moods (Fioravanti and Casale, 2020), and negative feelings (Balakrishnan and Shamim, 2013). In MSM research, SW is mainly a behavior that involves withholding information, mainly to avoid the negative outcomes of communication (Dienlin and Metzger, 2016). It involves avoiding contact with others altogether in addition to avoiding disclosure (Moore and Tangney, 2017). Table 1 reviews the SW-related literature, briefly describing studies' references, concepts, definitions, contexts, theoretical foundations, focuses, and key findings.

Based on the literature, we can see that SW is a multidimensional concept (Lee, 2021), encompassing both behavioral and psychological dimensions, with the latter often being ignored. Apart from addiction-related studies, the above mentioned studies mostly focus on the behavioral dimension of SW while the psychological dimension is rarely mentioned, especially in MSM research. Although addiction-related studies have paid attention to the psychological dimension, they only focus on the negative feelings that are aroused after activities are ceased, ignoring the negative feelings aroused during activities. However, it is precisely the uncomfortable use process that stimulates users' bad feelings the most. In addition, the MSM studies that do define SW tend to be Facebook-specific and do not lend themselves to WeChat research. Such definitions are incomplete. China is a strong-tie society where considerable importance is attached to the concept of *guanxi*, which is rooted in Confucianism. WeChat is a social platform on which Chinese people can maintain and enhance *guanxi* with others in their social networks (Zhao and Zhang, 2020). Thus, exploring the psychological dimension of SW on WeChat is particularly meaningful in the Chinese context. As outlined above, we propose the PSW concept and define it as "users' series of negative feelings when using WeChat." Then, we develop and validate measurement items for PSW based on our literature review, focus-group interviews, one-on-one in-depth interviews, and a survey.

3 Method

Following Hosseini et al. (2022), we employ a mixed-methods design. We derived important information about PSW in the WeChat context using qualitative methods. We then used this information to structure a questionnaire to measure PSW. Qualitative (phase 1) and then quantitative (phase 2) data were collected and analyzed in two consecutive phases. Phase 1 relied on information provided by focus-group and one-on-one in-depth interviews, aiming to form a measurement item pool for PSW. Phase 2 used an online survey to examine the reliability and validity of the PSW measurement items. We created the questionnaire using Sojump. Prior to the questionnaire, respondents viewed an information page describing the purpose of the research and the confidentiality of data.

In the qualitative research, first, we used the focus-group interviews and one-on-one interviews to collect users' opinions about PSW on WeChat. Then, we used NVIVO 12.0 to analyze the interview data and extract measurement items. An initial item pool was created

TABLE 1 Studies related with self-withdrawal.

Reference	Concept	Definition	Context	Theoretical foundation	Study focus	Key findings
Evans et al. (2000)	Social Withdrawal	A strategy coping with the difficulty of too much unwanted social interaction.	Chronic Residential Crowding	Systematic Literature Review	Whether the previously documented coping strategy of social withdrawal in response to chronic crowding is related to changes in social information processing.	Individuals residing in crowded homes were less cognizant of personal information about strangers.
Andreassen et al. (2012)	Withdrawal	The occurrence of unpleasant feelings when the activity is discontinued or suddenly reduced.	Facebook Addiction	Systematic Literature Review	Develop Facebook Addiction Scale	The BFAS has acceptable psychometric properties in terms of internal consistency, factor structure, and reliability, as well as in relation to content and convergent and discriminative validity.
Balakrishnan and Shamim (2013)	Withdrawal	Negative feelings experienced when the person is unable to perform the activity.	Facebook	Uses and Gratifications Theory, Brown's behavioral addiction framework	Facebook usage pattern, motivations and psychological/behavioral factors affecting the users	Malaysian students use Facebook for Social Networking, Psychological Benefits, Entertainment, Self Presentation and Skill Enhancement.
Dienlin and Metzger (2016)	Self-withdrawal	Active retention of information	Facebook	Privacy Calculus	Test the privacy calculus' generalizability and extend its theoretical framework by including both self-withdrawal behaviors and privacy self-efficacy.	Both privacy concerns and privacy self-efficacy positively predicted self-withdrawal. Regarding self-disclosure, benefits outweighed privacy concerns; regarding self-withdrawal, privacy concerns outweighed both privacy self-efficacy and benefits.
Moore and Tangney (2017)	Social Withdrawal	A form of concealment. It involves avoidance of contact with others altogether in addition to avoidance of disclosure.	Concealable Stigma	Systematic Literature Review	Examine whether criminal offenders' anticipated stigma predicts behavioral outcomes through social withdrawal.	Anticipated stigma during incarceration predicted social withdrawal three months postrelease, which then predicted more mental health problems 1 year postrelease.
Chen (2018)	Withdrawal Behaviors	Actively deleting and untagging posts	Social Media	Spiral of Silence Theory	The spiral of silence process on social media	Fear of social isolation (FSI) has an indirect effect on discouraging disagreeing opinion expression but not supporting opinion expression and on encouraging withdrawal behaviors through enhancing willingness to self-censor (WTSC) on social media.

(Continued)

TABLE 1 (Continued)

Reference	Concept	Definition	Context	Theoretical foundation	Study focus	Key findings
Leng et al. (2019)	withdrawal	One of addiction's core symptoms	Social networking sites addiction	Systematic Literature Review	The effect of different materials on desire and excitability of social network addicts	SNS-related stimulation, especially image clues, could significantly induce subjects for the craving and excitability of social networks, and the craving fluctuates.
Meier et al. (2020)	self-withdrawal	managing and withholding personal information by using privacy protecting software or by using privacy settings.	Facebook	Protection Motivation Theory	Investigate factors that predict Facebook users' privacy protection motivation and to examine whether fear appeals and social norms can raise participants' intention to protect personal data	Privacy threat perception and the perceived effectiveness of privacy protection are important factors for explaining self-withdrawal intention among Facebook users.
Fioravanti and Casale (2020)	withdrawal	One of addiction's core features	Facebook	Systematic Literature Review	Creat and validate a questionnaire to measure active and passive Facebook use, and evaluate its association to Facebook addiction	The APUF is a useful measure with good psychometric properties for assessing whether people use Facebook actively or passively
Ma et al. (2021)	self-withdrawal	Manifested as the withholding of information	WeChat Moments	Privacy Calculus Theory	The influence of ephemerality on the tension between information-privacy concerns and information disclosure	Individuals' perceptions of the ephemerality of technology features significantly impacted users' self-disclosure intentions by counteracting perceived severity and perceived intrusion concerning privacy risks.
Li et al. (2022)	withdrawal behavioral intention	The tendency of users to unfollow, leave groups and uninstall platforms.	mainstream social media platforms	cognition-affect-conation framework	Explore how perceived overload affects the passive usage intentions of social media users.	Perceived overload positively affects the passive usage intentions of mobile social media users.

by combining items collected from the literature review with those extracted from the interviews.

In the quantitative research part, we followed the scale development process of perceived anonymity (Hite et al., 2014) and conducted an online survey based on the initial item pool. SPSS 26.0 was used to carry out exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). This was a multistage process consisting of item selection, expert review, a pretest, pilot testing, and the full testing of the measurement instrument. This method includes numerous evaluations of reliability and validity and offers a rigorous framework for developing a reliable and valid measurement instrument. Throughout the development of the PSW measure, we took the Cronbach's alpha coefficient as the main indicator of reliability, similar to previous studies (Sigerson and Cheng, 2018; Fioravanti and Casale, 2020). All of the EFA solutions

were obtained using maximum likelihood extraction methods and unrotated solutions (similar results were obtained using alpha factoring extraction). During EFA in the pilot studies, factors with eigenvalues greater than one were extracted. CFA solutions executed for a second sample were obtained using maximum likelihood parameter estimation.

The formal measurement items were formed based on the qualitative and quantitative research. Figure 1 shows the research design.

4 Phase 1: qualitative research

Based on our literature review, we first collected some measurement items for PSW in the MSM context and revised them to make them suitable for our research. Table 2 shows the revised items.
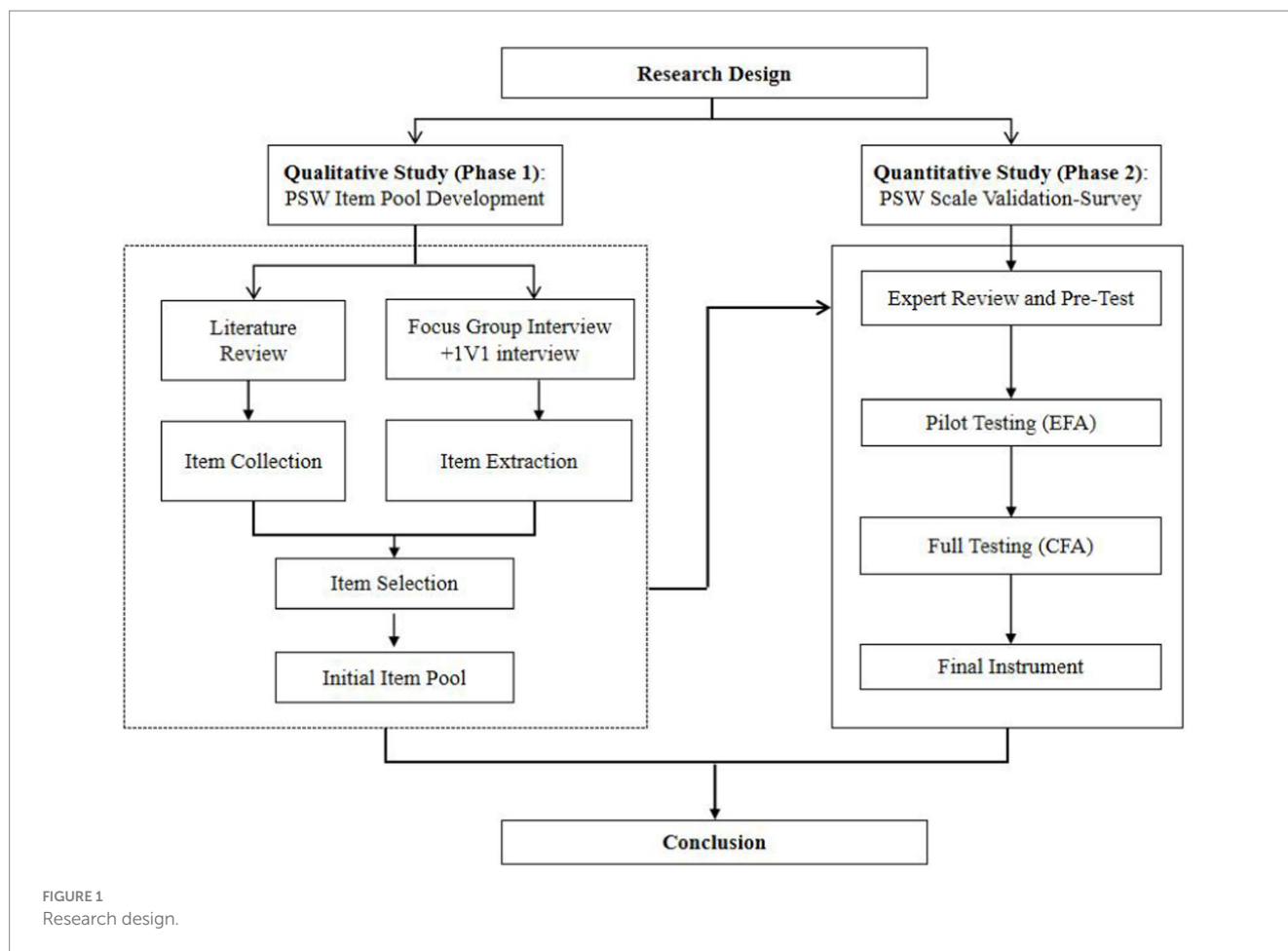
FIGURE 1
Research design.

TABLE 2 Revised measurement items for self-withdrawal.

Measurement items	Sources
I become restless or troubled if I am prohibited from using WeChat	Andreassen et al. (2012)
I often feel timid on WeChat	McDermott et al. (2013)
I limit what I do and say on WeChat	Dienlin and Metzger (2016)
I make my WeChat moments visible only to people I trust	Dienlin and Metzger (2016)
I often delete or withdraw messages or posts on WeChat	Chen (2018)
I delete some friends on WeChat	Li et al. (2022)

Then, we conducted the focus-group interviews to gain a deeper understanding of PSW.

4.1 Focus-group interview

For the purposes of this study, we defined the PSW construct as "users' series of negative feelings when using WeChat." Then, we conducted focus-group interviews to understand respondents' perceptions of PSW on WeChat. The focus-group format facilitates a dynamic exchange of views (Lopez-Gonzalez et al., 2021). Participants

were told that the study involved "exploring negative feelings related to WeChat use that lead to a series of information-control behaviors."

Focus-group participants needed to meet the following two criteria: (i) they were proficient in using WeChat, and (ii) they had had at least one experience in the past 6 months in which they did not want to reveal information on WeChat. To avoid the possible influence of gender and professional field, we recruited participants from different professional fields, and the gender distribution was equal. In total, eight people participated in the focus group. The participants' characteristics were as follows: All were recruited from a well-known university in southern China and were professionals in different fields, all had experienced a reluctance to disclose information, and all used WeChat every day. There were four men and four women; they ranged in age from 25 to 40 years old.

The host of the focus group was an MSM researcher who focused on topics related to passive use and had experience with focus-group interviews. The purpose of the focus group was to explore the psychological features that would stop users from self-disclosing on WeChat. Accordingly, we created a discussion guide comprising a series of open-ended questions, as shown in Appendix 1, focused on the following:

1 What does the participant use WeChat for (e.g., information, relationships, and entertainment)?
2 What negative feelings have the participants experienced when using WeChat? (They were asked for examples.)

3 How do the participants use WeChat?

4 Why do the participants use WeChat passively?

The focus-group setting involved the following three steps:

Step 1: Before starting the focus-group discussion, the definition of PSW, the purpose of the study, and the rules of the discussion were explained to the participants. Participants were informed of their rights and that they were free to leave the study at any time. They signed consent forms and participated voluntarily. Then, all of the participants were given five minutes to think about their WeChat use experiences.

Step 2: Questions were asked based on the discussion guide. The host asked the participants to discuss their own experiences related to PSW on WeChat to reduce subjective biases.

Step 3: The host summarized the findings of the discussion and showed them to the participants for follow-ups after the end of the focus-group interviews.

Respondents were encouraged to voice their opinions and were allowed to discuss points with each other. When no new information arose, the focus-group interview was concluded. Then, we conducted a preliminary analysis of the interview recordings, which provided many new ideas for the subsequent one-on-one in-depth interviews. The respondents were asked about their WeChat use habits, including features they typically use. One interviewee said, *My WeChat use is mainly relational use, because it is not very convenient to access information or to be entertained through WeChat*. Interviewees were probed about the feelings they had experienced when using WeChat, such as their concerns about using WeChat. One said, *Once, I commented on a girl's moments. I took it just as pure comfort. However, my girlfriend saw it and misunderstood it, and then she got angry, which had a bad effect on our relationship. Since then, I have tried not to give likes or comments to others*. Another person said, *Although I have set up groups, the people in the groups cross paths offline, which makes me feel stressed*. When asked about WeChat use patterns (e.g., whether to use WeChat Moment privacy settings or not), even though some interviewees said they had limited some friends' access to their moments, they still have some worries. For example, one interviewee said, *I want to limit someone's access to my moments, but it is easy for them to find out about this setting, which would magnify my behavior*. The focus-group session took approximately 2 hours. Some modifications of the discussion guide were then made to be suitable for the one-on-one in-depth interviews.

4.2 One-on-one in-depth interviews

To get a better understanding of PSW, we conducted one-on-one in-depth interviews with eight people, using the discussion guide modified based on the focus-group interview results. All of the interviews lasted about 1 hour. We focused on statements related to PSW to illustrate that the interviewees had experienced many uncomfortable feelings in their WeChat use. For example, one interviewee indicated concerns about self-disclosure, stating that *I have to consider so many WeChat friends' opinions when I want to post on Moment*. Another person reported that *WeChat Moment is a public place for me, and I usually post some scenery-related updates on it; I do not want people who are not familiar with me to know everything about me through my WeChat moments*. Another said, *Sometimes, I worry that I might ignore others' feelings when I disclose information on WeChat Moment; I also worry that others might misunderstand the statuses I post, so I think it is better to disclose less on Moment*. Similarly, another interviewee noted, *I worry that the updated status will be misunderstood, and misunderstandings can spread, so I might delete what I disclose on WeChat*. Interviewees also revealed their WeChat use stress. For example, one said, *WeChat Moment is a public place, and its nature is different from that of private chats. In a private chat, not replying will be considered impolite behavior, so private chats give others reply pressure*. These examples show that many users have experienced negative feelings when using WeChat.

Figure 2 summarizes the main steps we took in the focus-group and one-on-one interviews.

Once the data were collected, we used thematic analysis to identify themes (Lopez-Gonzalez et al., 2021) arising from the focus-group and one-on-one in-depth interviews. We used NVIVO 12 to analyze the content. Following Saldaña (2009), there were two coding cycles. In the first cycle, we divided the data into categories. In the second, we classified, prioritized, integrated, synthesized, abstracted, and conceptualized the content to build a theory. This analysis revealed seven main themes for SW on WeChat: (i) function deficiency, (ii) role conflict, (iii) social fatigue, (iv) social media addiction, (v) privacy concern, (vi) self-discrepancy, and (vii) impression management. Figure 3 shows the coding results, and Table 3 gives examples of the themes.

According to Liu et al. (2020) and Fan et al. (2020), with increases in users' social connections on social media, their social circles become more diverse. For example, WeChat friend groups contain acquaintances, friends, relatives, customers, and employees. As a result, WeChat users must play multiple roles and thus experience role conflicts. This makes it difficult to maintain their ideal image, thus leading to lurking behavior, a type of inactive online use behavior. Apart from growing social networks, the functions of WeChat have expanded as well. System function can also be a factor that influences negative MSM use behaviors (Teng et al., 2022). If there are function deficiencies, users might transfer to other platforms. Zhu and Bao (2018) suggested that impression management concern, privacy concern, and social fatigue can all influence passive MSM use. Regarding impression management, self-discrepancy must also be noted. When managing their impression, people struggle with their past self, ideal self, and actual self. If people believe their past disclosure does not represent who they are now, they might experience self-discrepancy. According to self-discrepancy theory, the greater an individual's self-discrepancy, the more discomfort he or she will suffer, which might result in strategic behaviors adopted to reduce self-discrepancy (Hu et al., 2022). For example, a user might delete his or her past self-disclosure. Self-discrepancy is also likely to be associated with problematic online behavior (Hu et al., 2022), such as WeChat addiction. Hence, based on the themes extracted from interviews, we added new measurement items for SW on WeChat, which are shown in Table 4.

4.3 Item selection

Combining items collected from the literature review with items extracted from the interviews, we developed a 13-item PSW scale (raw scale), as shown in Table 5. In the quantitative research part, we asked

FIGURE 2
Data collection and analytical approach.
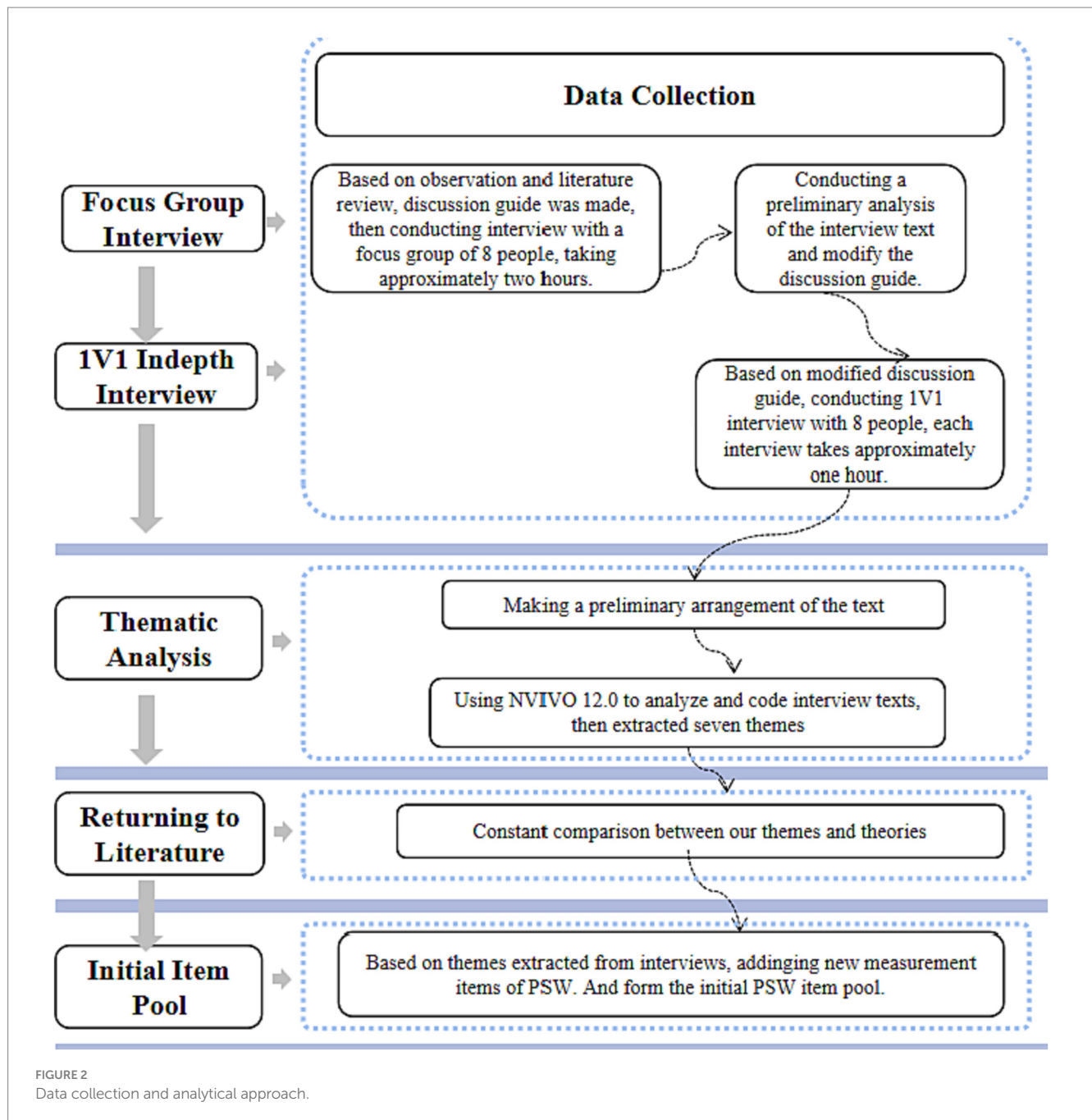
respondents to rate these items on a seven-point scale (1 = "strongly disagree" to 7 = "strongly agree").

5 Phase 2: quantitative research

5.1 Expert review and pretest

The item-construction process for a scale can greatly affect content validity (Sigerson and Cheng, 2018). Therefore, to evaluate the content validity of the PSW measurement instrument, instructors and graduate students at a large university in China reviewed the items. These experts were selected based on their knowledge of self-disclosure, social media, and privacy related to SW. After being given the definition of PSW, they were asked to review the items and provide feedback on how well they represented the inherent aspects of PSW. Additionally, the instrument was pretested using a group of individuals in several course groups. These activities provided important feedback, which prompted minor modifications to the phrasing of some items.
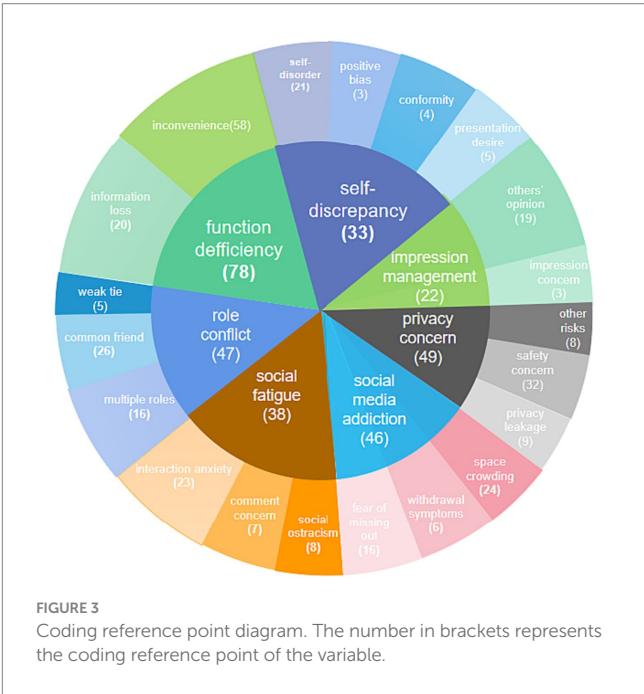
5.2 Pilot testing

Two separate pilot tests were used to test reliability and validity, and to refine and enhance the instrument. The first pilot test (Pilot Test 1) involved administering the instrument to a sample of 91 WeChat users. The second pilot test (Pilot Test 2) involved

administering the instrument to a subsample of 81 WeChat users taken from the sample used in Pilot Test 1. Participation in the pilot testing was voluntary. Data collected during both pilot tests were subjected to EFA to evaluate the unidimensionality and internal consistency of the instrument.

5.2.1 Pilot Test 1

The initial EFA results obtained from the Pilot Test 1 dataset (Table 6) indicated that the 13 items in the original item pool were dimensional. Four factors with eigenvalues greater than one were extracted. An analysis of the individual item factor loadings indicated that three items (i.e., 1, 3, 4, 5, 6, and 7) had factor loadings lower than 0.6 on all four factors, suggesting poor convergent validity (Fan et al., 2020). Therefore, these items were removed from the item pool to improve the unidimensionality of the instrument, thus reducing the instrument to seven items.

FIGURE 3
Coding reference point diagram. The number in brackets represents the coding reference point of the variable.

The removal of item 1 was justified in that this item did not relate to users' experience of using WeChat. Item 1 states, "I would become restless if I were prohibited from using WeChat." This item loaded relatively heavily onto the fourth principal component, which was likely associated with WeChat nonuse experience. The removal of items 3, 4, 5, and 6 was also theoretically justified in that all of these items were related to the consequences of SW. Item 3 states, "I consciously limit what I do and say on WeChat." Item 4 states, "I make my WeChat moments visible only to people I trust." Item 5 states, "I have deleted or withdrawn my WeChat posts or messages." Item 6 states, "I sometimes delete friends on WeChat." Item 7 states, "I find it inconvenient when I use certain WeChat functions." This item is related to environmental stimuli and can be considered an antecedent of internal PSW.

The results obtained from the EFA of the remaining seven items (Table 7) indicated the unidimensionality of the instrument. In general, the removal of the aforementioned items provided acceptable factor loadings for each individual item onto a single factor. However, an analysis of the individual item factor loadings indicated that there was still an item (i.e., 10) with a factor loading below 0.6 on the single factor. This can also be theoretically justified in that the fear of missing out is considered a type of social anxiety (Li et al., 2022), and high levels of anxiety can lead social media users to withdraw from Internet activities (Swiatek et al., 2021). Therefore, this item is related to the antecedent of PSW and was removed from the item pool to improve the reliability of the measurement instrument, thus reducing the instrument to six items.

The results obtained from the EFA of the remaining six items (Table 8) indicated the unidimensionality of the instrument. Furthermore, the removal of the aforementioned item provided acceptable factor loadings for each individual item onto a single factor. The remaining six items explained 51.22% of the total variance. The reliability coefficient for the resulting six-item instrument was 0.861 in Pilot Test 1.

5.2.2 Pilot Test 2

The second pilot test included the EFA of the refined six-item instrument obtained from Pilot Test 1, using the subsample of 81 participants taken from the sample used in Pilot Test 1. The analysis results (Table 9) showed that only a single factor with an eigenvalue over one was extracted, and this factor explained 50.85% of the total

TABLE 3 Examples of main theme.

Construct	Dimension	Interview example
Psychological Self-withdrawal	Function deficiency	Interviewee: "The main thing is that the storage period of profile information is relatively short, and it will easily expire after a long time"
	Role conflict	Interviewee: "This is similar to normal offline social networking, because one's connections can include classmates, relatives, friends, leaders, and mentors"
	Social fatigue	Interviewee: "Sometimes I think it is OK if I "like" someone's moment, but if others comment, I may become confused about whether to reply or not"
	Social media addiction	Interviewee: "In fact, I fear missing out on information; this is more disturbing"
	Privacy concern	Interviewee: "Sometimes, small games require authentication, and I'm a little worried about information leakage"
	Self-discrepancy	Interviewee: "Past posts do not represent who you are now, so of course there's no need to show them to others"
	Impression management	Interviewee: "Sometimes I post something in a certain emotional state, but when emotion passes, the post may negatively affect my overall image or something, and then I delete it"

variance. However, an analysis of individual item factor loadings indicated that two items (i.e., 12 and 13) exhibited factor loadings below 0.6 on the factor. Therefore, these items were removed from the item pool to improve the unidimensionality of the instrument, thus reducing the instrument to four items.

The removal of item 12 was justified in that some users use WeChat as a work platform and rarely update posts; thus, they lack such experience. This motivation type can be considered an antecedent

of PSW. Item 12 states, "I feel uncomfortable when my posts do not represent who I am now." This item loaded relatively lowly onto the principal component. The removal of item 13 was also justified in that this item is related to the antecedents of PSW. Item 13 states, "I feel afraid when people see my real but flawed side on WeChat."

The results obtained from the EFA of the remaining four items (Table 10) indicated the unidimensionality of the instrument. Furthermore, the removal of the aforementioned items provided acceptable factor loadings for each individual item onto a single factor. The remaining four items explained 64.40% of the total variance. Each individual item loaded well onto the single factor. The reliability coefficient for the resulting four-item instrument was 0.876 in Pilot Test 2.

5.3 Full testing

The full testing of the instrument involved collecting responses from 1,200 participants using an online platform that provides sample collection services for a fee. Participants completed an online survey

TABLE 4 Measurement items for psychological self-withdrawal extracted from interviews.

Measurement items
I find it inconvenient when I use certain WeChat functions
I feel stressed when I play multiple roles on WeChat
I feel stressed when I receive interactive messages from others
I worry about missing out on information on WeChat
I feel anxious when I disclose personal information on WeChat
I feel uncomfortable when my posts do not represent who I am now
I feel afraid when people see my real but flawed side on WeChat

TABLE 5 Initial item pool for psychological self-withdrawal.

Construct	Item content	Degree
Psychological Self-withdrawal	1 I would become restless if I were prohibited from using WeChat	1 = strongly disagree
	2 I feel timid when I disclose information on WeChat	2 = very much disagree
	3 I consciously limit what I do and say on WeChat	3 = disagree
	4 I make my WeChat moments visible only to people I trust	4 = general
	5 I have deleted or withdrawn my WeChat posts or messages	5 = agree
	6 I sometimes delete friends on WeChat	6 = very much agree
	7 I find it inconvenient when I use certain WeChat functions	7 = strongly agree
	8 I feel stressed when I play multiple roles on WeChat	
	9 I feel stressed when I receive interactive messages from others	
	10 I worry about missing out on information on WeChat	
	11 I feel anxious when I disclose personal information on WeChat	
	12 I feel uncomfortable when my posts do not represent who I am now	
	13 I feel afraid when people see my real but flawed side on WeChat	

TABLE 6 Pilot Test 1: thirteen psychological self-withdrawal items and maximum likelihood loadings ($n = 91$).

Psychological self-withdrawal item	1	2	3	4
1. I would become restless if I were prohibited from using WeChat	0.327	−0.252	0.242	0.495
2. I feel timid when I disclose information on WeChat	0.686	−0.382	−0.276	−0.189
3. I consciously limit what I do and say on WeChat	0.585	−0.080	0.207	−0.020
4. I make my WeChat moments visible only to people I trust	0.510	0.022	0.449	−0.281
5. I have deleted or withdrawn my WeChat posts or messages	0.394	−0.160	0.352	−0.028
6. I sometimes delete friends on WeChat	0.379	0.508	0.370	−0.080
7. I find it inconvenient when I use certain WeChat functions	0.471	0.054	−0.169	−0.132
8. I feel stressed when I play multiple roles on WeChat	0.704	0.306	−0.015	0.120
9. I feel stressed when I receive interactive messages from others	0.699	0.164	−0.261	−0.011
10. I worry about missing out on information on WeChat	0.616	−0.364	0.217	0.256
11. I feel anxious when I disclose personal information on WeChat	0.746	−0.218	0.112	−0.232
12. I feel uncomfortable when my posts do not represent who I am now	0.710	0.111	−0.192	0.307
13. I feel afraid when people see my real but flawed side on WeChat	0.769	0.324	−0.115	−0.015

TABLE 7 Pilot Test 1: seven psychological self-withdrawal items and maximum likelihood loadings (*n* = 91).

Psychological self-withdrawal item	1
2. I feel timid when I disclose information on WeChat	0.630
8. I feel stressed when I play multiple roles on WeChat	0.728
9. I feel stressed when I receive interactive messages from others	0.733
10. I worry about missing out on information on WeChat	0.526
11. I feel anxious when I disclose personal information on WeChat	0.652
12. I feel uncomfortable when my posts do not represent who I am now	0.746
13. I feel afraid when people see my real but flawed side on WeChat	0.801

TABLE 8 Pilot Test 1: six psychological self-withdrawal items and maximum likelihood loadings (*n* = 91).

Psychological self-withdrawal item	1
2. I feel timid when I disclose information on WeChat	0.607
8. I feel stressed when I play multiple roles on WeChat	0.736
9. I feel stressed when I receive interactive messages from others	0.750
11. I feel anxious when I disclose personal information on WeChat	0.619
12. I feel uncomfortable when my posts do not represent who I am now	0.736
13. I feel afraid when people see my real but flawed side on WeChat	0.821

TABLE 9 Pilot Test 2: six psychological self-withdrawal items and maximum likelihood loadings (*n* = 81).

Psychological self-withdrawal item	1
2. I feel timid when I disclose information on WeChat	0.882
8. I feel stressed when I play multiple roles on WeChat	0.813
9. I feel stressed when I receive interactive messages from others	0.671
11. I feel anxious when I disclose personal information on WeChat	0.833
12. I feel uncomfortable when my posts do not represent who I am now	0.441
13. I feel afraid when people see my real but flawed side on WeChat	0.524

TABLE 10 Pilot Test 2: four psychological self-withdrawal items and maximum likelihood loadings (*n* = 81).

Psychological self-withdrawal item	1
2. I feel timid when I disclose information on WeChat	0.907
8. I feel stressed when I play multiple roles on WeChat	0.788
9. I feel stressed when I receive interactive messages from others	0.640
11. I feel anxious when I disclose personal information on WeChat	0.850

including the PSW instrument. Participants accessed the survey via a QR code. Table 11 shows the demographic data.

The full testing of the instrument included CFA using the full test dataset. To allow for thorough testing, and because the full test dataset was sufficiently large, the dataset was randomly split into two sets (i.e., sets A and B). CFA was first conducted on Model A (Figure 4A) using dataset A.

Model A was renamed Model B (Figure 4B) and used to evaluate the model using dataset B (independent from dataset A), and a separate CFA was conducted. Model B had excellent comparative fit indices (NFI = 0.999, NNFI/TLI = 1.005, CFI = 1.000), which were also above the generally accepted level of 0.95. The chi-square/degrees-of-freedom ratio (χ^2/df) was 0.275, which is below the generally accepted level of 3. RMSEA was 0.000, which is below the generally accepted
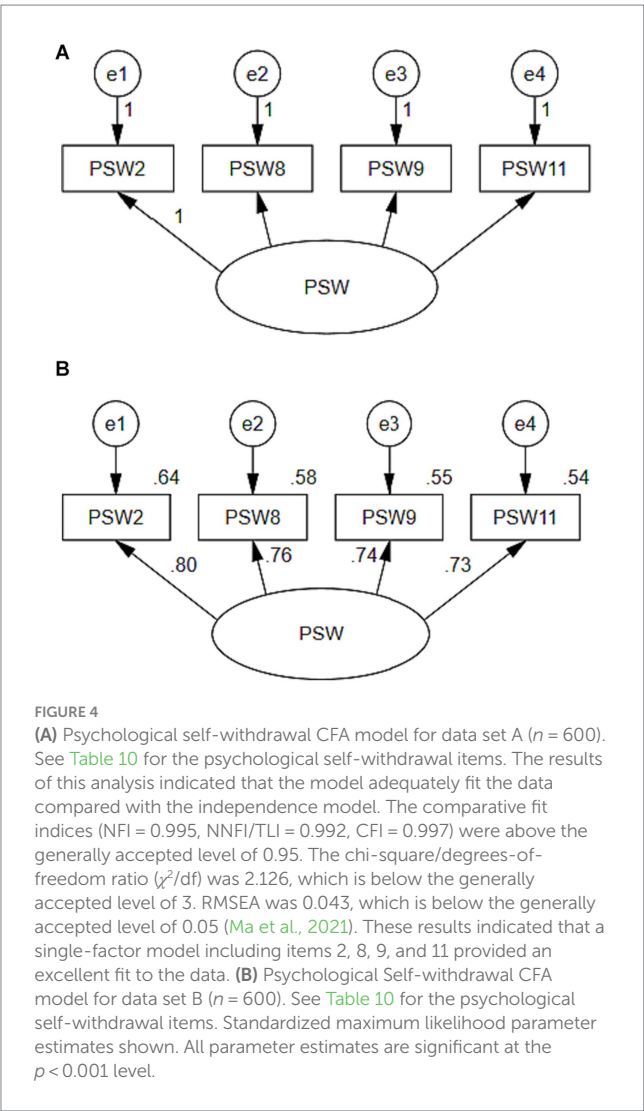
level of 0.05 (Ma et al., 2021). While there was overfitting, studies have verified that a model with excellent fit indices (NNFI/TLI > 1, CFI = 1, RMSEA = 0) is also good and acceptable, whether it is a large-sample model or a small-sample model (Cooper et al., 2008; Audrain-McGovern et al., 2009). Thus, these results also indicated that a single-factor model including items 2, 8, 9, and 11 provided an excellent fit with the data. Hence, the final PSW measurement instrument consisted of these four items.

6 Discussion

We define PSW as "users' series of negative feelings when using WeChat" and develop and validate an PSW measurement, using focus

Variables	Level	Frequency	Percentage (%)
Gender	Male	617	51.42
	Female	583	48.58
Education	High school and under	152	12.67
	Junior college or Bachelor	869	72.42
	Master	141	11.75
	Doctor	38	3.17
Length of WeChat use (days)	Less than 2 h	330	27.5
	2–3 h	452	37.67
	3–4 h	258	21.50
	Over 4 h	160	13.33
Number of WeChat friends	Less than 300	354	29.50
	301–1,000	472	39.33
	1,001–2000	306	25.50
	over 2000	68	5.67

FIGURE 4
(A) Psychological self-withdrawal CFA model for data set A ($n = 600$). See Table 10 for the psychological self-withdrawal items. The results of this analysis indicated that the model adequately fit the data compared with the independence model. The comparative fit indices (NFI = 0.995, NNFI/TLI = 0.992, CFI = 0.997) were above the generally accepted level of 0.95. The chi-square/degrees-of-freedom ratio (χ^2/df) was 2.126, which is below the generally accepted level of 3. RMSEA was 0.043, which is below the generally accepted level of 0.05 (Ma et al., 2021). These results indicated that a single-factor model including items 2, 8, 9, and 11 provided an excellent fit to the data. **(B)** Psychological Self-withdrawal CFA model for data set B ($n = 600$). See Table 10 for the psychological self-withdrawal items. Standardized maximum likelihood parameter estimates shown. All parameter estimates are significant at the $p < 0.001$ level.

groups, interviews, and a survey. A four-item PSW with acceptable reliability and validity was finally developed. The results of the pilot tests and final instrument development provide convincing evidence for the reliability and validity of the new PSW measure in the WeChat context. Appendix 2 presents the final instrument.

The reliability and validity of the instrument were evaluated throughout its development. The reliability coefficients obtained during pilot testing were at least 0.850, and the reliability coefficient for the full test was 0.831. These reliability coefficients are well above 0.7, which is the generally accepted value (Sigerson and Cheng, 2018). Thus, there is evidence that the PSW instrument presented here has sufficient reliability. The instrument's content validity was established during item selection, expert review, and pretesting. The extraction of a single factor with an eigenvalue greater than one during pilot testing established unidimensionality, as did the CFA results obtained during full testing, which evaluated construct validity. All of these evaluations and the subsequent results provide evidence that the PSW instrument has sufficient validity.

Among the four measurement items of PSW, "I feel timid when I disclose information on WeChat" was found to have the highest factor loading (0.907), while "I feel anxious when I disclose personal information on WeChat" had the second-highest factor loading (0.850). This indicates that WeChat users experience strong psychological withdrawal before disclosing information. "I feel stressed when I play multiple roles on WeChat" had the third-highest factor loading (0.788), while "I feel stressed when I receive interactive messages from others" had the lowest factor loading (0.640). If users experience strong role conflicts and social interaction anxiety when using MSM, they will develop physical withdrawal behavior. This aligns with previous studies (Fan et al., 2020; Liu et al., 2020).

6.1 Theoretical implications

Previous scales and definitions were mostly limited to Facebook and focused on the behavioral dimension. Our study,

therefore, deliberately defines and measures PSW on WeChat in the psychological dimension. This makes our scale suitable for measuring PSW on strong-tie platforms. Use behavior on WeChat is different from that of other MSM platforms (Chen et al., 2019). There is a need, then, for a relatively particular PSW instrument that can be used in the WeChat context. This study can provide a reference for future instrument development, allowing for modifications of other MSM contexts to customize the instrument for a particular context. The relationships between PSW on MSM and its antecedents and consequences are still not fully understood. This study takes a first step toward advancing our understanding of such relationships by defining PSW and providing researchers with a reliable and valid instrument for measuring PSW in the WeChat context. Given that such an instrument was previously nonexistent, this study makes a meaningful contribution to the field.

6.2 Managerial implications

Studying the PSW among MSM users has significant implications for platform enterprises like WeChat. When users experience PSW, they may become less likely to interact with other users or spend less time on the platform, ultimately leading to a decrease in user engagement and revenue. As such, it is crucial for platform enterprises like WeChat to understand and address PSW among their users. One suggestion to reduce PSW is to improve the user experience by enhancing platform design and features, such as providing personalized recommendations or creating a more intuitive user interface. Additionally, platform enterprises can facilitate communication and engagement among users to foster a sense of community and belonging, which may further reduce PSW. Ultimately, addressing PSW is essential for platform enterprises like WeChat to remain relevant and competitive in the ever-evolving social media landscape.

6.3 Limitations and future research

In an attempt to develop an PSW measurement instrument for an acquaintance MSM platform, we reviewed the literature and designed interview questions to explore WeChat users' opinions about PSW. The use of convenient student samples during the pilot testing might have limited the results.

Given that few studies have considered PSW on MSM, there are many possibilities for future research. Future studies could, for example, test the reliability and validity of the PSW instrument in other contexts, such as ZhiHu, QQ, and Weibo. An interesting possibility is the replication of previous SW studies where, instead of treating SW as simply a negative MSM use phenomenon, researchers could capture the relationship between psychological SW and behavioral SW. Longitudinal studies involving SW could also be promising; for example, we could explore the antecedents and consequences of SW on different MSM platforms. It would also be interesting to evaluate whether psychological SW will lead to behavioral withdrawal.

7 Conclusion

In this study, we introduce and evaluate psychological self-withdrawal as users' series of negative feelings when using WeChat. Then we develop and validate scales to measure psychological self-withdrawal using mixed methods, involving interview and survey. Given the flourishing development of research on mobile social media in recent years, mobile social media has become an essential part of people's lives, and the self-withdrawal of mobile social media users is an important research area that needs further development. Although there are many promising scales, each scale focuses on behavioral withdrawal. This study can provide effective guidance for researchers planning to conduct MSM withdrawal research and may provide new psychological measurement research for further evaluating scales of self-withdrawal among MSM users.

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 approval was not required for the studies involving humans because according to the law and related policies, our present research does not require ethical approval. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

CC: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Software, Supervision, Validation, Writing – original draft, Writing – review & editing. HY: Data curation, Formal analysis, Funding acquisition, Methodology, Software, Validation, Writing – review & editing, Resources.

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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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Appendix A

Focus-group discussion guide

1. Do you have any memorable experiences that cause you to feel uncomfortable when using WeChat?
2. Do you have any concerns when using WeChat's various functions?
3. When using WeChat, have you ever experienced a situation in which you want to block certain people but dare not block them? Why would this happen?
4. When using WeChat, do you ever experience a situation in which you want to post a moment but dare not post? Why would this happen?
5. When using WeChat, have you ever made a post and then deleted it or sent a message and later withdrew it? Why would you do that?
6. Are you familiar with WeChat's privacy settings? Which privacy settings have you used?
7. Would you stop using WeChat if you could? Why?
8. In addition to the above problems, do you have anything to add about self-withdrawal on WeChat?

Appendix B

Final psychological self-withdrawal measurement instrument

To what extent do you agree with the following statements related to the negative use behaviors of WeChat users?
I feel timid when I disclose information on WeChat.
I feel stressed when I play multiple roles on WeChat.
I feel stressed when I receive interactive messages from others.
I feel anxious when I disclose personal information on WeChat.
<Responses range from strongly disagree to strongly agree on seven-point Likert scales.>.

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The influence of streamers' physical attractiveness on consumer response behavior: based on eye-tracking experiments

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Live streaming marketing has become a popular topic of academic research. However, relatively few studies have been conducted in terms of the physical attractiveness of streamers, and even fewer studies have analyzed the changes in cognitive-emotional mechanisms that affect consumer response behavior. Based on SOR theory and cognitive-emotional system theory, this study proposes a theoretical research model and analyzes the internal mechanism of streamers' physical attractiveness affecting consumers' response using a combination of eye-tracking experiments and questionnaires. The results showed that: compared to streamers with lower physical attractiveness, consumers pay longer attention to streamers and products with higher physical attractiveness, and their response behaviors (continued watching intention, continued engagement intention, and purchase intention) are more active; compared to consumers with low involvement, consumers with high involvement pay longer attention to the product and perceive the process for a longer period of time; and quasi-social interaction and the flow experience play the role of a chain mediator between streamers' physical attractiveness and consumers' response behaviors. This study not only has certain theoretical significance for expanding the applicable boundaries of the physical appearance halo effect, but also has important practical significance for live broadcasting e-commerce companies to effectively adopt visual marketing and enhance customer retention.

1 Introduction

With the increase in Internet penetration and the increasing improvement of online sales platforms, live-streaming marketing has emerged. According to the "50th China Internet Development Statistical Report," the penetration rate of live e-commerce users in 2022 was as high as 65.5%, with a user scale of 469 million, and the trend is continuing to grow. The rapid development of live-streaming marketing has made streamers a competitive profession, and the low entry threshold has led to uneven quality of streamers in the existing live marketing market. For consumers, streamers have the role of recommending guidance, interactive display, but also one of the important factors that prompts them to make consumption decisions (Lin et al., 2021;

Li et al., 2022). As a result, the selection and cultivation of streamers has become one of the issues that live e-commerce companies should consider.

In the process of interpersonal communication, appearance is one of the most easily captured information, similarly, in the process of e-commerce live broadcasting, the easiest way to attract consumers' eyes is the appearance of the streamer. This feature affects the differences in others' judgments of an individual's ability, character, and degree of preference, and creates differences in expectations and perceptions. This phenomenon is known as appearance stereotyping (Agthe et al., 2014). Numerous studies have shown that beautiful people can receive more attention and are motivated to give more positive affective feedback from others, which in turn triggers approach behavior (Burns and Farina, 1987). As a result, consumers show more positive response behaviors toward the beautiful. This potential advantage due to beauty has been described as the "beauty is good" stereotype effect. Currently, research on this effect has focused on the areas of investment management, human resources, and consumer behavior. In the area of consumer behavior, most studies have been conducted on service personnel and endorsed models, while there is still a gap in research on the influence of streamers' physical attractiveness on consumer behavior. Therefore, the first question this study intends to explore is: does the physical attractiveness of streamers have an impact on consumer behavior?

Most of the previous studies on live streaming marketing have focused on changes in consumers' single cognitive or affective systems, e.g., social presence (Sun et al., 2021; Chen and Liao, 2022; Liu et al., 2022), psychological contract (Hsu, 2023), quasi-social interaction (Xu et al., 2020), flow experience (Cui et al., 2022), pleasure and arousal (Li et al., 2022; Tong et al., 2022). Existing research still lacks empirical analyses that take consumer cognitive-emotional systems as the focus of research and delve into the relationship between streamers and consumer response behaviors. Cognitive-emotional system theory suggests that individuals, under the stimulating effect of the external environment, will produce rational cognitive and emotional impulse responses, and ultimately affect individual behavior. Cognitive and affective systems interact with each other, and the psycho-cognitive processes produced by individuals after receiving external stimuli are often accompanied by emotional arousal (Mischel and Shoda, 1995). Since quasi-social interaction and flow experience belong to cognitive and affective factors, respectively, and it has been shown that quasi-social interaction has an impact on consumers' arousal emotion (Xu et al., 2020). Therefore, this study hypothesizes that there is an intrinsic connection between quasi-social interaction and flow experience. The second question to be explored in this paper is: what is the mechanism of action between the physical attractiveness of streamers and consumer response behavior?

ELM (The Elaboration Likelihood Model) states that individuals transform information through central and marginal processing paths. Consumer involvement affects individuals' choice of information processing paths, and existing studies have shown that consumer involvement plays a moderating role in influencing consumer behavior (Park and Lee, 2008). Consumers with low involvement are more likely to process information through marginal paths and rely more on cognitive tendencies generated by external stimuli to make consumption decisions. Therefore, the third question to be explored in this study is: how does consumer involvement

modulate the role of streamers' physical attractiveness on consumer response behavior?

Relevant studies in psychology agree that eye movements can reflect the allocation of subjects' visual attention (Rayner, 1998), and eye-tracking technology can more accurately describe eye movement data (Scheiter and Van Gog, 2009), which has been widely used in the fields of psychology, news communication and consumer behavior. Previous studies related to streamers were more often conducted in the form of questionnaires, which were often used to collect and measure data by way of respondents' hindsight recall, resulting in researchers being unable to assess the real-time situation of consumers when watching live broadcasts. Therefore, focusing on the attractiveness of streamers' physical appearance to consumers from the perspective of visual attention can further understand the potential psychological cognitive process of consumers. In addition, the study showed that consumer eye movements can help marketers capture information such as consumer attention and their product choice (Pieters and Warlop, 1999). Thus, pre-exploring the fourth question of this study: What are the links between streamers' physical attractiveness, consumers' attention duration and consumer response behavior, and what role does consumer involvement play? In conclusion, this study intends to use a combination of eye tracking and behavioral data to deeply explore the influence of streamers' physical attractiveness on consumers' response behavior, exploring the effects of different physical attractiveness of streamers on consumers' visual attention process (perceptual process) by means of eye-tracking, and exploring the effects of different physical attractiveness of streamers on consumers' psychological cognitive outcomes and behavioral decision-making outcomes (perceptual outcomes) by means of questionnaire data.

In summary, based on S-O-R theory and cognitive-emotional system theory, this study intends to explore the influence of streamers' physical attractiveness on consumers' response behaviors in the process of live streaming marketing through eye-tracking experiments. This study intends to construct a model of the mechanism of action based on quasi-social interaction and flow experience. It also introduces consumer involvement as a moderating variable to explore the role of consumer traits in the purchase decision process. The results of this research will help to expand the research scope of physical attraction, and can provide suggested theoretical support and practical suggestions for improving the customer retention index of live broadcasting and promoting the sales growth of live broadcasting products.

## 2 Literature review and research hypotheses

In the live-streaming marketing context, the streamer is the main body that brings cognitive and emotional value to consumers. Current research related to streamers has found that streamer's traits (professionalism, real-time interactivity, attractiveness, and image matching) directly affect consumer's perceived value, which in turn has an impact on their purchase intention (Zhou and Huang, 2023). Guo et al. (2022) classified streamers' attractiveness, competence, and communication style as beauty, warmth, expertise, humor, and passion, exploring the impact of these characteristics on consumers' behavioral intentions through the mediating role of their perceived

value (utility and hedonic). In addition, other scholars focus on a particular characteristic of streamers, and the study confirmed that the interactivity of network star streamers have an impact on consumers' purchase intention through social presence and flow experience (Sun et al., 2021). All of the above studies have explored the influence of one or more attributes of streamers on consumers' purchasing decisions. However, these studies have not deeply explored the most intuitive trait of streamer's physical attractiveness, and have not broken down the cognitive path of consumer information processing. Similarly, these studies have not deeply analyzed the micro-mechanisms of how consumers' cognitive-emotional system influences their response behaviors when they are stimulated by the streamers' appearance.

Compared with traditional e-commerce, live e-commerce can provide more vivid explanation services and visual experience, so that consumers and streamers can produce emotional connection. Under the influence of "all people love beauty," live broadcast e-commerce can attract consumers' eyes by choosing streamers who have the advantage of appearance to explain the products. Therefore, consumers have a greater likelihood of continuing to watch the live broadcast, so that consumer attention can be converted into e-commerce marketing revenue. For individual consumers, whether the more aesthetic visual experience can attract consumers' attention, whether it can trigger their positive cognitive and emotional responses, especially whether it can enhance their continued watching, engagement and subsequent purchase intention, are all topics worthy of in-depth exploration. Figure 1 shows the theoretical framework.

2.1 S-O-R theory

S-O-R (Stimulus-Organism-Response) theory was initially proposed and applied to environmental psychology research by Russell, and Jacoby subsequently expanded it to the field of consumer behavior. Donovan and Rossiter first applied the model to retail settings. To date, the S-0-R model has been widely used in a variety of retail studies in online and offline environments (Donovan and Rossiter, 1982) to understand consumer behavior, including e-commerce live streaming (Liu et al., 2022), online reviewing (Bigne et al., 2020), and mobile travel (Fang et al., 2017). Among them, stimulus means "external influences that evoke an individual." "Organism" refers to the individual's emotional and cognitive responses to the surrounding environment, the cognitive state represents the consumer's mental processes, including everything in the consumer's mind related to the acquisition, processing, retention, and retrieval of information; and the affective state reflects the consumer's emotions such as excitement and pleasure in response to environmental stimulus. "Response" refers to the approach and avoidance behaviors of stimulus and organism. In summary, the theory describes the positive (approach behavior, including positive communication, willingness to buy, willingness to browse, etc.) or negative (avoidance behavior, including negative communication, lack of willingness to buy/stay, etc.) responses of an individual through environmental cues, affective, and cognitive processes (Bitner, 1992; Eroglu et al., 2001; Floh and Madlberger, 2013).

FIGURE 1
The theoretical framework.
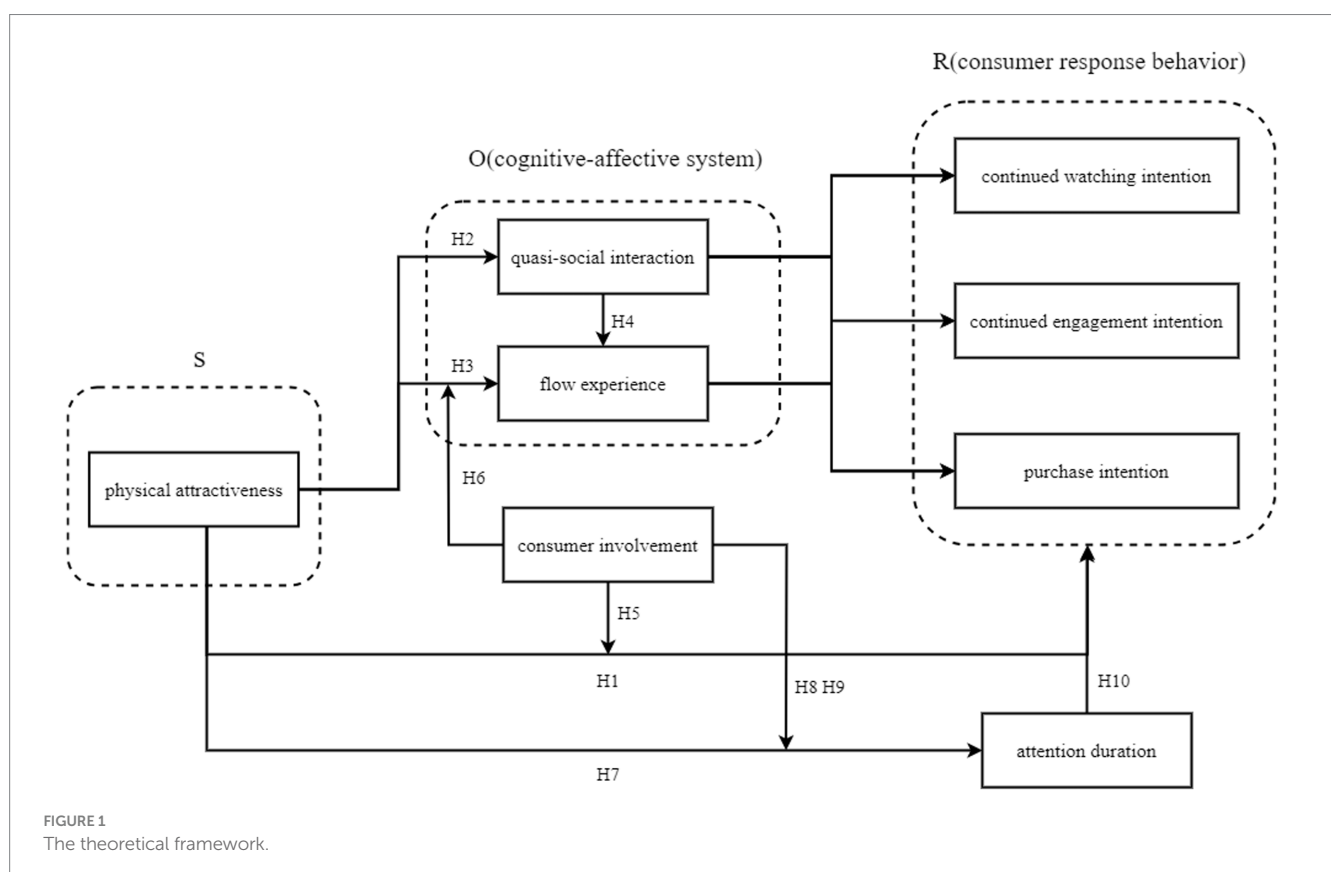
2.2 Cognitive-affective theory

Cognitive-Affective Theory was proposed by Mischel in the 1970s. The theory states that stimulus from external situations interact with the complex cognitive-affective units (CAUs) in an individual's system, prompting rational cognitive or affective impulsive responses and ultimately influencing the individual's behavioral choices (Mischel, 1973). The theory consists of two major perspectives: first, a single cognitive or affective system within an individual is activated in a given situation, which in turn leads to individual behavior; second, an individual's internal cognitive and affective systems are activated in a given situation, which manifests situational factors activate the individual's cognitive system, which furthermore evokes the affective system and ultimately influences the emergence of the individual's attitudes and behaviors (Mischel and Shoda, 1995). Based on the second viewpoint, this study explores the effect of streamers' physical attractiveness on consumers' cognitive and affective systems. This theory has been applied by some scholars in the field of consumer behavior. For example, Dai et al. (2020) investigated how perceived information overload (cognition) affects social media users' information avoidance intentions through fatigue, frustration, and dissatisfaction (affect). Loh et al. (2022) investigated the cognitive (mobile usefulness, price retention, and relevant network size)-affective (satisfaction and technological stress) linkages of consumers' payment continuance intention during the COVID-19 period.

2.3 Halo effect

Halo effect refers to an individual's tendency to form an overall impression of another person based on positive or negative partial impressions, this preference phenomenon discovered by Thorndike in 1920 (Lachman and Bass, 1985). A prime example of the halo effect is the influence of physical attractiveness on an individual's perception, which is known as the "beautiful is good" effect (Dion et al., 1972). Specifically, attractive individuals are often perceived as having more desirable traits, for example, such individuals are perceived as more confident, emotionally stable, intelligent, responsible, sociable, and trustworthy (Batres and Shiramizu, 2023), and as a result, they are treated more positively than unattractive individuals (Efran, 1974; Landy and Sigall, 1974; Langlois et al., 2000).

2.4 The effect of streamers' physical attractiveness on consumer response behavior

SOR theory suggests that external stimuli can influence an individual's internal state, which in turn triggers his or her behavioral response (Cui et al., 2022). In the live-streaming shopping context, the streamer acts as an information transmitter, which directly affects consumers' information reception and behavioral decisions. Attractiveness is considered to be the first step in establishing a relationship (Zheng et al., 2020). Extrinsic attractiveness refers to the degree to which the target person is pleasant and is crucial in the online socialization process (Lo, 2008). During interpersonal interactions, due to the halo effect of physical appearance, lookers are

more likely to obtain higher willingness to interact from others and tend to inspire more positive emotional responses from others (Korabik, 1981). It has been shown that the appearance attractiveness of service workers can have a positive impact on customer response, Argo et al. (2008) found that service workers with higher appearance attractiveness resulted in higher customer satisfaction and customer purchase intention; Customers tend to choose attractive salespeople and are more likely to respond to their sales pitches, ultimately demonstrating a higher purchase intention (DeShields et al., 1996). Therefore, streamers who have a pleasing appearance and whose external stimuli agree with consumers' aesthetics will lead to more positive response behaviors, i.e., continued watching intention (Chen and Liao, 2022), continued engagement intention (Lv et al., 2022), and purchase intention (Liu et al., 2022; Dong X. et al., 2023).

In summary, the physical attractiveness of streamers can be used as an external stimulus, which in turn affects consumers' behavioral responses. Therefore, the following hypotheses are proposed in this study:

H1: Streamers with high physical attractiveness elicit more positive response behavior from consumers than those with low physical attractiveness.

H1a: Consumers have a more positive continued watching intention in the face of a streamer with high physical attractiveness compared to a streamer with low physical attractiveness.

H1b: Consumers have a more positive continued engagement intention in the face of a streamer with high physical attractiveness compared to a streamer with low physical attractiveness.

H1c: Consumers have a more positive purchase intention in the face of a streamer with high physical attractiveness compared to a streamer with low physical attractiveness.

2.5 The mediating role of quasi-social interaction and flow experience

Quasi-social interaction has been defined as the extent to which media users perceive media characters as close social partners (Horton and Richard Wohl, 1956), and it is an illusion created by viewers to have face-to-face conversations with media characters through the medium and to want to get as close as possible to the media characters in reality (Kim and Song, 2016). In the context of live-streaming marketing, quasi-social interaction is defined as the intention of consumers who are attracted to the streamer during their participation in the live shopping process and want to get to know and interact with the streamer in reality. Predictors of quasi-social interaction include media characters' attractiveness in terms of socialization and appearance (Perse and Rubin, 1989). Rubin and Step (2000) found that media characters' interpersonal similarity and attractiveness affect viewers' perceived quasi-social interaction, and the two are positively correlated. In addition, some studies confirmed that quasi-social interaction play a mediating role between media personalities and consumers' purchase intentions. Lee and Watkins (2016) showed that YouTube platform users' perceived quasi-social interaction with video bloggers positively affect their luxury goods purchase intentions; the

effect of viewers' self-congruence and value congruence with the hosts of hotel livestreaming program on consumers' purchase intentions were mediated by quasi-social interaction (Shen et al., 2022). Therefore, in the live-streaming marketing context, the appearance of streamers can attract consumers' attention and affect their quasi-social interaction perception, which in turn affects their response behavior.

Csikszentmihalyi proposed the concept of flow experience in 1975, which refers to a psychological state in which an individual forgets the existence of time, ignores the surrounding environment, loses self-consciousness, and enjoys himself or herself because of his or her total dedication to something (Csikszentmihalyi, 1988). This concept is widely used in sports, education, website design, and consumer behavior. In the context of live-streaming marketing, the flow experience is defined as a psychological state in which consumers are fully engaged in the live streaming situation when watching live e-commerce broadcasts, and are attracted to and immersed in the live streaming environment (the streamer, the product, and the live streaming background, etc.). In previous studies, the antecedent influences of the flow experience can be categorized into two aspects: external environmental characteristics and consumers' characteristics (Dong et al., 2010; Cui et al., 2022; Tian and Ou, 2023). Website attractiveness, speed and interactivity as external environment features are directly related to the viewer's flow experience (Skadberg and Kimmel, 2004). And streamer physical attractiveness, as an external trait of the streamer and as an external environmental stimulus in the live-streaming context, is one of the influencing factors acting on the consumers' flow experience. In addition, existing research showed that the flow experience has a direct positive effect on both consumer behavioral intention and consumption behavior. When consumers browse on the relevant website, the resulting flow experience can further influence consumers' intention to purchase products from the website and their intention to visit and use the website again (Luna et al., 2003). Dong et al. (2010), Dong W. W. et al. (2023), and Dong X. et al. (2023) found that website characteristics (interaction, entertainment, and service quality), streamer attributes (credibility, professionalism, attractiveness, and interactivity), and consumer purchase intention were mediated by the flow experience. Therefore, in a live marketing situation, streamers attract consumers through their appearance advantage, prompting them to immerse themselves in the live broadcast, generate a mind-flow experience, and then stimulate consumers to generate responsive behaviors.

Based on the SOR theory and the above compendium, this study takes the physical attractiveness of streamers as an external stimulus (S), quasi-social interaction, and flow experience as changes in consumers' own internal states (O), and consumer responses as their subsequent behavioral responses (R). The following hypotheses are ultimately proposed:

H2: Quasi-social interaction mediates the relationship between streamers' physical attractiveness and consumer response.

H2a: Quasi-social interaction mediates the relationship between streamers' physical attractiveness and consumers' continued watching intention.

H2b: Quasi-social interaction mediates the relationship between streamers' physical attractiveness and consumers' continued engagement intention.

H2c: Quasi-social interaction mediates the relationship between streamers' physical attractiveness and consumers' purchase intentions.

H3: Flow experience mediates the relationship between streamers' physical attractiveness and consumers' response.

H3a: Flow experience mediates the relationship between streamers' physical attractiveness and consumers' continued watching intention.

H3b: Flow experience mediates the relationship between streamers' physical attractiveness and consumers' continued engagement intention.

H3c: Flow experience mediates the relationship between streamers' physical attractiveness and consumers' purchase intention.

2.6 Chain mediation of quasi-social interaction and flow experience

Cognitive-affective systems theory suggests that stimuli from the external environment act on an individual's cognitive and affective systems and ultimately affect their own behavior, either by a single cognitive or affective unit acting or by both units interacting with each other (Mischel and Shoda, 1995). It has been found that the psycho-cognitive processes produced by individuals after receiving external stimuli are often accompanied by emotional arousal (Xu et al., 2020). In a live marketing situation, certain factors in the live broadcasting process induce consumers' cognitive and subsequent emotional responses. For example, the consumer's self-congruence and value congruence with the host of hotel livestreaming program increased the consumers' perception of the host's quasi-social interaction (cognitive unit), which triggers his or her emotional engagement (affective unit), and finally acts on the consumer's purchase intention (Shen et al., 2022); live streaming contextual matching positively affects the consumer's cognitive process (perceived trust and perceived value), and then subsequently has an impact on the consumer's affective process (perceived pleasure), which in turn facilitates the consumer's purchase intention generation (Shang et al., 2023). Dong W. W. et al. (2023) and Dong X. et al. (2023) showed that social presence (cognition) and flow experience (emotion) stimulate consumers' purchase intention in live-streaming marketing contexts.

To summarize, quasi-social interaction is the interpersonal association between consumers and media characters perceived by consumers, which belongs to the cognitive unit in the individual cognitive-emotional system; whereas the flow experience is an emotional state manifested by consumers, which belongs to the emotional unit in the individual emotional cognitive system. Therefore, in the context of live marketing, the physical attraction of streamers will prompt consumers to want to establish a social relationship with the streamer, which in turn triggers a change in the emotional state of the consumer, resulting in a flow experience in which the consumer is immersed and oblivious, and ultimately the consumer will follow the streamer's guidance to produce more positive

response behavior. Based on the above analysis, this study proposes the following hypotheses:

> *H4*: Quasi-social interaction and flow experience act as chain mediators between streamers' physical attractiveness and consumers' response.

> *H4a*: Quasi-social interaction and flow experience act as chain mediators between streamers' physical attractiveness and consumers' continued watching intention.

> *H4b*: Quasi-social interaction and flow experience act as chain mediators between streamers' physical attractiveness and consumers' continued engagement intention.

> *H4c*: Quasi-social interaction and flow experience act as chain mediators between streamers' physical attractiveness and consumers' purchase intention.

2.7 The moderating effect of consumer involvement

Consumer involvement is defined as the degree to which a consumer pays attention to something based on his or her intrinsic interests, values, and needs (Zaichkowsky, 1985), which is usually related to the consumer's personality and emotions, or to the perceived importance of the subject of attention and the stimulus (Park and Lee, 2008). Research has shown that the generation of consumer behavioral decisions is closely related to the level of involvement. The ELM states that individuals have two paths for processing information, the center path and the edge path. When consumers have the ability and motivation to scrutinize and think deeply about the details of thematic information, they will actively search for information and devote more cognitive resources to synthesize and process the information in a detailed way, which relies on the central path; on the contrary, consumers will be influenced by simple cues in the context, such as associations generated by the thematic information or a certain kind of emotional stimulation, which follows the edge path (Cacioppo and Petty, 1982). In the live marketing context, a beautiful streamer can trigger positive emotions in consumers. Consumers with a higher degree of involvement tend to think rationally about the product information, so the cognitive tendency triggered by external stimuli will be weakened by their rational purchasing decisions; while consumers with a lower degree of involvement rely more on the emotional changes caused by the appearance of the streamer to make consumption decisions. In addition, the consumers' flow experience relies on consumers' personal traits. For example, Koufaris (2002) confirmed that consumers' product involvement level has the greatest influence on the flow experience; Csikszentmihalyi (1988) and Teng (2011) found that individual personality traits and temperament affect their own flow experience, confirming that people with curiosity, endurance, and self-transcendence traits are more likely to have a flow experience。.

Based on this, this study argues that both the streamer's physical attractiveness and consumer involvement will have an impact on consumers' flow experience and response behavior in a live marketing context. And the following hypotheses are proposed:

> *H5*: Consumer involvement significantly influences the relationship between streamers' physical attractiveness and consumers' response behavior.

> *H5a/H5b/H5c*: When consumer involvement is low, Streamers with high physical attractiveness can trigger consumers more positive continued watching/continued engagement/purchase intention.

> *H5d/H5e/H5f*: When consumer involvement is high, the effect of streamers with high physical attractiveness on consumers' continued watching/continued engagement/purchase intention is not significant.

> *H6*: Consumer involvement significantly influences the relationship between streamers' physical attractiveness and flow experience.

> *H6a/H6b/H6c*: Consumer involvement effectively moderates the relationship between streamers' physical attractiveness and consumers' continued watching/continued engagement/purchase intention through the mediating role of flow experience.

2.8 Eye-tracking technology

Eye-tracking technology, a non-invasive, simple and innovative cognitive neuroscience technique, is commonly used to explore consumers' visual attention allocation and cognitive processes in response to a given stimulus (Just and Carpenter, 1980). Attention duration is one of the main measures of eye-tracking, and the longer the duration of attention to a stimulus usually indicates that the stimulus is more attractive to the consumer (Ji et al., 2023). Studies have shown that there is a general association between individual attention and visual aesthetics (Mitrovic et al., 2020), and that highly attractive faces are more effective in attracting the attention of subjects compared to less attractive faces (Valuch et al., 2015). In addition, Visual attention is often a prerequisite for the subsequent process of guiding consumers to choose a product (Behe et al., 2015). There are clear correlations between gaze and choice, and many studies have confirmed that there is a relationship between gaze allocation and choice (Armel et al., 2008; Shevlin and Krajbich, 2021). In the field of e-commerce and consumer behavior, eye-tracking techniques have been widely used, and Wang et al. (2017) found that when smile intensity is low, Duchenne smiles attract subjects' attention to the model's face and product information more than non-Duchenne smiles, and lead to consumers' stronger purchase intention. Fei et al. (2021) confirmed that highly attractive streamers can immediately attract more attention, which in turn leads to more favorable responses from consumers to the information conveyed by the streamer.

Based on the above analysis, this study concludes that streamers with different physical attractiveness will cause different attention allocation situations for consumers in a live marketing situation. So the following hypothesis is proposed:

H7: Streamers with high physical attractiveness are able to gain more consumer attention to the streamer's face and products.

H8: Consumers with low involvement are more likely to be attracted by the external appearance of streamers, and their attention duration to streamers is longer.

H9: Consumer involvement significantly influences the relationship between streamers' physical attractiveness and consumers' attention duration. There is a significant difference in the attention duration that consumers with low involvement level spend on different physical attractive streamers, while there is no significant difference in the attention duration that consumers with high involvement level spend on different physical attractive streamers.

H10: Consumers' attention duration is positively related to consumers response behavior.

H10a/H10b/H10c: Consumers' attention duration is positively related to consumers continued watching/continued engagement/purchase intention.

3 Research methodology

This experiment adopts the between-group design of 2 streamers' physical attractiveness (high/low) × 2 consumers' involvement (high/low). This experiment simulates a real Taobao live shopping scene with the help of eye-tracking equipment. Subjects first viewed screenshots of the live broadcast and subsequently scored their continued watching intention.

3.1 Experimental stimulus materials

The screenshots of the live broadcast in this study were taken from Taobao Live, and in order to avoid the influence of external factors such as the name of the live room, the number of viewers, and the bullet screen, only the streamer and the product information were retained in the screenshots of this experiment. In addition, in order to reduce the potential influence of the experimental product brand on the subjects, this study used PS software to erase the brand information of the product.

First of all, lipstick was chosen as the experimental material in this study for the following reasons: first, Kahle and Homer (1985) showed that the appearance attractiveness of an endorser has a more significant effect on consumers when promoting appearance-related products (including perfume, cosmetics, and hair care products). Second, in the live-streaming marketing context, lipstick, as an experience product, can be more intuitively displayed by the streamers. Third, lipstick is a more familiar product for college students, which can reduce the impact of consumer curiosity on this experiment.

Second, in determining the streamers with high and low physical attractiveness, this study intercepted the live interfaces of four groups of streamers with high and low extrinsic attractiveness in four different e-commerce stores, and ensured that the live scene furnishings and streamers' clothes were similar in each group of experimental materials.

Finally, a pre-experiment was conducted on the four groups to determine the final experimental material. At this stage, 30 subjects were recruited to rate the physical attractiveness of each of the four groups of streamers. The scale for measuring physical attractiveness is adapted from Crocker et al. (2003) and adjusted to delete some of the measurement items, resulting in 1 measurement questions (Table 1). The results showed that all four groups of streamer pictures were significantly different, and the most was finally selected as the stimulus material for this experiment ($M_{high} = 4.45 \pm 1.203$, $M_{low} = 1.53 \pm 0.746$, $t = 10.2543$, $p < 0.001$).

3.2 Subjects

In this experiment, 128 college student subjects were openly recruited from a university in Hebei, including 64 males and 64 females, aged between 18 and 25 years old, with an equal proportion of males and females in each experimental group. The demographic details are given in Table 2. All subjects' naked eye/corrected visual acuity was within the standard range, and all of them had experience in webcast shopping. Subjects were randomly assigned to four different experimental groups.

3.3 Experimental instruments

In this study, the iView X RED telemetric eye-tracking device from SMI, Germany, was used, with a sampling frequency of 120 Hz, and the data of the subjects' eye-tracking indexes were automatically recorded throughout the study. The experimental stimulus material was presented on a 19-inch computer monitor with a resolution of 1,280 × 1,024 pixels. Finally, the heat map of the eye-tracking experiment was plotted by Begaze 3.3, and data were examined and analyzed by SPSS 20.0 (processv3.3).

3.4 Experimental procedures

Before the experiment began, the subjects were first introduced to the experimental procedure, and then guided to sit about 60 cm in front of the computer screen. The subjects were also instructed to place their heads on the stand so that the subjects' line of sight was flush with the center of the monitor, and finally the eye-tracker was calibrated and adjusted to start the formal experiment. During the formal experiment, the text description of this experimental scenario was first displayed on the screen, "You are ready to buy lipstick for a close friend, and you are ready to shop on an e-commerce live platform for the convenience of purchase at an affordable price." Subsequently, each subject viewed the live pictures, and the eye-tracker automatically captured and recorded the subject's eye movements at the same time. After viewing the live pictures, the subjects were invited to fill out a questionnaire, and finally, the subjects were given a reward for the experiment as a token of appreciation.

3.5 Questionnaire design

Before starting the experiment, subjects need to be grouped according to their level of consumer involvement. And at the end of the

TABLE 1 Construct items and sources.

S. No.	Var.	Items	Statements	References
1	PA	PA1	This streamer looks attractive in appearance.	Crocker et al. (2003)
2	QI	QI1	I look forward to watching the streamer live.	Lee and Watkins (2016)
		QI2	I feel like the streamer is an old friend.	
		QI3	I hope to meet the streamer in real life.	
		QI4	This streamer makes me feel comfortable, like I am with a friend.	
		QI5	When the streamer shows me how she feels about the lipstick, it will help me decide what I think of the lipstick.	
3	FE	FE1	I had a pleasant time watching the streamer live.	Koufaris (2002)
		FE2	While watching the streamer's live stream, I felt like time passed quickly.	
		FE3	I felt immersed while watching the streamer's live stream.	
		FE4	I would be unaware of my surroundings while watching the streamer's live stream.	
4	CWI	CWI1	I have a desire to continue watching the streamer live in the future.	Chen and Liao (2022)
		CWI2	I plan to continue to watch the streamer live on a regular basis.	
		CWI3	I will always try to continue to watch this streamer live.	
5	CEI	CEI1	I still come to watch this streamer's live stream.	Algesheimer et al. (2005), Hollebeek et al. (2014), and Martins Rebouças Nery et al. (2021)
		CEI2	I would like to like and retweet the streamer's live stream.	
		CEI3	I will be watching for the streamer's next live time and live preview.	
6	PI	PI1	I have a high purchase intention from this streamer's live stream.	Dodds et al. (1991)
		PI2	When I need to buy similar products, I will prioritize buying from this streamer.	
		PI3	I would recommend the products recommended by this streamer to others.	
7	CI	CI1	Lipstick is very important to me.	Zaichkowsky (1985)
		CI2	I am very interested in lipstick.	
		CI3	I will make an effort to search for information before purchasing lipsticks.	
		CI4	I would take the time to compare the differences between different brands of lipsticks.	
		CI5	I would choose the brand of lipstick very carefully.	
		CI6	I would have great fun buying lipsticks.	

PA, physical attractiveness; QI, quasi-social interaction; FE, flow experience; CWI, continued watching intention; CEI, continued engagement intention; PI, purchase intention; CI, consumer involvement; Var, variable.

TABLE 2 Respondents profile.

Measures		Frequency	(%)
Gender	Male	64	50.0
	Female	64	50.0
Age	18–25	123	96.1
	25–35	5	3.9
Education	Undergraduate	38	29.7
	Master	90	70.3
Income	0–999	71	55.5
	1,000–1999	45	35.1
	2000–2,999	6	4.7
	3,000–above	6	4.7

experiment, each subject was asked to fill out a questionnaire. Therefore, a questionnaire was designed and a seven-point Likert scale was used, with measurement dimensions ranging from complete disagreement (1) to complete agreement (7). The measurement scale of consumer involvement is adapted from Zaichkowsky (1985) and contains 6

measurement items. The measurement scale for quasi-social interaction is adapted from Lee and Watkins (2016), resulting in 5 measurement question items. The measurement scale of flow experience is adapted from Koufaris (2002), which included 4 measurement question items. Consumer response behaviors are divided into continued watching intention, continued engagement intention, and purchase intention, in which the measurement scale of continued watching intention is adapted from Chen and Liao (2022) and included 3 measurement question items; the measurement scale of continued engagement intention is adapted from the scales of Algesheimer et al. (2005), Hollebeek et al. (2014), and Martins Rebouças Nery et al. (2021), and contains 3 measurement items; the measurement scale of purchase intention is adapted from Dodds et al. (1991) and contains 3 measurement items. The adapted questionnaire is given in Table 1.

4 Results

4.1 Measurement models

Difference test were first conducted on the groupings of streamers' physical attractiveness and consumer involvement. The results show

that there is a significant difference in the physical attractiveness of streamers ($M_{high} = 4.03 \pm 1.699$, $M_{low} = 1.88 \pm 0.826$, $t = 9.0129$, $p < 0.001$), and the difference in consumer involvement is equally significant ($M_{high} = 6.0547 \pm 0.58196$, $M_{low} = 3.5026 \pm 1.02676$; $t = 17.299$, $p < 0.001$). Therefore, the experimental grouping design of this study has good operational validity.

Secondly, the reliability and validity of the scales for quasi-social interaction, flow experience, continued watching intention, continued engagement intention, purchase intention, and consumer involvement were examined, and the results of the test showed that the combined validity CR were 0.892, 0.887, 0.880, 0.897, 0.921, 0.890, the α coefficients were 0.899, 0.900, 0.928, 0.892, 0.954, 0.894, and the AVE were 0.626, 0.664, 0.805, 0.744, 0.795, 0.656. The test results showed that the scale used in this experiment had good reliability and validity.

4.2 Hypothesis test

4.2.1 The main effect of physical attractiveness on consumer response

ANOVA was conducted with continued watching intention, continued engagement intention and purchase intention as dependent variables, respectively. The results showed that subjects in the high physical attractiveness group had active continued watching intention ($M_{high} = 3.2604 \pm 1.44196$, $M_{low} = 1.8854 \pm 0.82342$,

Results of the main effect on the physical attractiveness of streamers.
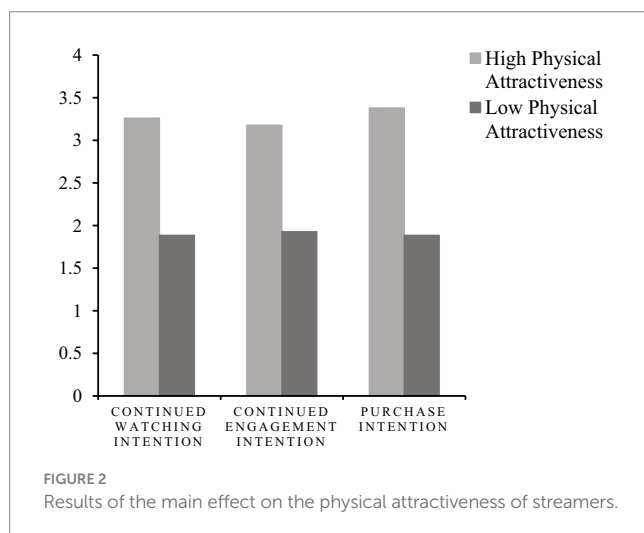
$F = 43.884$, $p < 0.001$), continued engagement intention ($M_{high} = 3.1771 \pm 1.34383$, $M_{low} = 1.9271 \pm 0.76858$, $F = 41.726$, $p < 0.001$), and purchase intention ($M_{high} = 3.3802 \pm 1.65218$, $M_{low} = 1.8854 \pm 0.68033$, $F = 44.792$, $p < 0.001$). As shown in Figure 2, H1, H1a, H1b, and H1c were confirmed.

4.2.2 Mediating effects of quasi-social interaction and flow experience

First, Bootstrap method was used to test the mediating effect of quasi-social interaction, and the test results were shown in Table 3. The results showed that consumer's quasi-social interaction mediates the effect of the physical attractiveness of streamers on consumer's continued watching intention (Indirect effect: $\beta = 0.3334$; LLCI = 0.1949, ULCI = 0.4614), continued engagement intention (Indirect effect: $\beta = 0.2810$; LLCI = 0.1746, ULCI = 0.3048) and purchase intention (Indirect effect: $\beta = 0.3093$; LLCI = 0.1795, ULCI = 0.4459). After adding the mediating variable quasi-social interaction, the effects of the physical attractiveness of streamers on consumers' continued watching intention, continued engagement intention and purchase intention were still significant, which proved that quasi-social interaction partially mediates the effects between the physical attractiveness of streamers and consumers' continued watching intention, continued engagement intention and purchase intention, which accounted for 50.6, 47.7, and 44.6% of the total effect (0.6585; 0.5895; 0.6952), respectively. H2, H2a, H2b, and H2c were confirmed.

Second, Bootstrap method was used to test the mediating effect of flow experience, and the test results were shown in Table 3. The results showed that consumer's quasi-social interaction mediates the effect of the physical attractiveness of streamers on consumer's continued watching intention (Indirect effect: $\beta = 0.3758$; LLCI = 0.2515, ULCI = 0.5027), continued engagement intention (Indirect effect: $\beta = 0.2796$; LLCI = 0.1340, ULCI = 0.4215) and purchase intention (Indirect effect: $\beta = 0.3032$; LLCI = 0.2467, ULCI = 0.5373). After adding the mediating variable flow experience, the effects of the physical attractiveness of streamers on consumers' continued watching intention, continued engagement intention and purchase intention were still significant, which proved that flow experience partially mediates the effects between the physical attractiveness of streamers and consumers' continued watching intention, continued engagement intention and purchase intention, which accounted for 57.1, 47.4, and 43.6% of the total effect (0.6585; 0.5895; 0.6952), respectively. H3, H3a, H3b, and H3c were confirmed.

TABLE 3 Results of the mediating effects of quasi-social interaction and flow experience.

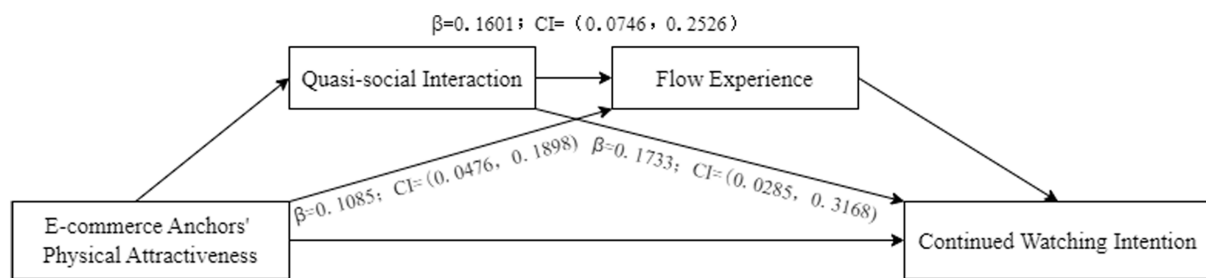| Path	β	95% confidence interval	
		LLCI	ULCI
Physical attractiveness—quasi-social interaction—continued watching intention	0.3334	0.1949	0.4614
Physical attractiveness—quasi-social interaction—continued engagement intention	0.2810	0.1746	0.3048
Physical attractiveness—quasi-social interaction—purchase intention	0.3093	0.1795	0.4459
Physical attractiveness—flow experience—continued watching intention	0.3758	0.2515	0.5027
Physical attractiveness—flow experience—continued engagement intention	0.2796	0.1340	0.4215
Physical attractiveness—flow experience—purchase intention	0.3032	0.2467	0.5373

FIGURE 3
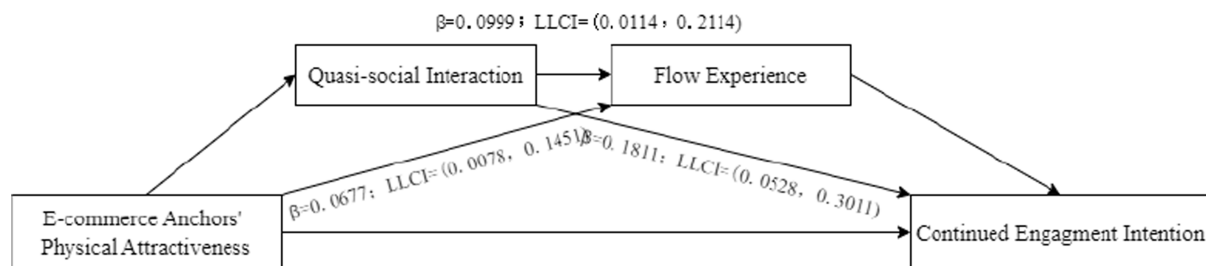Chain mediation effect test results 1.

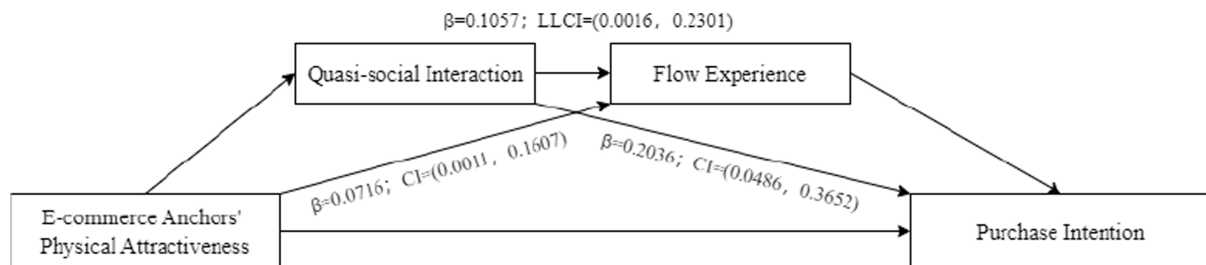**FIGURE 4**
Chain mediation effect test results 2.

FIGURE 5
Chain mediation effect test results 3.

4.2.3 Chain mediating effects of quasi-social interaction and flow experience

First, the chain mediation model of "Physical Attractiveness—Quasi-social interaction—Flow Experience—continued watching intention" was validated by using the Bootstrap method, and the results were shown in Figure 3. The results showed that the mediating effects of quasi-social interaction ($\beta = 0.1733$; LLCI = 0.0285, ULCI = 0.3168) and flow experience ($\beta = 0.1085$; LLCI = 0.0476, ULCI = 0.1898) were significant, and the hypotheses H2a and H3a were verified again. And the mediating effects of quasi-social interaction and flow experience were also significant ($\beta = 0.1601$; LLCI = 0.0746, ULCI = 0.2526). Therefore, H4a were confirmed.

Second, the chain mediation model of "Physical Attractiveness—Quasi-social interaction—Flow Experience—continued engagement intention" was validated by using the Bootstrap method, and the results were shown in Figure 4. The results showed that the mediating

effects of quasi-social interaction ($\beta = 0.1811$; LLCI = 0.0528, ULCI = 0.3011) and flow experience ($\beta = 0.0677$; LLCI = 0.0078, ULCI = 0.1451) were significant, and the hypotheses H2b and H3b were verified again. And the mediating effects of quasi-social interaction and flow experience were also significant ($\beta = 0.0999$; LLCI = 0.0114, ULCI = 0.2114). Therefore, H4b were confirmed.

Third, the chain mediation model of "Physical Attractiveness—Quasi-social interaction—Flow Experience—purchase intention" was validated by using the Bootstrap method, and the results were shown in Figure 5. The results showed that the mediating effects of quasi-social interaction ($\beta = 0.2036$; LLCI = 0.0486, ULCI = 0.3652) and flow experience ($\beta = 0.0716$; LLCI = 0.0011, ULCI = 0.1607) were significant, and the hypotheses H2c and H3c were verified again. And the mediating effects of quasi-social interaction and flow experience were also significant ($\beta = 0.1057$; LLCI = 0.0016, ULCI = 0.2301). Therefore, H4c were confirmed.
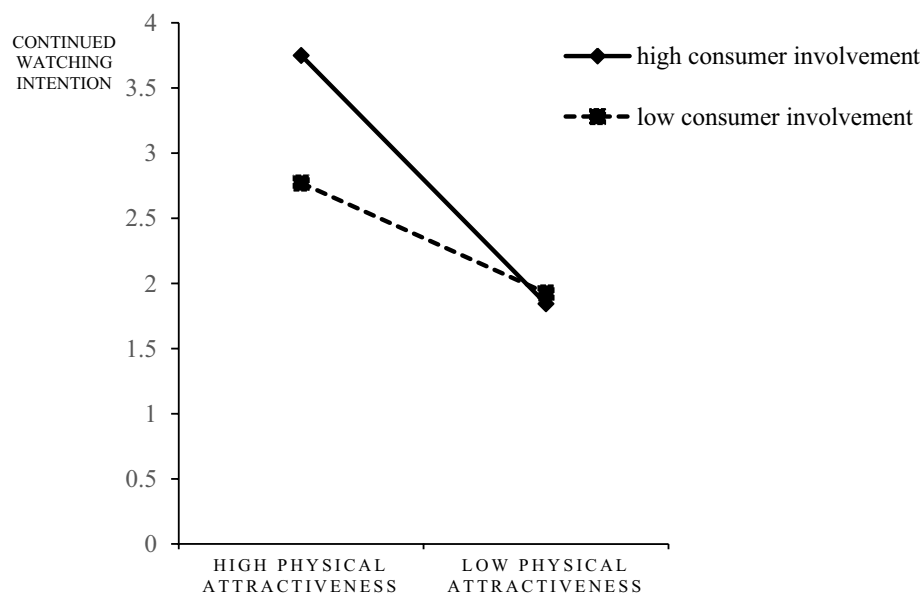
FIGURE 6
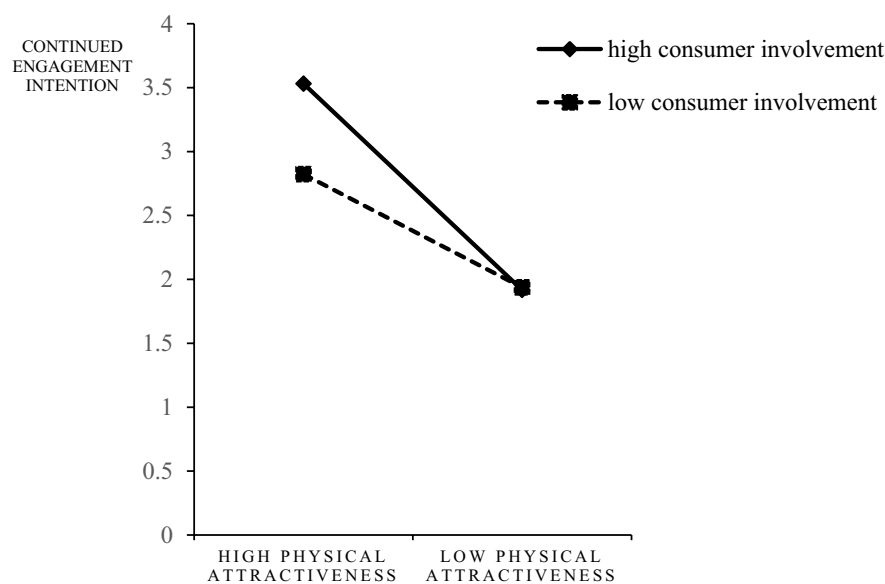The interaction of physical attractiveness and consumer involvement on continued watching intention.

FIGURE 7
The interaction of physical attractiveness and consumer involvement on continued engagement intention.

4.2.4 Moderating effects of consumer involvement

First, the moderating role of consumer involvement between the physical attractiveness of streamers and consumer response was examined, and the interactions were shown in Figures 6–8. For subjects with high consumer involvement, the extrinsic attractiveness of streamers significantly affected their continued watching intention ($M_{HH} = 3.75 \pm 1.47135$; $M_{HL} = 1.8438 \pm 0.91966$, $F = 38.623$, $p < 0.05$), continued engagement intention ($M_{HH} = 3.5313 \pm 1.39856$; $M_{HL} = 1.9167 \pm 0.82956$, $F = 31.549$,

$p < 0.05$), and purchase intention ($M_{HH} = 4.0313 \pm 1.82448$; $M_{HL} = 1.8229 \pm 0.71334$, $F = 40.665$, $p < 0.05$). For subjects with low consumer involvement, the effects of streamers' extrinsic attractiveness on their continued watching intention ($M_{LH} = 2.7708 \pm 1.25134$; $M_{LL} = 1.9271 \pm 0.72702$, $F = 10.877$, $p < 0.05$), continued engagement intention ($M_{LH} = 2.8229 \pm 1.20627$; $M_{LL} = 1.9375 \pm 0.71561$, $F = 12.753$, $p < 0.05$), and purchase intention ($M_{LH} = 2.7292 \pm 1.15915$; $M_{LL} = 1.9479 \pm 0.65094$, $F = 10.877$, $p < 0.05$) were still significantly different. Therefore, H5d, H5e, and H5f were confirmed, but H5a, H5b, and H5c were not confirmed.
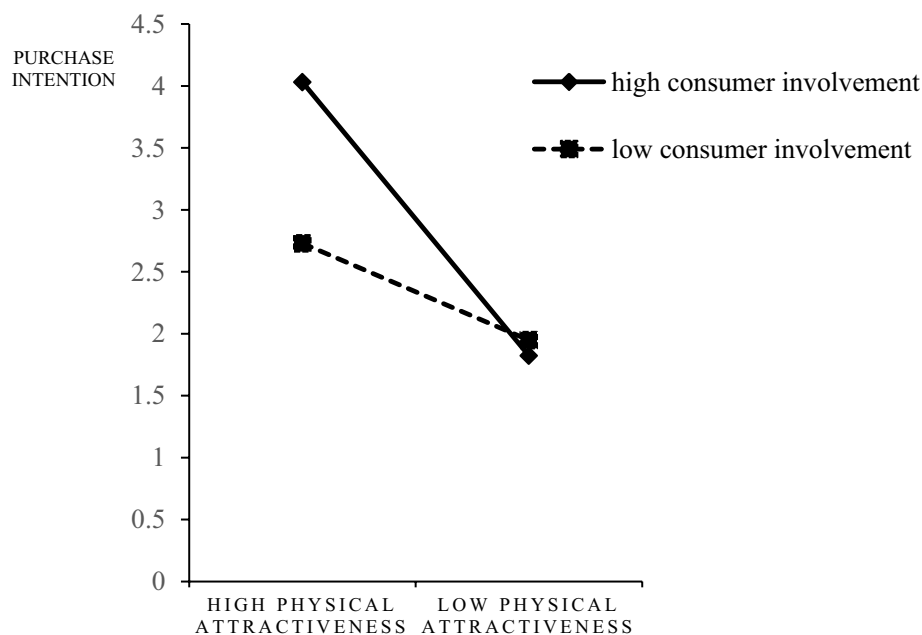
FIGURE 8
The interaction of physical attractiveness and consumer involvement on purchase intention.

TABLE 4 Results of the mediating effect of flow experience moderated by consumer involvement.

Path	β	95% confidence interval	
		LLCI	ULCI
Physical attractiveness—flow experience—continued watching intention	0.0271	−0.0049	0.0631
Physical attractiveness—flow experience—continued engagement intention	0.0198	−0.0034	0.0490
Physical attractiveness—flow experience—purchase intention	0.0201	−0.0032	0.0538

Secondly, the mediation analysis of flow experience under the moderation of consumer involvement was conducted through Bootstrap method, and the test results were shown in Table 4. The results showed that consumer involvement cannot effectively moderate the relationship between the physical attractiveness of streamers and consumers' continued watching intention (Indirect effect: $\beta = 0.0271$; LLCI = −0.0049, ULCI = 0.0631), continued engagement intention (Indirect effect: $\beta = 0.0198$; LLCI = −0.0034, ULCI = 0.0490), and purchase intention (Indirect effect: $\beta = 0.0201$; LLCI = −0.0032, ULCI = 0.0538) through the mediation of flow experience. Therefore, H6, H6a, H6b, and H6c were not confirmed.

4.2.5 Main and interaction effects of physical attractiveness and consumer involvement on attention duration

ANOVA of 2 physical attractiveness (high/low) × 2 consumer involvement (high/low) was conducted with physical attractiveness and consumer involvement as independent variables and attention duration as dependent variable. The test results showed that: the main effect of physical attractiveness was significant ($F = 21.466$, $p < 0.001$, $\eta_p^2 = 0.148$), consumers' attention

duration for high physical attractiveness stimulus materials was longer ($M_{high} = 9409.75 \pm 5282.58$, $M_{low} = 6082.61 \pm 2763.72$). As shown in Figure 9, compared with the low physical attractiveness experimental group, the subjects in the high physical attractiveness experimental group were more likely to be attracted by the streamers, thus paying more visual attention; the main effect of consumer involvement was significant ($F = 8.188$, $p < 0.05$, $\eta_p^2 = 0.062$), the subjects in the low consumer involvement group had longer attention duration ($M_{high} = 6718.73 \pm 3061.88$, $M_{low} = 8773.63 \pm 5444.88$). As shown in Figure 9, compared with the high consumer involvement experimental group, the subjects in the low consumer involvement experimental group invested more time in cognition and had a longer cognitive process; however, the interaction effect of physical attractiveness and consumer involvement was not significant ($F = 3.505$, $p = 0.064$, $\eta_p^2 = 0.027$), as shown in Figure 10. Different degrees of involvement did not have a significant effect on the eye movement index, as shown in Figure 9, there is no significant difference in the allocation of attention harvested by equal physical attractiveness streamers, regardless of the degree of consumer involvement. Therefore, H7 and H8 were confirmed and H9 was not confirmed.
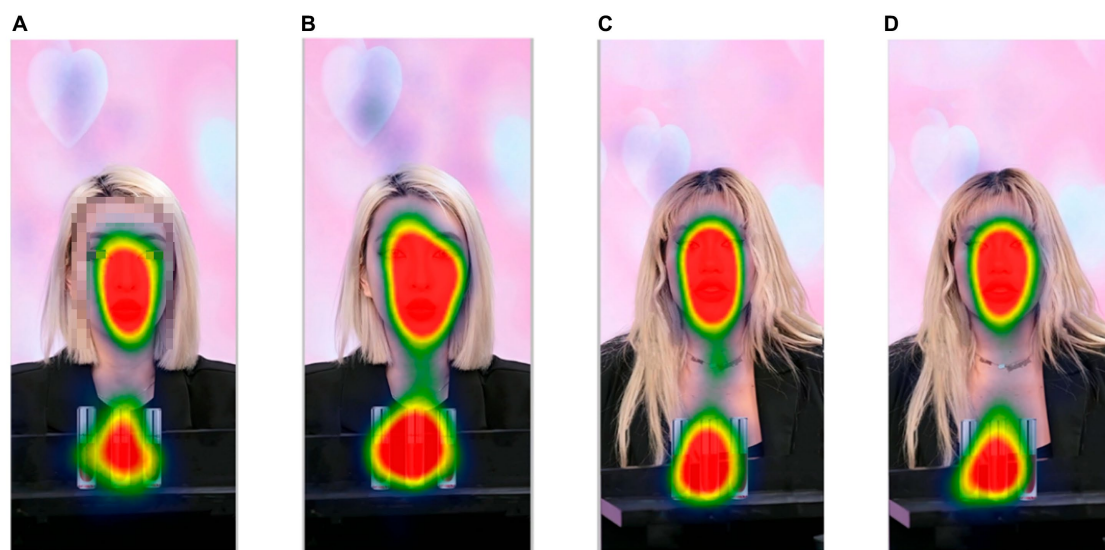
FIGURE 9
Heat map of eye-tracking experiment. **(A)** High physical attractiveness high consumer involvement. **(B)** High physical attractiveness low consumer involvement. **(C)** Low physical attractiveness high consumer involvement. **(D)** Low physical attractiveness Low consumer involvement.
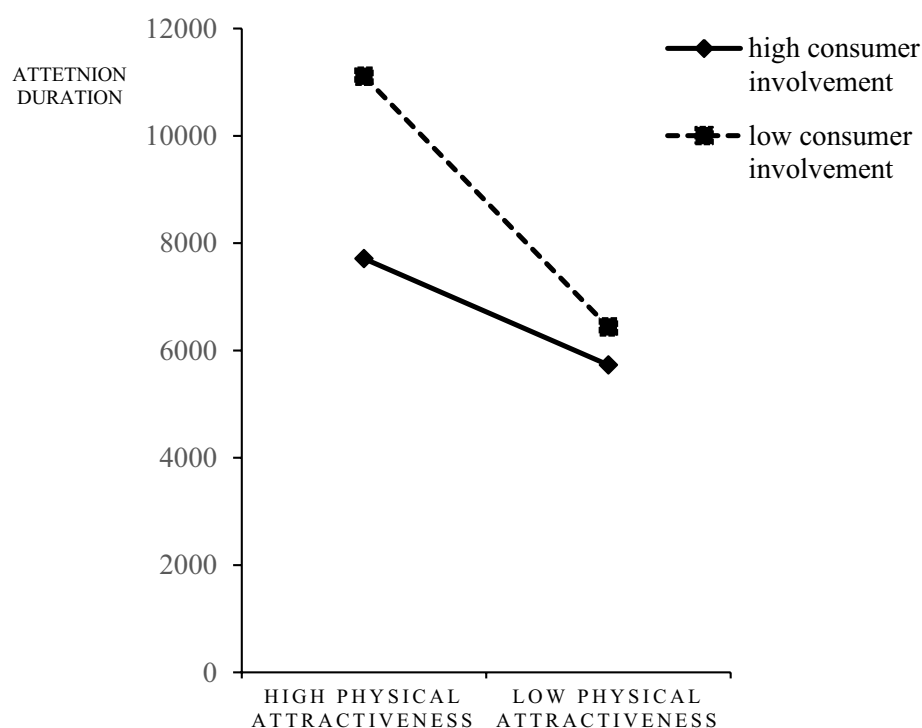

FIGURE 10
Interaction of physical attractiveness and consumer involvement on attention duration.

4.2.6 Effects of attention duration on consumer response behavior

Regression analysis was used to test the effect of consumer attention duration on consumer response behavior, and the results showed that there was no significant effect of consumer attention duration on consumers' willingness to watch continuously ($F = 2.349$, $p = 0.128$), willingness to participate continuously ($F = 2.879$, $p = 0.093$), and willingness to purchase ($F = 2.273$, $p = 0.134$). Therefore, H10a, H10b, and H10c were not valid.

5 Discussion

5.1 Conclusion

Based on the ELM and the Cognitive-Affective system Theory, this study introduced the characteristic variable of consumer involvement, and verified the effects of streamers' physical attractiveness and individual involvement on consumers' cognitive (attention duration, quasi-social interaction) and affective (flow experience) systems, as well as on consumers' responsive behaviors (continued watching intention, continued engagement intention, and purchase intention) through eye-tracking experiments, so as to ultimately revealed the mechanisms of the streamer physical attractiveness's influence on consumers' decision-making. The overall results hypothesis testing in this study were show in Table 5.

First, consumers' attention allocation and purchase behavior decisions were influenced by the physical attractiveness of streamers, but consumers' attention duration has no significant effect on consumers response behavior. From the perspective of consumers' attention allocation, beautiful-looking streamers are more likely to attract consumers' eyeballs, and can obtain more sustained attention duration, prompting consumers to stay in the live broadcasting room. The result of study on subjects' attention duration validate selective attention theory and interpersonal attraction theory (Hamermesh, 2011; Ruffle and Shtudiner, 2015), such as the recent study by Ji et al. (2023), which found that highly attractive anchors elicit longer attention durations from consumers. In addition, this study confirmed that streamers with high external attractiveness can stimulate consumers' more positive continued watching intention, continued engagement intention and purchase intention. This result is consistent with a recent study by Li et al. (2019), which found that service representatives with high physical attractiveness have a positive impact on consumer responses (customer satisfaction, perceived service quality, and favorability of the service representative). The same confirms the findings of Hong et al. (2019) that speakers with high physical attractiveness convey more credible and persuasive messages. This finding suggested that for a hedonic product such as lipstick, streamers with high extrinsic attractiveness are able to elicit more attention time and motivate more positive response behavior from consumers than streamers with low extrinsic attractiveness. The "beauty is good" stereotype still exists in the live marketing context, and people will still be attracted to and "pay" for beautiful things. There is no significant relationship between consumers' attention duration and consumers response behavior, which is consistent with the findings of Ji et al. (2023), but contradicts the conclusion that there is a clear relationship between gaze and choice (Behe et al., 2015), which may be related to the fact that the present study only use attention duration as the visual data.

Second, quasi-social interaction and flow experience played a chain mediating role between streamers' physical attractiveness and consumer responses. This study confirmed that streamers with high extrinsic attractiveness can bring more pleasant cognitive and emotional experiences to consumers, and can trigger stronger perceived prosocial interaction and flow experience, resulting in more positive consumer response behaviors. This finding suggested that streamers with high physical attractiveness can bring higher cognitive and emotional values to consumers, enabling them to immerse themselves more

deeply. Good-looking streamers are more likely to generate approach behaviors that lead to a higher degree of consumer trust and preference. This finding is consistent with previous research on physical attractiveness, which suggests that physical attractiveness may have a significant impact on customers' mood (affect), perceived value (cognition), and satisfaction, which may lead to positive behavioral intentions (Till et al., 2000; Peng et al., 2020). Similarly, it is illustrated that attractive streamers tend to generate consumer preference, admiration, love and emotional responses (Solomon et al., 2014).

Third, the moderating effects of consumer involvement on consumer response and flow experience were not significant, and the interaction effects of physical attractiveness and consumer involvement on attention duration were also not significant. This study confirmed that beautiful-looking streamers are able to elicit more positive response behaviors and longer attention duration from consumers regardless of the level of consumer involvement. After interviews with several live streaming users, it was found that for beauty products, consumers preferred the recommendations and trials of high-gloss streamers because streamers with high physical attractiveness can bring consumers a more aesthetic, pleasurable, and comfortable visual experience. The effect of "everyone loves beauty" was more significant, and thus consumer engagement failed to moderate the effect of the external attractiveness of streamers on consumers' attention duration and response behavior. In addition, this study showed that consumer involvement failed to mediate the relationship between the physical attractiveness of streamers and consumers' response behaviors through the mediating effect of flow experience. It was speculated that the reason for this is that consumer involvement belongs to the consumer cognitive motivational characteristic variables, which cannot clearly respond to the consumer's personal traits, while the flow experience is influenced by the physical environment characteristics and the consumer's characteristics (Dong et al., 2010; Cui et al., 2022; Tian and Ou, 2023), and thus the moderating effect was not significant.

5.2 Theoretical implications

First, this study enriches the research on physical attractiveness and reveals the mechanism by which the physical attractiveness of streamers influences consumer response behavior. Previous studies on extrinsic attractiveness have focused on service personnel (DeShields et al., 1996; Argo et al., 2008), human resources (Hamermesh, 2011), game character (Lo, 2008), and social media influencer (Masuda et al., 2022). And there is a lack of relevant studies on streamer physical attractiveness. In addition, in previous studies on streamer characteristics, scholars have mostly focused on streamer professionalism (Liu et al., 2022) and interactivity (Sun et al., 2021), and there is a lack of research related to physical attractiveness, which is most easily observed by consumers. This study takes the physical attractiveness of streamers as the research object, which expands the application boundary of the "halo effect of beauty" and the research scope of physical attractiveness.

Second, this study broadens the usage scenario of cognitive emotional system theory and further explains the changes of consumers' internal psychological state in the context of live streaming

TABLE 5 Hypothesis testing results.

Number	Hypothesis	Results
H1	Streamers with high physical attractiveness elicit more positive response behavior from consumers than those with low physical attractiveness.	Proved
H1a	Consumers have a more positive continued watching intention in the face of a streamer with high physical attractiveness compared to a streamer with low physical attractiveness.	Proved
H1b	Consumers have a more positive continued engagement intention in the face of a streamer with high physical attractiveness compared to a streamer with low physical attractiveness.	Proved
H1c	Consumers have a more positive purchase intention in the face of a streamer with high physical attractiveness compared to a streamer with low physical attractiveness.	Proved
H2	Quasi-social interaction mediates the relationship between streamers' physical attractiveness and consumer response.	Proved
H2a	Quasi-social interaction mediates the relationship between streamers' physical attractiveness and consumers' continued watching intention.	Proved
H2b	Quasi-social interaction mediates the relationship between streamers' physical attractiveness and consumers' continued engagement intention.	Proved
H2c	Quasi-social interaction mediates the relationship between streamers' physical attractiveness and consumers' purchase intentions.	Proved
H3	Flow experience mediates the relationship between streamers' physical attractiveness and consumers' response.	Proved
H3a	Flow experience mediates the relationship between streamers' physical attractiveness and consumers' continued watching intention.	Proved
H3b	Flow experience mediates the relationship between streamers' physical attractiveness and consumers' continued engagement intention.	Proved
H3c	Flow experience mediates the relationship between streamers' physical attractiveness and consumers' purchase intention.	Proved
H4	Quasi-social interaction and flow experience act as chain mediators between streamers' physical attractiveness and consumers' response.	Proved
H4a	Quasi-social interaction and flow experience act as chain mediators between streamers' physical attractiveness and consumers' continued watching intention.	Proved
H4b	Quasi-social interaction and flow experience act as chain mediators between streamers' physical attractiveness and consumers' continued engagement intention.	Proved
H4c	Quasi-social interaction and flow experience act as chain mediators between streamers' physical attractiveness and consumers' purchase intention.	Proved
H5	Consumer involvement significantly influences the relationship between streamers' physical attractiveness and consumers' response behavior.	Not proved
H5a	When consumer involvement is low, Streamers with high physical attractiveness can trigger consumers more positive continued watching intention.	Not proved
H5b	When consumer involvement is low, Streamers with high physical attractiveness can trigger consumers more positive continued engagement intention.	Not proved
H5c	When consumer involvement is low, Streamers with high physical attractiveness can trigger consumers more positive purchase intention.	Not proved
H5d	When consumer involvement is high, the effect of streamers with high physical attractiveness on consumers' continued watching intention is not significant.	Proved
H5e	When consumer involvement is high, the effect of streamers with high physical attractiveness on consumers' continued engagement intention is not significant.	Proved
H5f	When consumer involvement is high, the effect of streamers with high physical attractiveness on consumers' purchase intention is not significant.	Proved
H6	Consumer involvement significantly influences the relationship between streamers' physical attractiveness and flow experience.	Not proved
H6a	Consumer involvement effectively moderates the relationship between streamers' physical attractiveness and consumers' continued watching intention through the mediating role of flow experience.	Not proved
H6b	Consumer involvement effectively moderates the relationship between streamers' physical attractiveness and consumers' continued engagement intention through the mediating role of flow experience.	Not proved
H6c	Consumer involvement effectively moderates the relationship between streamers' physical attractiveness and consumers' purchase intention through the mediating role of flow experience.	Not proved
H7	Streamers with high physical attractiveness are able to gain more consumer attention to the streamer's face and products.	Proved
H8	Consumers with low involvement are more likely to be attracted by the external appearance of streamers, and their attention duration to streamers is longer.	Proved
H9	Consumer involvement significantly influences the relationship between streamers' physical attractiveness and consumers' attention duration. There is a significant difference in the attention duration that consumers with low involvement level spend on different physical attractive streamers, while there is no significant difference in the attention duration that consumers with high involvement level spend on different physical attractive streamers.	Not proved
H10	Consumers' attention duration is positively related to consumers response behavior.	Not proved
H10a	Consumers' attention duration is positively related to consumers continued watching intention.	Not proved
H10b	Consumers' attention duration is positively related to consumers continued engagement intention.	Not proved
H10c	Consumers' attention duration is positively related to consumers purchase intention.	Not proved

marketing. Most of the previous studies on live streaming marketing have focused on single cognitive or emotional changes of consumers (Chen and Liao, 2022; Hsu, 2023), which still lacks a more comprehensive interpretation of consumer psychology. In contrast, this study analyzes the impact of streamers' physical attractiveness on consumers' response behavior in a more systematic way by exploring the intermediary mechanism of the chain of quasi-social interaction and flow experience.

Third, this study uses eye-tracking technology to further reveal the information processing and cognitive mechanisms behind the influence of streamers' physical attractiveness on consumer behavior from the perspective of visual attention. The eye-tracking index obtained by eye-tracking technology is a relatively more objective physiological data, which can more accurately reflect the consumer cognitive decision-making process. At the same time, this study reveals the mechanism of

streamers' physical attractiveness on consumers' response behavior through the analysis of physiological data and self-reported data, which makes the study more complete.

5.3 Practical implications

First of all, hire high-value streamers to attract consumers' attention. The live broadcast room should make reasonable use of the halo effect of beauty to attract the attention of consumers, and to capture the consumer's "love of beauty" psychology. When consumers enter the live broadcast room for the first time, what attracts their eyes most is the streamer itself, and choosing the streamer with high external attractiveness is one of the effective strategies for the live broadcast room to obtain higher sales and income. Although utilizing the beauty advantage may only bring consumers a short stay, attracting consumers is what will bring the chance of increased customer retention. Streamers should fully stimulate consumers' quasi-social interaction and flow experience during live viewing by enhancing the attractiveness of their own image, thus triggering a positive cognitive-emotional experience for consumers. Live streaming e-commerce can also optimize the layout of the live room and improve the match between the streamer, the product and the live room in order to attract consumers by providing a comfortable visual experience.

Secondly, improve the streamer's own quality to win the trust of consumers. Using the halo effect of beauty brings short-term benefits, and enhancing consumers' shopping experience and satisfaction still requires the support of the streamer's professional ability. High professionalism can provide consumers with more valuable products and related information, which in turn affects the cognitive purchasing decisions of consumers with a high degree of involvement. "Shouting sales" mode has gradually deviated from the original intention of live marketing, the lack of relevant product introduction and the pursuit of sales live with goods mode has made consumers dissatisfied; in addition, the frequent appearance of bad streamers and consumers cannot protect their rights has also made the live marketing market a mess. As a result, streamers need to improve their own professional level, focusing on product information, timely reconnaissance of market dynamics, improve product screening capabilities, improve the level of product demonstration, and then be able to win the trust of consumers with a strong professionalism.

Finally, the appropriate use of broadcasting techniques to stimulate consumer spending. Streamers can use some live broadcasting techniques to stimulate consumers' competitive awareness, in order to briefly "shield" the influence of consumer involvement on their consumption decisions. In the live broadcast process, the streamers can use hunger marketing, purchase time limit and music play, etc., to enhance the influence of edge cues on consumer information processing, in order to stimulate consumer purchase motivation; streamers can also increase the bullet screen interaction and user lottery and other links to create a lively atmosphere of the live room, in order to enhance the degree of user participation, which in turn improves the quasi-social interaction perception and the flow experience, and use the "herd effect" to improves user retention and order conversion rate.

5.4 Limitations and future prospects

First, this study only explored the effect of streamers' appearance attractiveness on consumer response behavior. Shen et al. classified attractiveness into appearance attractiveness, social attractiveness, and task attractiveness (Shen et al., 2019). Appearance is the first impression, which is the primary condition for consumers to enter and stay in the live broadcasting room, but the subsequent traffic conversion needs other charisma additions of the streamers. In future research, social attractiveness and task attractiveness can be further explored as other measurement dimensions of streamer characteristics.

Second, this study only used lipstick as the stimulus material for this experiment, which is relatively single and more targeted to the female group. Future research can verify whether the halo effect of beauty is applicable to live broadcasting scenarios of other product types by dividing different product types (hedonic products and practical products).

Third, this study only discussed the influence of the streamer on consumers as a person in the "people, goods, and field." In the future, products (goods) and live broadcasting background (field) can be used as external stimuli to further explore their effects on consumer response behavior.

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 humans were approved by the Institutional Review Board of Yanshan University. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

XT: Conceptualization, Supervision, Writing – review & editing. ZH: Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft. XL: Conceptualization, Data curation, Methodology, Writing – review & editing.

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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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Self-perception evolution among university student TikTok users: evidence from China

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The effects of short movies on social media platforms are gaining worldwide popularity and are now attracting global academic attention. Employing self-perception theory and qualitative research methodology, the study examines the influence of short video applications (TikTok) on app-user engagement and evaluates the self-perceived cognitive psychological understanding of Chinese university students. The findings show that identity, attitude change, emotional perception, and civic engagement are the most influential aspects of Chinese youths' self-perceptions. Furthermore, the positive and negative correlated components influence the distribution of short video values. Such tactical use of personality construction contributes to the present psychological research of Chinese university students.

Introduction

The viewership of short videos is growing in popularity all around the world (Wang, 2020). However, there are heated discussions in the research literature concerning its relevance and prospective impacts, notably its implications on the personality evaluations of adolescents (Jarman et al., 2021), social wellbeing (Best et al., 2014) as well as isolation and loneliness (Leigh-Hunt et al., 2017). People can learn from their own thoughts, sentiments, and other emotional reactions in part by inferring them from their observable behaviour or the world of uncertainty in which such behaviour occurs (FeldmanHall and Shenhav, 2019). As a kind of social perception, self-perception is a person's subjective perception of oneself, the psychological basis of behaviour, and a complex psychological process (Turner and Oakes, 1986). Perception, experience, needs, and motivation all impact a person's self-evaluation and self-judgment, which are accomplished by self-control, self-evaluation, and other self-learning processes (Fauzi and Widjajanti, 2018). These are the most important indicators of a person's psychological health, and ultimately, overall

psychological well-being (Houben et al., 2015). TikTok has gained significant popularity and broad adoption among young people and Generation Z, making it one of the most popular applications (Hase et al., 2023; Schellewald, 2023). Regarding this matter, the research not only focuses primarily on TikTok as the major platform to be analysed in this paper. It is crucial to write a document that thoroughly explains the platform, emphasizing its capabilities and affordances (Cervi, 2021), its cultural context in-between (De Leyn et al., 2022), and its usage by Generation Zers (Stahl and Literat, 2023). It is crucial to recognize and examine the existing extensive body of literature on this subject in order to provide a solid foundation for the research. Therefore, it is also essential to explore the self-perception aspect while delving into the study of TikTok via an academic perspective.

It is becoming increasingly important for academics to start investigating how applications for creating short videos, including TikTok, are affecting Chinese youths' cultural practices and their psychological patterns of interpersonal perceptions. This study investigates how the rise of the video-sharing platform TikTok is impacting traditional Chinese cultural traditions and psychological modes changing. The present study intends to investigate the following research questions: (1) How do elements within short video content contribute to biases in the transmission of values, particularly in relation to self-perception? (2) What are the primary factors that influence distortions in self-perception resulting from the communication of values through short videos? (3) To what extent does the prevalence of TikTok influence the self-concept and daily practices of Chinese university students, encompassing their entertainment preferences, behavioural patterns, and evolving cultural dynamics. To further investigate these research questions, a combination of quantitative and qualitative research methods was applied to the study of the most widely prevalent short videos on TikTok among Chinese university students from the years 2012 through 2022. The goal of this research would be to determine the extent to which the popularity of TikTok has an impact on the participants' conceptions of themselves as individuals. The outcomes of this study show how short video apps, which are an essential component of the lifestyles of Chinese university students, affect their day-to-day practises, including their amusement preferences, self-perception, behavioural patterns, and younger cultures.

The following sections are set as follows: First, the authors started to summarize related literature to the topics, including the issues of self-perception of symbolic interaction, attitude, psychological emotion, and social comparison. Second, the next section introduces the research methodology, which includes a semi-structured interview and a grounded theory approach. Research findings would be displayed in the following section, together with the discussion and conclusion sections. The present research contributes to a deeper understanding of the philosophic, theoretical, and methodological interpretations of the theory of self-perceptions about TikTok users, particularly teenagers and university students.

Literature review

Self-perception of symbolic interaction

Sociability, information sharing, communication, and self-perception are inescapable aspects of everyday lives that need symbolic interaction (Daniels, 2021). Self-perception is a fundamental component of symbolic interaction since one must participate in symbolic contact in order to see the self, others, and the symbolic meanings they hold (Stets and Burke, 2003). Individuals are able to communicate more actively with others on social networks to express themselves and form connections (Caton and Chapman, 2016). Consequently, symbolic interaction as a sort of behaviour is therefore influenced, resulting in an influence on each of us in society.

Symbolic interaction as a form of behaviour is often thought of as people interacting with each other, while self-perception is relatively uncommon. When symbols are expressed in different ways, they are perceived differently and therefore affect the perception of others. In particular, Mckenny (2012) suggests that social identification with the benefit stakeholder group and competence with the group's need both increase the possibility of stumbling onto and making use of an opportunity for social entrepreneurship. In this regard, Wallace et al. (2012) conducted research to investigate whether or not adolescent's locus of control influenced the relationship between self-perception factors and aggressiveness, which mainly consists of (1) user interaction was related to self-perception; (2) behaviour was mainly influenced by personal interests.

Consistent with previous research, it has been shown that symbolic interaction may lead to self-perception, which can impact others and transform oneself, given that people see different symbols in different ways and therefore construct self-perception (de Vries and Kühne, 2015). In the preceding part of the introduction, we expounded on this subject in connection to pertinent research in order to give a theoretical foundation and research gap for future study. The part that follows will continue to build on and explore self-perception within the context of relevant studies.

Self-perception and social networking

People communicate symbolically with one another in social networks (Aakhus et al., 2012; Kane, 2012), which is more of a result of symbolic expression and engagement with other people than of a feeling or a sensation. People have diverse ways of seeing and depicting other people depending on the situation in which they find themselves; as a result, individuals build their own self-perceptions and influence others via symbolic relationships. In terms of social interaction, when we feel that others recognize us, we will interact with each other actively, which is consistent with our cognitive level. In the meantime, we will have greater psychological demands to gain the recognition and support of others (Wong, 2022), and when we feel that others recognize us, we will make greater efforts to satisfy others, and we will communicate with them symbolically more effectively. When we are the recipients of compliments and appreciation from others, we are motivated to do more to win their approval and are better able to connect with them on a metaphorical level, which ultimately results in the creation of more shared ideals and the strengthening of ourselves. A positive element of social networks is that they enable us to transmit our ideas and emotions to others symbolically (Seng et al., 2018). This makes it simpler for people to identify themselves in order to establish contacts and communicate. When taken together, the above arguments demonstrate to the utmost extent that mental activity and symbolic

connection both affect how we see ourselves and our feelings, while simultaneously being effectively impacted and inspired (Janicke et al., 2018). Four significant types of symbolic interaction are outlined below: interaction, symbolic cognitive activity, symbolic expression, and self-perception.

Self-perception is an aspect of consciousness that is an organic component of the interaction and communication that makes up civilization (Keromnes et al., 2019). This indicates that, from the standpoint of human-computer interaction, we could investigate the dissemination of concepts via the use of short videos (Szolin et al., 2022). Such an understanding, which integrates human self-perception with the social environment, transcends the limitations of human-computer interaction. It also incorporates social engagement with other individuals, reflection on behaviour, and the investigation of the alteration of human self-perception in the cultural ecology of short videos from the standpoint of symbolic interaction (Charmaz et al., 2019; Meltzer et al., 2020). This strategy may also be accomplished by integrating human exposure and reactions to short videos, a radical alternative for action rather than the actor that harkens back to symbolic interactionism (Szabla and Blommaert, 2020; Namisango et al., 2022). Through a summary of the available literature, this paper synthesizes the associated research viewpoints, methodologies, and contents, so producing the research framework outlined below (see Figure 1).
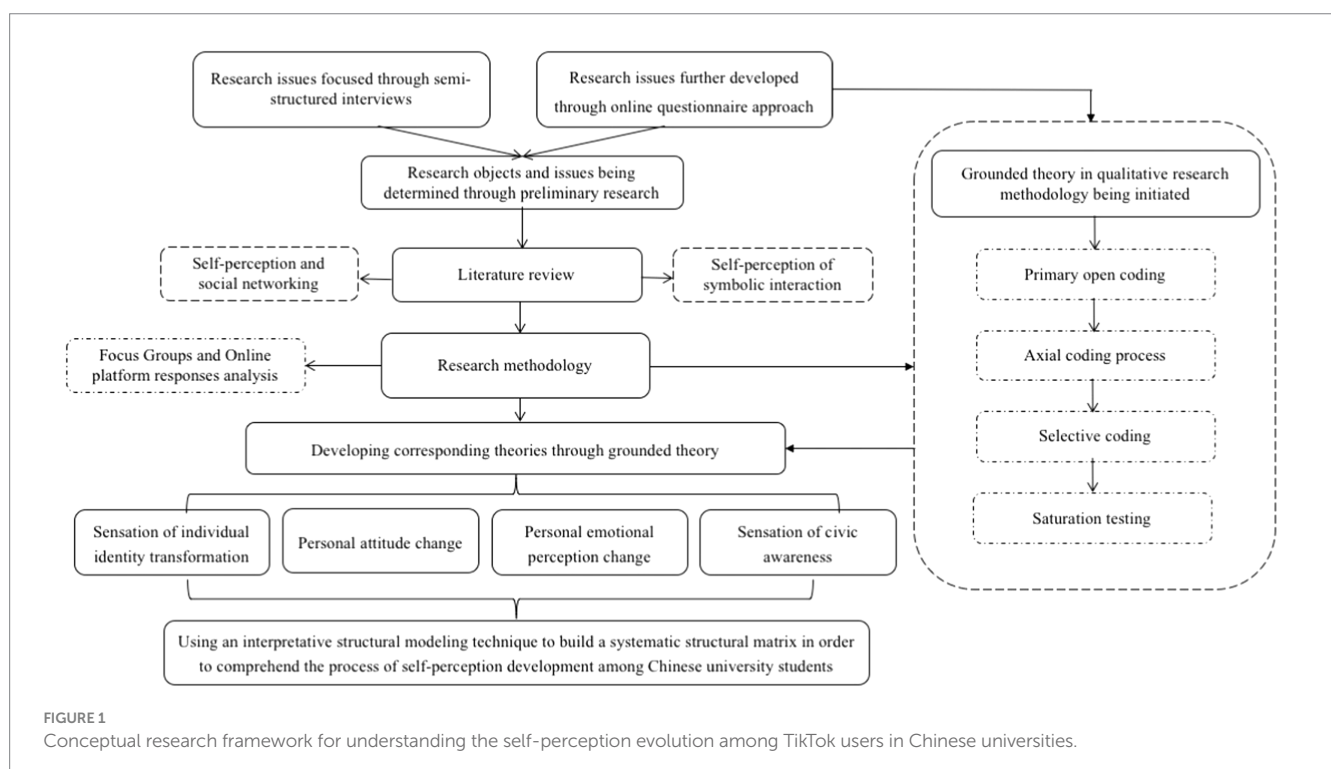
Mixed research methodologies

Similar to the research of Dearnley (2005) and Mcintosh and Morse (2015), the current paper used semi-unstructured interviews to identify key measures of self-perception, environmental perception and online behaviour.

Adopting semi-structured interviews in qualitative research methodology

The semi-structured interview may be done without a predetermined standard questionnaire or research question form (Dearnley, 2005; McIntosh and Morse, 2015; Bahari et al., 2022). The interviewers are just given a basic direction for the subject of the interview, around which the authors and interviewees are allowed to converse (Rowley, 2012; Rutakumwa et al., 2020). As noted by Brönnimann (2022), the authors should be in favour to protect the situation from change and constantly modifying the structure of the questions based on the current context of the interview. During the course of the interview, the interviewers are flexible to change some directions when inspiration strikes or go further into a certain topic (Kvale, 2003; Morrison et al., 2019). In contrast to structured interviews, semi-structured interviews are frequently used to gain insight into complex facts that cannot be captured by fixed-procedure questionnaire surveys (Diefenbach, 2009; Brinkmann, 2014; Magaldi and Berler, 2020). This is particularly the case when it comes to essential aspects such as personal attitudes, values, and intentions that are difficult to summarize directly in standard questions (Foerstl et al., 2021). Thus, semi-structured interviews, which are used far more often to permit quantitative analysis of the information obtained from interviews, are adopted in the present study.

Numerous techniques for evaluating the self, perception, attitude, cognition, and emotion emerged with the advent of social cognitive psychology research, and numerous scientists developed scales for this purpose (Bandura, 2001; Barone et al., 2012). Due to the advantages of qualitative research (Alvarado and Waern, 2018; Yin et al., 2021), in this study, semi-structured interviews were utilized to determine the human-computer interaction aspects of short videos that impact individuals' perceptive value. Based on the precedential research, the

Conceptual research framework for understanding the self-perception evolution among TikTok users in Chinese universities.

authors create a series of questions meant to elicit information about the research participants' state of mind or the mental processes they have engaged in while watching the TikTok app, and the research participants respond to each open-end question based on how it resonates with their own subjective experience. The current study gives participants a standardized interview subject to facilitate free-flowing conversation (Dempsey et al., 2016). For the following part of the empirical study, the interviewees' remarks collected from the semi-structured interviews were transcribed into texts and further analysed using content analysis to summarize the self-perceived components of the short video that influence value interaction.

Adopting a grounded theory approach in qualitative research methodology

The grounded theory, which was established by Strauss and Glaser (Glaser and Strauss, 1964; Glaser et al., 1968), stresses the researcher's capacity to engage completely with empirical data and to progressively generalize fundamental conceptualizations (Zahrai et al., 2022). The advantage of grounded theory research is that it takes the mystery out of qualitative research and moves beyond descriptive research into the realm of interpretive theoretical frameworks (Birks and Mills, 2011; Zhu et al., 2022). The qualitative material is fragmented, requiring the researcher to group it into corresponding themes, constantly comparing the commonalities that exist in all the qualitative material (Klykken, 2022). The gathered themes from the study were contrasted based on their substantial differences across classifications (Cabi, 2018; Choi et al., 2020). In the course of comparing, evaluating, integrating, and classifying qualitative data, and finally distilling novel theoretical concepts, this procedure is intended to provide a rational conceptual analysis (Jackson, 2015).

Sampling

As a result, eight universities in Guangxi, including comprehensive postgraduate universities, normal undergraduate universities, finance and economics undergraduate universities, medicine undergraduate universities, and vocational colleges, were chosen to conduct interviews with students. Students from eight different universities, including both undergraduates and postgraduates at their respective institutions, participated in the interviews. Table 1 contains the basic information for 33 respondents, whose actual identities are substituted by code names.

In the application of the grounded theory research method, it is essential to provide the applicable concept and theoretical framework for data analysis with the speculative idea, to treat the theoretical accomplishments of predecessors dialectically, and to consider the pertinent theories under specific conditions. Simultaneously, the authors' argumentative reasoning and empirical knowledge then permeate the right application of the predecessors' theories. The next step is to construct an adaptable, substantial, and reliable theory of inspiration based on empirical shreds of evidence.

Interview process

An interview time is reserved with the interviewee for a face-to-face conversation. The open-ended questions of the interviews

focused on the following four themes: (1) What perspectives were shown in the short TikTok videos? (2) What cognitive dissonances were conceivable? (3) What positive or negative emotions do they experience when exposed to short TikTok videos? (4) Does the process of observing include introspective rationality of self-perception? The respondents were simply instructed to describe their attitudes, emotions, and actions after viewing the short videos, and were encouraged to share their actual sentiments. Following the approaches of Sutton and Austin (2015), the data was then simplified and summarized in accordance with the field notes and voice recordings. The interview was limited to 30 min to reduce participants' fatigue, which might lead to disengagement and discrepancies in the discussion. The interview was conducted to provide the interviewee with a positive atmosphere by asking encouraging questions and to create an environment comparable to a casual discussion for the interviewee so that the most genuine information could be acquired (Emans, 2019). Over the same interview process, data were collected on participants' ambient cognitive bias and online behavioural bias during the short video exposure. After the interview, it was sufficient to organize the textual data received in the words into the relevant categories.

Open coding process

During the phase of the open coding process (Denzin and Lincoln, 1998; Brannen, 2004), the current research evaluated and analysed the initial responses of the student participants, as well as synthesised the themes and theories. Data analysis and coding are the foundation of grounded theory (Bate et al., 2019; Baek et al., 2021). Because qualitative resources are dispersed and fragmented, the authors must synthesize them into appropriate themes, continually analyse the commonalities across all qualitative materials, and evaluate the key distinctions within categories (see Tables 1, 2). In the process of comparing, analysing, merging, and classifying, qualitative materials are subjected to a credible category analysis, and fresh theoretical perspectives are ultimately retrieved (Konecki, 2019; White and Cooper, 2022). The main objective of this study is to establish the association between a macro theory and a micro key factor for the value transmission bias of short video by using the grounded theory research approach. The authors' consideration of the case's most influential aspects leads to the deductive hypothesis (Gilgun, 2019). In the use of the grounded theory research method, it is critical to regularly compare theories with empirical data, followed by a synthesis of the data's and theories' interconnections in order to extract relevant categories and their fundamental thematic attributes (Sarkar and Banerjee, 2023).

The interview provides evidence that self-perception may be broken down into three distinct levels of subject matter. On the basis of the facts presented here, we are able to come to the conclusion that there are four second-level themes the level of the first-level theme of self-perception. There are 11 third-level themes following the level of the second-level theme. Table 2 presents the detailed synopsis for the current perusal.

Axial coding process

In this process, this study has efficiently categorized the self-perception theories in the disciplines of psychology, communication, sociology, etc., and presented the preliminary applied theories ahead of time (Zhang Y. et al., 2020). The data gathered via the interview session were sorted, classified, and categorized accordingly (Conrad

TABLE 1 Demographic information about the student interviewees.

Pseudonym	Gender	Age	Education	Daily mobile phone screen time (Including usage of short video platforms such as TikTok)
ZS	Male	35	PhD	Above 3 h
XYW	Male	20	Undergraduate	Above 2 h
TJF	Female	19	Undergraduate	Above 4 h
YRY	Female	19	Undergraduate	Above 4 h
YF	Female	22	Junior university student	Above 4 h
ZYL	Female	22	Undergraduate	Above 3 h
LSY	Female	20	Junior university student	Above 3 h
YH	Male	29	PhD	Above 8 h
LSY	Female	21	Undergraduate	Above 2 h
LY	Male	24	Postgraduate	Above 3 h
HX	Female	19	Undergraduate	Above 4 h
HYM	Female	27	Postgraduates	Above 5 h
HHJ	Male	22	Undergraduates	Above 3 h
LMS	Male	26	Postgraduates	Above 8 h
CFY	Male	18	Undergraduates	Above 2 h
DHY	Male	20	Undergraduates	Above 2 h
ZSX	Male	19	Undergraduates	Above 6 h
HJJ	Male	38	PhD	Above 2 h
SZQ	Female	32	Postgraduates	Above 3 h
LSS	Female	29	Postgraduates	Above 3 h
CYJ	Male	19	Junior university student	Above 4 h
WYX	Male	28	Postgraduates	Above 3 h
LDY	Male	20	Undergraduates	Above 8 h
LJ	Male	28	PhD	Above 4 h
ZF	Female	20	Undergraduates	Above 6 h
ZY	Female	27	Postgraduates	Above 4 h
LS	Male	20	Undergraduates	Above 3 h
LWY	Male	19	Undergraduates	Above 6 h
XRH	Female	25	Postgraduates	Above 2 h
ZB	Male	27	PhD	Above 4 h
HH	Female	24	Postgraduates	Above 3 h
ZQ	Female	25	Postgraduates	Above 5 h
CS	Female	29	PhD	Above 4 h

The rightmost column in this table is labelled as "Daily mobile phone screen time (including usage of short video platforms such as TikTok)" to account for a mobile phone application that calculates daily and weekly screen time usage.

and Tucker, 2019). After a thorough analysis of the data in the class and genus, the data with comparable features were grouped and categorised into a single attribute, i.e., distinct attributes were separated under different classifications (Kendall, 1999; Vollstedt and Rezat, 2019). The distinctions between classes and characteristics should be compared continually and with deliberation. Finally, the preliminary descriptions of theories and conceptual genera are compared to assess their link. Considerations were given to whether the theory or the classification of genera may be altered. All of these will contribute to developing a scientific and credible theoretical

framework for the next phase of empirical inquiry, as stated in Table 3.

The decision to employ grounded theory as the research methodology in this study aimed to conduct a thorough analysis of theoretical loci, inductive thematic patterns, and data saturation (Saunders et al., 2018). This saturation approach streamlined our research process, from the initial theoretical conceptualization and data collection to thematic analysis and theoretical refinement (Charmaz and Thornberg, 2021). To confirm with the objective of data saturation, we did another run of semi-structured interviews to the

TABLE 2 Three-level theme division of self-perception.

First level	Second level	Third level
Self-perception	The sensation of individual identity transformation	Career perceptions
		Impression prediction
		Image differentiation
	Personal attitude change	Visual stimulation
		Utility satisfaction
	Personal emotional perception change	Real information
		Emotional outburst
		Emotional transformation
	The sensation of civic awareness	Entertainment satisfaction
		Freedom of choice
		The critical thinking

interviewees. Consequently, the interview results indicate that there were no new themes emerged from the interviews, affirming the adequacy of theme extraction and the alignment of the study's theoretical focus. Thus, the data saturation process indicated that there were no further samplings and interviews needed for the current study.

The four themes relating to university students' self-perceptions are further developed after examining the important aspects that contribute to the student's self-perception of the worth of short videos are extracted using grounded theory research. This section attempts, through empirical and quantitative analysis, to achieve accurate attribution of third-level themes and to discover the primary factors influencing the value perceptions of short videos to university students. On the basis of this categories framework, the self-perception theory model asserts that short video consumers undergo an identity transformation in response to stimuli and subsequently create a matching physiological output (Hsiao, 2017). Hsiao (2017) argues that the obsessive use of smartphone apps might negatively impact people's psychological health and social relationships. Underneath the influence of these short videos, subscribers may display different manifestations of social networking exhaustion. Based on a such line of thinking, a total of 11 categories (see Table 3) among the three dimensions of self-perception of social media impacts produced from the above analysis according to the grounded theory. The frequencies of various coding elements reported by the viewers of the short video among Chinese university students varied from one another, as shown by the frequencies of the statements shown above.

Research findings

The sensation of personal identity reformation

According to the interviews conducted, exposure to a multitude of videos plays a pivotal role in shaping an individual's sense of identity. In this research, various factors contribute to the sensation of personal identity transformation, including one's perception of their anticipated future occupation or identity, the alignment of self-perception with external perceptions, and the comparative analysis of one's real self with their virtual social interaction self-image. In

alignment with studies conducted by Parry et al. (2020), the utilization of social media platforms like TikTok, through video content consumption, lays the foundational groundwork for shaping life principles at the level of self-perception. Personal attributes such as courtesy, tranquillity, appreciation for labour, integrity, and benevolence emerge as fundamental components in the construction of individual value systems. For instance, an interviewee shared the following perspective:

> I adore viewing videos on Tiktok that depict physicians saving lives and healing people in my everyday life. By watching these movies, I am also able to comprehend the challenges that the medical field we are studying will face in the future, while simultaneously gaining confidence and gaining insight into a future medical career. This should be the procedure for developing and distinguishing the representation of the professional path that we students identify with. (LY is currently a graduate student at the institution, where he is majoring in medicine. During the interview, he offered a positive reaction to the consequences of app-viewing behaviour. The interview was conducted at some point in time prior to June 2022.)

The intensity of students' identification with specific coding components impacts these metrics, consequently influencing the construction of a distinct self-identity through individual reflection (D'Angelo and Ryan, 2021). Students gain a profound understanding of the importance of mastering this professional skill through the social connections fostered by short video content. This process facilitates the establishment of one's identity through self-presentation. It is posited that students delineate their self-presentation and formulate unique self-identities, driven by diverse motivations and objectives triggered by their consumption of short video content.

Personal attitude change via watching the TikTok short videos

Yeshurun et al. (2021) propose that the default mode network is a dynamic and responsive sense-making network that combines current extrinsic information with pre-existing intrinsic knowledge to construct complex, context-dependent situational models. As shown in this study, these self-perception changes can occur as a direct or indirect outcome of the short video-viewing experience. The emotional resonance that people experience with the content symbols as a reaction to the visual stimulation of short movies is one of the topics that are present in the higher education section. In this research, HX believes she has a negative attitude and emotion for the short video clip in which she displayed the following statements.

> The initial push of the positive short video left me feeling good. The problem is that they remain the same items, for instance, the information about celebrities, rumours, and cosmetics. Over years of viewing these movies, it seems that the app makes it hard to determine how often they alter the themes that are pushed on me. It reminds me of the "information cocoon chamber," only there does not appear to be any way to escape it. (As a 19-year-old university student, HX criticized and questioned the information-pushing

TABLE 3 The open coding − generalized open coding − axial coding − selective coding process.

Opening coding (labelling) to initial statements from the interview participants	Opening coding (conceptualization)	Axis coding (categorization)	Selective encoding (core categorization)
Admire the doctor when watching the life-saving video. Some travel videos recommended routes, food trustworthy. We media will perform better and more professionally.	Positive career motivation Introduction to Occupational Environment	1. Career perceptions	The sensation of individual identity transformation
Dressing up, inserting yourself into movie characters, Posting on moments. Used all the smart image functions.	Feel ourselves Show ourselves	2. Impression prediction	
Watching videos and live streams of younger girls, making jokes, and making friends with strangers.	Virtual social interaction	3. Image differentiation	
Not used to reading too long text When watching those (video) snippets, time goes by in a flash.	Immersed in short videos Kill time	4. Visual stimulation	Personal attitude change
Retweeting short videos is a way to display a personal hashtag, I will retweet fitness, and healthcare content, and jokes to family groups.	Satisfaction of motivation Consumption of culture	5. Utility satisfaction	
I feel that the short videos pushed by TikTok are quite good at first, but after a while, they are always the same thing.	Experience of emotion Information cocoon room	6. Real information	Emotional perception change
Sometimes I hate the themes that TikTok recommends. For example, when the thief got out of jail, TikTok was full of him. I think the video of the beautiful girl in Chengdu looks false.	Conflict with a video theme Negative emotions after viewing	7. Emotional outburst	
I like to see young girls in TikTok, and I will paint a lot of gifts for them because I do not get to know so many girls in real life. If they do not feed back to me, I would be disappointed.	Negative emotional interaction Virtual social addiction	8. Emotional transformation	
Usually, TikTok sends me the content of comics. I like drawing and playing games, such as quadratic elements. I prefer watching beauties in TikTok and watching variety shows. The teacher recommended excellent media coverage, but I do not watch, I prefer entertainment shows.	Pursuit of the nonconformity Pursuit of entertainment	9. Entertainment Satisfaction	The sensation of civic awareness
The leisure and entertainment function of the short video platform does not affect one's attention to current events. Although TikTok does recommend some news, it is very rare. It is mostly entertainment	Pay close attention to current political issues Prefer the theme of leisure and entertainment	10. Freedom of choice	
Video journalism is more attractive than in-depth text reporting; Watching videos is much more comfortable than reading those long reports I will go to see the freezing point or Pengpai news for deep reports	Ditch deep thinking	11. The critical thinking	

mechanism of short-video social media platforms. The interview took place in June 2022.)

The extent to which watching short videos meets the individual's particular wants and requirements for information, and the consequent changes in the individual's attitudes about short video content as a result of these changes. Individuals acquire emotional experiences via media engagement. This is based on genuine information that we can rapidly and correctly collect, which is both knowledgeable and useful. Individuals prefer to invest a certain

amount of confidence in media outlets that convey a feeling of informational veracity. For instance, the benefits of authoritative media in terms of communication, advice, influence, and legitimacy allow them to play an important role in value orientation. A poor example of duplicate information experience is the TikTok video pushing mechanism, which has been roundly criticized by university internet users.

Emotional perception change

Yeshurun et al.'s (2021) study show that an individual's effective perception and experience of changes in their own emotions during exposure to short videos. In this process, the themes influencing perception change include one's own experience with the authenticity of information and the resultant rise or reduction in confidence in the source seen by university students. The emotional outbursts that occur in short-video-based virtual interaction. Therefore, the creation of positive or negative emotions in response to short video exposure influences the emotional perception of Chinese university students. Emotional normalcy in the cultural ecology of short-form video is a process of a connotation for people, and excellent self-awareness may assist university students in developing long-lasting, healthy personality qualities that contribute to the stability of social values. LS, one of the interview participants, has a negative view of the use of short videos to exhibit bloggers' hashtags and an emotional aversion to some of the suggested content.

> When that (faking images and videos) happens, the videos that Tiktok messages to me may be rather frustrating. In particular, there are several shots of a burglar who took the battery off of an electric bike and displayed them online. Additionally, the videos and images of females in Chengdu city are mostly fabricated and illusioned without a solid foundation. (LS is a second-year student at one of the institutions that participated in this research. He is majoring in hotel management. The interview was carried out in the location where he was interning and working in July of 2022.)

The comments to this interview reveal that, based on a greater grasp of university students' thought processes, contemporary Chinese university students are seeing and analysing TikTok videos on a deeper level. Students engage in a four-part cycle of planning, implementing, observing, and commenting on the process of video viewing in an effort to develop reasonable mechanisms for applying their off-campus learning. In this study work, the authors base their pedagogical and instructional activities on a consideration of this occurrence and the subsequent stage.

The sensation of civic awareness

During their exposure to short videos, university students' concern for information in the public domain either increased or decreased. The higher education themes include changes in the amount of energy devoted to social and public affairs as a result of the influence of entertainment messages and the cost of reflection required to comprehend and assimilate short-form content. The components of civic awareness suggest that, in the context of

short-form video, there must be variations in persons' attention to national public issues, which are directly related to the construction of one's basic values at the national and social levels. As a typical member of contemporary university students, TJF shows a certain lack of civic consciousness.

> TikTok only gives me humorous material. In my leisure time, I like sketching portraits, particularly of gorgeous, featured females. I like playing video games as well. TikTok allows me to view them all. The teacher also suggested that we read more excellent media reports and public accounts, such as People's Daily and China Youth Daily, but I didn't read them much. I did not see any current political news. However, as for me, I hardly follow current political events. (TJF is a first-year undergraduate student attending one of the institutions that were researched for this article. Through her consumption of Tictok videos, she communicated her disinterest in both the recent news and her participation in public life. The interview was scheduled for August of 2022 and was taking place at the institution.)

For Chinese university students, new media and modern news education have evolved simultaneously. The fast expansion and broad usage of new media have resulted in dramatic changes in the way information is distributed and people connect (Zhuravskaya et al., 2020). Compared to conventional media, new media is relatively developing in a new formation (Etter et al., 2019). The new media refers to both the interactive peer-to-peer state of communication and the altered ecology of information delivery. New media communication is distinguished from conventional media by the immediacy of the communication state, the interactivity of the communication topic, and the breadth of the communication scope. In terms of future development patterns, new media will undoubtedly thrive with the significant developments in the Internet and digital technologies. The steady demise of the old media business and the trend toward media convergence will accompany the rise of new media.

Career perceptions

Among the core socialist values, dedication is one of the core elements at the individual level, which is the value evaluation of citizens' professional code of conduct and fully reflects socialist professionalism. The more accurate the cognition of occupation, the more accurately one can position one's role in society and form reasonable occupational values, instead of falling into self-denial, cynicism, blind arrogance, and other negative perceptions of occupational values. For instance, a student in the medical field, whose initials are represented by the code XYW, views quite brought immense of encouraging material in the short videos.

> On Tiktok, I saw first-hand medical professionals rescuing patients and tending to the wounded. They have my utmost respect. A video uploaded on Tiktok a few months ago in which Doctor Zhu helped an older gentleman quickly rise to prominence. I like this doctor's Tiktok posts, and I appreciate that she often shares motivational fitness videos. Arguments have been made that youngsters are being misled by short videos. Actually, in my opinion, it is conditional. (A

20-year-old student describes the beneficial aspects of viewing Tiktok on a smartphone. The interview was conducted at one university in Guangxi, China, in June 2022.)

After the rise of social cognitive psychological research with contents such as self, perception, attitude, cognition and emotion, several methods to measure these psychological elements appeared, and many scholars created some measuring scales that are still in use today. Self-report scale is the most commonly used method in psychometric measurement. In this method, the authors design a series of questions about mental states or mental activities, and subjects answer these questions one by one according to their psychological feelings or past behaviours.

Discussion

Students at modern universities are significant users of short video services (Luo et al., 2013; Guo et al., 2014; Olowo et al., 2020). They are enthusiastic about news information suggestions, the distribution of short videos, data visualization news, chatbots, and intelligent audio-visual applications (Andersson et al., 2018; Rajkumar and Ganapathy, 2020). Under the effect of the media circumstances generated by a short video, what is their value orientation as the cornerstones of the cause of socialism with Chinese characteristics in the present revolution? It has a significant impact on the future development of socialism with Chinese characteristics, which can be summarized as Chinese-style modernity (Zhu et al., 2021). Using it as the subject of study has commonplace and substantial practical applicability (Rouse, 2007).

Students at universities with greater media literacy education get more instruction in scientific perspectives on complicated information, as well as more education on media literacy (Hobbs and Jensen, 2009; Share et al., 2019). They would be more competent with critical media literacy in the areas of information screening, information analysis, information utilization, and other elements (Alvermann and Hagood, 2000). As a consequence, they are better able to cope with knowledge in a comprehensive manner (Coiro, 2021; Isnawati and Yusuf, 2021), which enables them to utilize information more successfully in the context of the interaction between themselves and information from the outside world. In the process of interacting with short videos, students depend on their experience in self-judgment, introspective thought, and observation of differences, among other areas. As a result, students have a better ability to comprehend how to get useful information from various media information platforms.

Positive correlation variables of self-perceived level values metric: career perception, impression prediction, freedom of choice, thinking cost

According to the present research, the interview demonstrates that university students learn more knowledge about their prospective future careers using the short video platform. Following the findings of Lagu and Greysen (2011), the findings of the present study indicate that social media users gain from the development of professional

ethics, professionalism, and responsibility. University students pay greater attention to their self-image and the expectations of others and incorporate more empathy into their information communication behaviour during short video interactions (Chretien and Kind, 2013). It is more conducive to establishing superior communication expectations. With the assistance of the information platforms and resources like TikTok, university students may overcome the current information barriers caused by algorithms at the level of self-awareness, which is favourable to the formation of positive values. As a consequence, university students are prepared to use more intellectual energy and mental energy in the process of acquiring short videos, which assists in their capacity to integrate their necessitous. Thus, youngsters are able to elaborate on videos depicting social public events with substantial societal impact, thus enhancing their self-perception values.

Negatively correlated variables of the values metric: utility satisfaction, information realism, entertainment satisfaction

It can be observed from utility satisfaction that as utility satisfaction, information realism, and entertainment satisfaction grow, university students' self-perceived values become more divergent, or the establishment of benign values becomes less favourable. On the one hand, university students' utility satisfaction reflects the use of short videos for knowledge acquisition (Margaris et al., 2019). On the other hand, it indicates that people may have a dependency on short videos, such as being content with the algorithm suggestion process (Campana and Delmastro, 2017; Zhang T. et al., 2020). This obsessive dependence confines adolescents in a media environment centred on their interests, and they may also be addicted to virtual social interaction. Under the cultural ecology of short videos, university students are more susceptible to being influenced by unidirectional information. Some short videos of curiosity, for instance, might easily hinder the healthy development of an individual's values. Information realism indicates, to some degree, an individual's confidence in short videos (Kaur and Dubey, 2014). Due to the fact that the algorithm of short video platforms does not include a system for automatic detection, false news, clickbait news, and post-truth news occasionally occur (Kumar and Shah, 2018; Li and Cho, 2022). Individuals' excessive reliance on the veracity of this news is likely to have a detrimental effect on their self-perceived social values.

Under the premise of human-computer interaction in short video communication, it is evident that self-perception values are strongly connected with career perception, impression prediction, freedom of choice, and thinking cost. Whereas utility satisfaction, information realism, and entertainment satisfaction are negatively correlated with values at the level of self-perception.

Conclusion

According to the semi-structured interview and content analysis, the dissemination of short video values is based on the level of self-perception, with the following components: career perception, impression prediction, freedom of choice, thinking cost, utility

satisfaction, information realism, and entertainment satisfaction. This paper analyses the values dissemination of short videos from the perspective of the self-perception of university students, which provides ideas for optimizing algorithms, enhancing the mode and behaviour of individual self-perception, and the beneficial guidance of external self-perception to individuals. This paper examines three aspects of self-perception, symbolic interaction, and social networks. Through experimental comparisons of the three types of perception, we find that self-perception influences people's perceptions of others and their self-perception. On this basis, we can find that when interacting with others, symbolic interaction can enhance individuals' perceptions of others as well as their self-perceptions.

Therefore, symbolic interaction is not only beneficial for social interaction, but also the psychological health and integrity of the individual. Symbolic interaction is a process in which multiple subjects participate in social life, in which each individual understands society through social practice, so that he or she can develop and improve oneself and make progress. Self-perception is one of the most important factors that help us to discover and define ourselves and to influence others. Symbolic interaction and social interaction are a process in which we both perceive ourselves and others and connect with them. In the process of symbolic interaction, we are constantly self-perceiving both ourselves and others; at the same time, we can perceive the symbolic meaning in others. From self-perception, we are able to enhance our self-worth and self-image. So, in this process, we are influenced by symbolic interaction and self-perception, which affects others and changes us. So, when symbolic interaction can change us, we need to actively perceive others and engage in self-expression and symbolic interaction. In turn, symbolic interactions can enhance an individual's self-perception and also change their own perceptions and emotions. We can improve our ability to express ourselves, communicate and judge right and wrong, as well as our self-awareness and social adaptability in our interactions with others; and we can be more active in our interactions with others.

Theoretical and managerial contributions

The contributions of this paper are manifestly significant from both theoretical and managerial standpoints. Firstly, it underscores the dual nature of symbolic engagement, demonstrating that it not only facilitates identification and connection with others but also actively promotes understanding and meaningful connections. Symbolic interaction enriches the process of deciphering symbolic meanings in interpersonal communication. Therefore, a profound understanding of how to actively discern and convey symbolic meanings is imperative. This theoretical insight enhances our comprehension of the dynamics of symbolic engagement.

Secondly, this paper extends the current discourse on social media governance concepts, emphasizing the importance of heightened awareness and cognitive abilities in effective symbolic communication. It highlights the role of symbolic engagement in bolstering self-perception, fostering interpersonal connections, and facilitating active participation in online interactions. From a managerial perspective, this insight underscores the need for a more nuanced approach to social media governance, considering the cognitive capacities required for effective symbolic communication.

Furthermore, from a managerial standpoint, it underscores the responsibility of social media regulatory bodies to promote self-awareness regarding symbolic engagement, enhance cognitive abilities, and facilitate self-discovery in the digital realm. This managerial implication underscores the role of regulatory bodies in shaping the online landscape to encourage responsible and meaningful symbolic interactions.

Lastly, this paper elucidates how optimizing self-perception among university students, including understanding the algorithmic mechanisms of short video dissemination, can contribute to the dissemination of values through such videos. From a managerial perspective, this insight highlights the potential for leveraging short videos to enhance university students' professional cognition. Overall, the study provides valuable theoretical insights and practical guidance for both scholars and social media managers.

Limitations and future studies

Our study is designed as an observational study, which means that it captures data at a specific point in time and explores associations between TikTok usage and self-perception among Chinese university students. While our research provides valuable insights into these associations, it is essential to acknowledge that establishing causality in observational studies can be complex. We recognize that further longitudinal and experimental research would be required to establish a causal relationship definitively, in which we have identified in the limitation section of our research ending section. Future studies could investigate changes in TikTok usage patterns and their impact on self-perception over an extended period. Additionally, experimental designs could be employed to manipulate TikTok exposure to assess its direct influence on self-perception. It is also recommended that additional research be conducted on the following concerns in the future. When university students are exposed to short videos, it is advised that they be guided to focus their efforts on forecasting their own and other's perceptions and to think thoroughly about the content information. Additionally, it is vital to investigate other genres, formats, and platforms in order to diminish university students' reliance on a particular algorithm application. The information authenticity screening feature was developed to help university students have a positive opinion of the legitimacy of knowledge. Future studies should also be placed on lowering the burden of entertainment information distribution.

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

Ethical approval was not required for the study involving human samples in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin. Written

informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

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The influencing mechanism of scenic spot online attention and tourists' purchase behavior: an AISAS model based investigation

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Introduction: In the era of the Internet, online digital traces have become a new way to study the online attention of scenic spots and tourists' purchase behavior. The public's information search on major search platforms is a series of manifestations of potential tourists' attention and interest in scenic spots, but there are few studies on how attention, interest and information search affect potential tourists to generate real purchase behavior.

Method: This paper selects four dimensions of short video platform, travel website, search engine and social media to comprehensively measure the online attention of high-quality scenic spots in Yunnan Province, and then establishes a gray association analytic hierarchy process based on the relevant variables of the AISAS model to empirically analyze the primary and secondary factors affecting tourists' purchase behavior.

Results: (1) From the perspective of the online attention of scenic spots on different platforms, the intensity of the public's scenic spots online attention on the four types of media platforms is in the order of travel websites, search engines, short videos and social media (2) From the perspective of spatial distribution characteristics, the online attention of high-quality scenic spots in Yunnan Province is unevenly distributed, that is, there is a big difference between the attention of higher star scenic spots and their star rating and popularity, while the attention of low-star scenic spots is not much different from their star rating and popularity (3) From the perspective of spatial agglomeration characteristics, the comprehensive online attention of high-quality scenic spots in Yunnan Province presents the spatial agglomeration characteristics of "the multi-core linkage of high-density in the east and north, and sub-high-density in the south" (4) The factors influencing the purchase behavior of potential tourists are sharing experience, attracting attention, generating interest and searching information.

Discussion: By exploring the formation mechanism of high-quality scenic spots online attention in Yunnan Province and the mechanism of its spatial differentiation, this study not only enriches the logical chain of "tourism information source → potential tourists → demand driven → tourism information search → travel preference → destination selection → purchase decision → travel experience → real tourists → feelings after traveling → focus on feedback → tourism information source," but also broadens the application scenarios and application boundaries of travel preference theory and AISAS behavior model to a certain extent.

1 Introduction

The advancement of information and communication technologies (ICTs), particularly the Internet, has significantly impacted on the tourism sector (Amaro and Duarte, 2013). According to the China Internet Network Information Center (CNNIC) as of June 2023, the number of Internet users in China have reached 1.079 billion, and the Internet penetration rate reached 76.4%. Among them, the number of online travel bookings has reached 454 million, accounting for 42.1% of all Internet users.[1] These increases reflect the accelerated development of the information age, which can provide new impetus for the transformation and upgrading of the tourism industry and tourism consumption.

With the most concentrated of tourism resources (Li et al., 2022), scenic spots play a crucial role in promoting the development of tourism (Chen and Wu, 2021). Gunn, a pioneer in tourist attraction research, categorizes it as (Gunn, 1993): tourist attraction, tourism support service area, and commercial service area. MacCannell (2013) argues that a tourist attraction consists of tourists, attractions, and signs. Some scholars also discuss it from the perspective of tourism supply and demand, think that scenic spots can serve as a symbol to inspire tourists to visit, and fulfill tourists' tourism needs through their unique characteristics (Weidenfeld et al., 2010). This paper defines scenic spot as a spatial complex with a distinct geographical scope that attracts tourists to participate in tourism through exceptional scenery or human resources. Scenic spots serve as the carriers of tourists' activities, while network media act as the "reproduction" of the actual spaces of these attractions and the "re-dissemination" of relevant information about them.

With the penetration and integration of the Internet into the tourism industry, travel websites, search engines, social media and short video platforms have gradually become the main channels for people to publish, transmit and obtain information (Vuylsteke et al., 2010; Önder et al., 2020) Potential tourists use the Internet to search for ticket prices, weather, accommodation, travel tips, and after traveling, they leave digital traces by posting travel notes and comments on travel websites, social media, short video platforms, and other platforms that is, tourism online attention (TOA). The online attention of scenic spots is mainly based on online platforms, and through specific digital traces such as views, likes, and posts, it reflects the public's attention to scenic spots and the status of tourism demand (Pan and Fesenmaier, 2006; Bi et al., 2020), which is an important source of information for analyzing tourists' purchase behavior (Srikanth et al., 2004). According to a study conducted by Podium, nearly 60% of consumers browse online product reviews at least weekly, and 93% think online reviews influence their shopping

choices.[2] People's attention is limited, particularly in the information age where Internet attention is scarce. Studies have shown a link between online attention and stock buying (Barber and Odean, 2008). Moreover, the public's focus on various online platforms can influence their purchase behavior (Dasgupta and Mondria, 2018). Yet, there has been limited focus on how the online attention of scenic spots affects the purchasing behavior of tourists under different online platforms.

Given this, this paper selects four dimensions: short video platform, travel website, search engine and social media to comprehensively measure the online attention of high-quality scenic spots in Yunnan Province, and establishes a gray association analytic hierarchy process model based on the relevant variables of the AISAS model to empirically analyze the primary and secondary factors affecting tourists' purchase behavior. The purpose of this paper is to study the following questions: (1) the formation mechanism of online attention of scenic spots (2) the spatial distribution pattern of online attention of high-quality scenic spots in Yunnan Province, and (3) the factors influencing tourists' purchase behavior.

Overall, this paper makes the following contributions: First, it introduces the theory of travel preference and tourism information search behavior theory to explore the formation logic behind the online attention of scenic spots, enriching the "tourism information source → demand driven → purchase decision → travel experience → focus on feedback" process. The second contribution is the establishment of a quantitative model for measuring Attention-Interest-Search-Action-Share based on the AISAS behavior model. This model investigates the primary and secondary factors of the online attention of high-quality scenic spots in Yunnan Province affecting tourists' purchase behavior by the four types of platforms, and further explores the scope of application and economic significance of the model. This is of great significance for promoting the transformation, upgrading, and high-quality development of tourism in Yunnan Province in the digital era.

1.1 Online attention and tourism online attention

Attention refers to the degree of social groups' attention to an event or people; it can reflect the internal relationship between an event and social group behavior (Girvan and Newman, 2002). Whether capturing information through search engines (Zhao et al., 2020), websites (Yang et al., 2014), social media (Park et al., 2016), or short video platforms (Du et al., 2022), users will leave corresponding digital traces (Wu et al., 2024). These digital traces can reflect behavioral preferences (Cerina and Duch, 2020) and public concerns (Cho and Hong, 2009). Since then, scholars in various fields have

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taken the large amount of intersected Internet search data as the data source for the research of online attention by virtue of the open, shared and interactive characteristics of the Internet (Lazer et al., 2009). Based on the stronger timeliness of network data, some scholars were the first to apply network search data to epidemiological surveillance to predict regional epidemic outbreak rates (Ginsberg et al., 2009); Subsequently, some scholars have used Internet search data to predict or analyze unemployment rates, room demand (Carneiro and Mylonakis, 2009), stock investment (Kristoufek, 2013), suicide rate (Solano et al., 2016), and commodity attributes (Yakubu and Kwong, 2021).

The online attention can reflect the popularity in the process of information dissemination in time manner, while the tourism online attention is an indirect manifestation of the travel preferences of potential tourists and the actual tourist flow of scenic spots (Guanghai and Hongying, 2022). In recent years, some scholars have used search engine data as the data source to study tourism online attention (Bangwayo-Skeete and Skeete, 2015), which verified a positive correlation between tourism online attention and actual tourist flow (Huang et al., 2017); Scenic spot managers can enhance their value-added services by utilizing the public's access data on travel websites, thus encouraging tourists to make repeat purchases (Lexhagen, 2004). Similarly, a good online travel experience can directly or indirectly change potential tourists' attitudes, behaviors and actual intentions toward a destination (Skadberg et al., 2005). Some scholars have also found that more and more post-travel tourists like to share their travel experiences and feelings on different online platforms during or after their trips, so as to provide reference for others' travel decisions (Pop et al., 2022). Potential tourists, on the other hand, are more inclined to obtain relevant travel information released by post-trip tourists through online channels such as search engines, social media, official websites, and short video platforms before traveling, so as to make corresponding travel plans (Pan and Fesenmaier, 2006). However, in the field of tourism, studying the online attention of scenic spots is limited to integrate various of network platforms' data. This paper introduces the travel preference theory (TP) and tourism information search behavior (TIS) model to analyze the distribution characteristics and differences of online attention of scenic spots from a network perspective, aiming to understand tourists' attention preferences promptly.

1.2 Travel preference and tourism information search

Preference first belongs to the category of economics, and it essence is the expression of attitudes or tendencies expressed by the public (Cacioppo et al., 1994). In tourism psychology, attitude is fundamental for generating preferences. Tourists develop attitudes through the "cognition-evaluation" process of specific objects, leading to the formation of travel preferences (TP). Travel preference refers to a psychological tendency presented by potential or actual tourists with regard to a certain tourism destination (Ankomah et al., 1996). Some scholars have pointed out that the first condition for tourists to choose a destination is to generate demand motivation (Um and Crompton, 1991), and tourists' preferences play a decisive role in the choice of destinations to a greater extent (Goodall, 1991), which is an important factor influencing the travel behavior of potential tourists (Clawson

and Knetsch, 2013). As a powerful platform for the sale of tourism products and services (Abou-Shouk et al., 2013), tourists can meet their travel needs by searching for relevant tourism information on the Internet (Buhalis, 1998). Information search (IS) is defined as the decision-making process in which consumers actively obtain and integrate information from various channels before making buying decisions (Schmidt and Spreng, 1996), while tourism information search (TIS) is the process of collecting and collating information about tourist destinations on major platforms before potential tourists make travel decisions (Chiang et al., 2005). Potential tourists can not only reduce travel uncertainty (Gursoy and McCleary, 2004) but also use it as a reference for destination selection and trip planning (Jenkins, 1978), thereby enhancing the travel quality. Although online platforms aggregating the information of travel-related products and services positively have a positive impact on tourists' purchasing behavior by influencing their travel preferences, the huge amount of travel information makes it difficult for potential tourists to accurately search for the information they need (Buhalis and Law, 2008). This study analyzes the public's search behavior on four online platforms: short video platforms, travel websites, search engines, and social media, and explores the variations in attention to scenic spots across different platforms. Furthermore, the paper introduces the AISAS behavior model to examine the impact of attention, interest, information search, and sharing experiences share on tourists' purchasing behavior.

1.3 AISAS behavioral model

The predecessor of the AISAS model is the AIDMA model. The AIDMA model was proposed by the famous American advertising scientist E.S. Lewis in 1898 and systematically organized by Hall in the 1920s (Hall, 1926). The AIDMA model focuses on consumer purchasing behavior under the traditional marketing model, while the AISAS model focuses on describing consumer purchasing behavior in the Internet era. In the era of information explosion, consumers can not only search for product-related information before purchasing but also share information after using, influencing the purchasing behavior of potential consumers (Xue et al., 2021). AISAS comprises five phases: Attention, Interest, Search, Action, and Sharing. The AISAS behavior model emphasizes the significance of search and sharing processes, as they can boost purchase frequency. With the increasing integration of the Internet and the tourism sector, travelers now rely on blogs, social media, travel websites, and other platforms to seek information and buy tourism products and services. Some scholars have highlighted the importance of information search prior to travel purchases by studying online shopping behavior (Lee et al., 2007), and some have noted positive correlations between attention and interest, interest and search, and search and behavior (Hendriyani et al., 2013). Despite the gradual application of the AISAS behavior model in tourism and hotel studies (Xue et al., 2021), there remains a gap in research on the online attention of scenic spots and tourists' purchase behavior. Therefore, this study introduced relevant variables of the AISAS model and utilized the gray correlation analytic hierarchy process to investigate the impact of differences in online attention across the four platforms on tourists' purchasing behavior from the perspective of online attention. The findings of this research offer valuable insights for both theoretical and practical purposes.

TABLE 1 Evaluation index system of online attention.

System of index	Objects	Index	Units	Attribute	Weights
Online attention (A)	Short video platform play volume (B_1)	TikTok (C_1)	Times	+	0.0666
		Kuaishou (C_2)	Times	+	0.0577
	Travel website reviews (B_2)	Ctrip (C_3)	Times	+	0.0673
		Dianping (C_4)	Times	+	0.0605
		Qunar (C_5)	Times	+	0.0719
		Fliggy (C_6)	Times	+	0.0755
		Mafengwo (C_7)	Times	+	0.1577
	Search engine search volume (B_3)	Baidu (C_8)	Times	+	0.0508
		Bing (C_9)	Times	+	0.0079
		360 (C_{10})	Times	+	0.1669
		Sogou (C_{11})	Times	+	0.0710
	Social media reading (B_4)	WeChat (C_{12})	Times	+	0.0210
		Weibo (C_{13})	Times	+	0.1250

Practically, the results pinpoint primary and secondary factors that capture attention, spark interest, facilitate information search, and encourage experiences share, influencing tourists' purchasing behavior. This enables scenic spot managers to tailor marketing strategies for each platform, thereby enhancing exposure and attracting potential tourists.

Next, section 2 presents the research design, while section 3 discusses the empirical results. Section 4 concludes, noting the study's limitations and the directions for future research.

2 Materials and methods

2.1 Construction of evaluation indicators

2.1.1 Online attention index construction

Referring to the literature on online attention (Yang et al., 2015; Park et al., 2016; Chang et al., 2020), this study divides its evaluation model into three index layers from top to bottom as follows: (1) Layer A is the comprehensive evaluation system (2) Online attention to A-level scenic spots in Yunnan Province is divided into four target layers, B_1–B_4 (3) Based on the criterion layer, the four indicators are further subdivided into three-level index layer, C_1–C_{13} (Table 1).

2.1.2 Selection of impact indicators

Scenic spots play a crucial role in the development of tourism (Pigram, 1983), with those rated 3A and above level serving as the representatives of the attractions' brand image (Huang et al., 2010). This study adopts China's "Delineation and Evaluation of Quality Grades of scenic spots" to define high-quality scenic spots as those 3A and above level. Through a review of the literature, it is evident that the number of likes on social media posts reflects people's conscious attention (Oliveira et al., 2022), the average likes on short videos indicate the popularity of the content (Zhang and Fan, 2023), search engine queries represent users' information-seeking behavior to fulfill specific needs (Wilson, 2000), and online reviews can influence consumer purchasing decisions (Wei and Lu, 2013). As a result, this study focuses on 471 high-quality scenic spots in Yunnan Province,

analyzing the online search data from major platforms between January 1, 2017, and December 31, 2022. Using the AISAS behavior model, the study sets purchase behavior data as the reference sequence, while attention, interest, information search, and sharing experience data are set as the comparison sequence to explore their impact on the reference sequence. Specifically, purchase behavior is characterized by tourist numbers, attention by social media reading, interest generation by TikTok likes, information search by search engine search volume, and sharing experience by travel website reviews (Table 2).

2.2 Data collection

2.2.1 Scenic spots directory data

A list of A-level scenic spots in Yunnan Province, released on February 15th, 2023, was downloaded from the website of the Department of Culture and Tourism of Yunnan Province. The statistics for high-quality scenic spots in 16 regions in the province were obtained. Then, the coordinate picking tool in Baidu Maps[3] was used to obtain the latitude and longitude coordinates of each scenic spot. Finally, ArcGIS was used to display the location of each scenic spot in space.

2.2.2 Online attention data

Online attention data is mainly collected from four types of platforms: short video platforms, travel websites, search engines and social media, and the specific collection steps are as follows:

1. Search engine search volume. Step 1: Enter the names of scenic spots on Baidu, Bing, 360, and Sogou. Step 2: Set the time range, and set the retrieval date to January 1st, 2017, to December 31th, 2022. Step 3: Record the retrieval quantity for each scenic spot from the four search engines

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3　https://api.map.baidu.com/lbsapi/getpoint/

TABLE 2 Construction of impact indicators of tourists' purchase behavior under AISAS model.

Data series	Target layer	System layer	Indicator layer
Reference sequence	Action	The scale of the tour	Number of domestic tourists
Compare sequences	Attention	Social media reading	The number of WeChat article reads
			The number of Weibo topic reads
	Interest	Short video platform play volume	TikTok likes
	Search	Search engine search volume	Baidu search volume
			Bing search volume
			360 search volume
			Sogou search volume
	Share	Travel website reviews	Ctrip of reviews
			Dianping of reviews
			Qunar of reviews
			Fliggy of reviews
			Mafengwo of reviews

FIGURE 1
Online attention index of 16 regions and star-rated scenic spots.
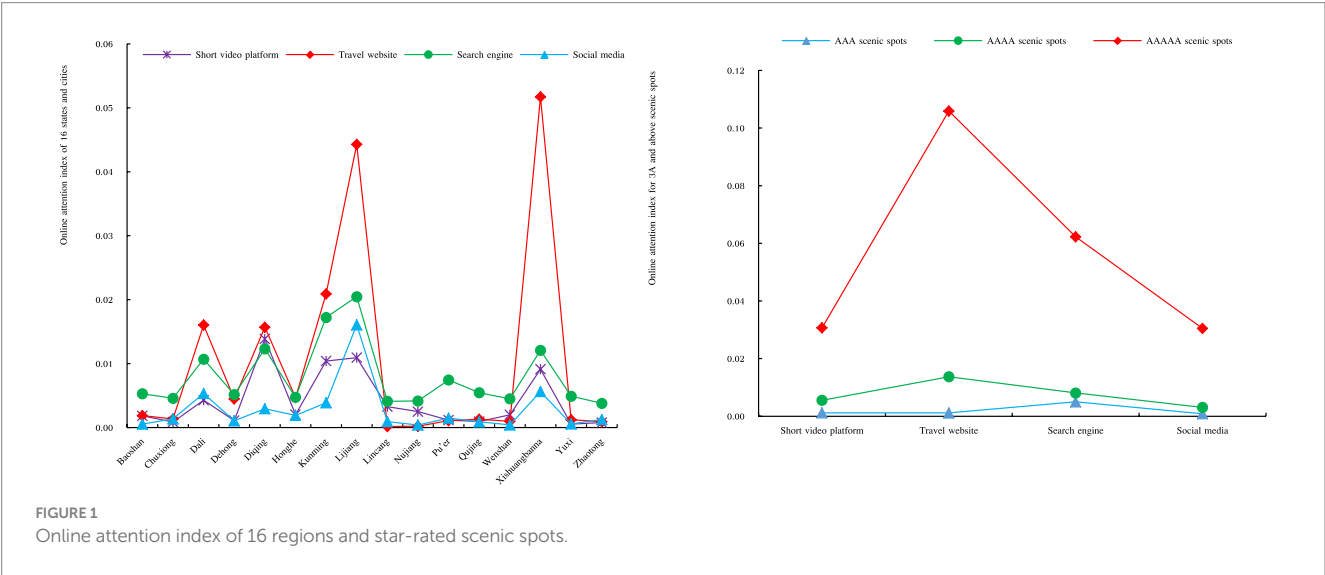
2. Travel website reviews. Step 1: Enter the names of the 471 scenic spots into five travel websites with high domestic influence: Ctrip, Dianping, Fliggy, Qunar, and Mafengwo. Step 2: Retrieve the number of comments from January 1st, 2017, to March 31th, 2023. Step 3: Use python to crawl the total number of comments of each scenic spot. Step 4: Manually eliminate duplicate reviews or invalid reviews. Step 5: Record comments on these scenic spots on the five travel websites

3. Social media reading. Regarding WeChat articles, the first step is to search the official WeChat account for each scenic spot. The next step involves retrieving tweets with the WeChat tweet time set between January 1st, 2017, and March 31th, 2023. Step 3: Given the high volume of tweets per year, this study chooses the top three tweets from the yearly promotional posts, calculates the total number of tweets read each year, and documents them. Regarding the on-site Weibo volume of the tourist attraction, the first step is to input the name of the tourist spot in the Weibo search box; The subsequent step is to select the search category as "Location"; The final step is to visit the homepage of the searched tourist spot to observe the

on-site Weibo posts dated between January 1st, 2017, and March 31th, 2023, and make a record

4. Short video platform play volume. Step 1: Enter the names of the scenic spots in the search boxes of TikTok and Kuaishou Apps. Step 2: Sequence the number of video plays. Step 3: Specify the time frame from January 1st, 2017, to March 31th, 2023, and utilize web crawling technology to gather data. Step 4: Manually screen out the top five short videos whose video content is most suitable for the scenic spot and record the corresponding data.

2.2.3 Impact indicator data

As shown earlier, the number of tourists in this research is utilized to depict the tourism purchasing behavior of the reference sequence. Due to the unavailability of tourist data in high-quality scenic spots in Yunnan Province and the difficulty in obtaining it, the number of tourists in 16 regions in Yunnan Province was used for this study. The data on the purchasing behavior of the reference series is sourced from the "Yunnan Provincial Statistical Yearbook" spanning from 2017 to 2022 and the statistical bulletin of the national economic and social development of each region.

It is important to highlight that to ensure the reliability and accuracy of the research findings and maintain data consistency between the reference and comparison sequence, the study involved counting the number of high-quality scenic spots in the 16 regions of Yunnan Province. Subsequently, the comparative data on high-quality scenic spots in each prefecture and city from January 1st, 2017, to December 31th, 2022, were calculated, followed by the computation of the comparative data for all 16 regions in Yunnan Province.

2.3 Data processing

Since the selected network attention data comes from multiple platforms, there will be dimensional differences between the data, so the article needs to standardize the original data first. The processing steps are as follows:

First, to eliminate the influence of different index dimensions, it is necessary to use the range method (Zhang et al., 2011) to standardize the original data; namely,

$$X_{ij}' = (x_{ij} - x_{\min}) / (x_{\max} - x_{\min}) + 0.0001, \quad (1)$$

$$X_{ij}' = (x_{\max} - x_{ij}) / (x_{\max} - x_{\min}) + 0.0001, \quad (2)$$

Where X_{ij}' is the original value of the j index of the i scenic spots. $x_{\max}$ and $x_{\min}$ are, respectively, the maximum and minimum values of the evaluation object under the same evaluation index. X_{ij}' represents the dimensionless values of different indicators; the value range is [0,1].

Second, based on the standardization of the data, the entropy method is used to determine the weight of each index according to the variation degree of each index (Wang et al., 2019). This method can avoid the influence of subjective factors on the weight of each . index and can better explain the results. The steps are as follows:

Index proportion adjustment:

$$P_{ij} = \frac{X_{ij}'}{\sum\limits_{i=1}^{m} X_{ij}}. \quad (3)$$

Index entropy value:

$$E_j = -\frac{1}{\ln m} \sum_{i=1}^{m} P_{ij} \times \ln P_{ij}. \quad (4)$$

Indicator information utility value:

$$D_j = 1 - E_j. \quad (5)$$

Index weight:

$$W_j = \frac{D_j}{\sum\limits_{j=1}^{n} D_j}. \quad (6)$$

Then, the comprehensive online attention index of scenic spots is calculated

$$T_{(i)} = \sum_{j=1}^{13} W_j \times X_{ij}', \quad (7)$$

Where $T_{(i)}$ represents the comprehensive score for online attention to i scenic spots. W_j represents the weight value of the j index. X_{ij}' represents the normalized value of the i scenic spots and the j index. j indicates the number of indicators, and $1 < j < 13$. i indicates the number of scenic spots, and $1 \le i \le 471$.

2.4 Research method

2.4.1 Nearest-neighbor index

The nearest-neighbor index can intuitively reflect the distribution types of point elements in geographical space (Mansour, 2016). The sample group comprises 471 high-quality scenic spots, and these scenic spots are distributed in a point form in geographical space. Thus, this study uses the nearest-neighbor index R to judge the spatial distribution types. If $R < 1$, the distribution reflects aggregation; the closer it is to 0, the higher the aggregation degree. $R = 1$ indicates random distribution. $R > 1$ means uniform distribution (Zhong et al., 2021):

$$R = \frac{\bar{r}}{r_E}, \quad (8)$$

$$r_E = \frac{1}{2\sqrt{n/s}}, \quad (9)$$

Where R represents the nearest-neighbor index, r_E represents the theoretical nearest-neighbor distance, $\bar{r}$ represents the average nearest-neighbor distance, n indicates the number of scenic spots, and s is the total area of the study area.

2.4.2 Kernel density estimation

Kernel density estimation judges the areal agglomeration or dispersion of point elements by counting the number of point elements in a certain neighborhood and showing the spatial distribution law of point elements in a visual form (Cong et al., 2014). This study uses the kernel density tool in ArcGIS to calculate the point vector data of online attention to scenic spots. The formula is:

$$f_h(x) = \frac{1}{nh} \sum_{i=1}^{n} k\left(\frac{x_i - x}{h}\right), \quad (10)$$

Where $f_h(x)$ is the density function, $k(\cdot)$ is a kernel function, n represents the number of points in the neighborhood, h is the search radius, and $x_i - x$ indicates the x distance from the x_i scenic spots.

2.4.3 Gray relational analysis

Gray correlation analysis is a method to reflect the strength, size, and order of each factor by determining the size of the gray correlation

value of the reference data column and several comparison data columns (Peng et al., 2023). Based on the AISAS behavior model, this paper sets the data of purchase behavior as the reference sequence Y_0, and sets the data series of Attention X_1, Interest X_2, Search X_3 and Sharing X_4 experience as the comparison sequence. Therefore, the gray correlation model is used to analyze the correlation between the comparison sequence and the reference sequence, and the larger the gray correlation degree, the higher the correlation level between the comparison sequence and the reference sequence, that is, the more significant the influence of the comparison sequence on the reference sequence. The calculation steps are as follows (Zhang et al., 2023):

Determine the reference sequence Y_0 and comparison sequence X_i for the analysis:

$$
\begin{aligned}
Y_0 &= \left\{ Y_0(t), (t=1,2,3,\dots 471) \right\}, \\
X_i &= \left\{ X_i(t), (i=1,2,3,4)(t=1,2,3,\dots 471) \right\}.
\end{aligned}
\tag{11}
$$

Quantification of sequence matrices without program:

$$
Y_0^{'} = Y_0(t)/Y_0(1), \quad X_i^{'} = X_i(t)/X_i(1).
\tag{12}
$$

Calculate the difference between the dimensionless reference sequence and the comparison sequence:

$$
\Delta_{0i}(t) = \left| Y_0^{'}(t) - X_i^{'}(t) \right|.
\tag{13}
$$

Determine the maximum and minimum values of the difference between the reference series and the comparison series:

$$
\Delta_{\max} = maxmax\left(\Delta_{0i}(t)\right), \Delta_{\min} = minmin\left(\Delta_{0i}(t)\right).
\tag{14}
$$

Calculate the gray correlation coefficient:

$$
\varepsilon_{0i}(t) = \frac{\Delta_{\min} + \rho\Delta_{\max}}{\Delta_{0i}(t) + \rho\Delta_{\max}}.
\tag{15}
$$

Where ρ is the resolution coefficient, and the value range is 0.5; To calculate gray correlation:

$$
\gamma_{0i} = \frac{1}{m}\sum_{t=1}^{m}\varepsilon_{0i}(t).
\tag{16}
$$

3 Result analysis

3.1 Scenic spots online attention evaluation

The obtained data are calculated by combining the entropy method with the comprehensive evaluation method, and the online attention index of 471 high-quality scenic spots in Yunnan Province is obtained. Using the natural fracture method in ArcGIS, the comprehensive online attention index and the online attention index of four subsystems (i.e., short video platforms, travel websites, search engines, social media) are graded.

3.1.1 Online attention of scenic spots in 16 regions

It can be seen from Figure 1: Judging from the online attention of scenic spots in various regions, the public's online attention intensity on the four types of platforms is travel websites, search engines, short videos and social media, which shows that the public is more inclined to use major travel websites to check travel destination information or share post-travel experiences, while short videos and social media play a relatively small role in attracting attention to scenic spots; despite the rapid rise of new media such as TikTok, Weibo, and Kuaishou in recent years, the vast majority of people in Yunnan Province scenic spots have not yet made full use of the powerful marketing attributes of this type of new media, and this type of new media platform has not yet truly played an intermediary role in the development of scenic spots. In addition, these four types of platforms all formed four peaks of online attention in Lijiang, Diqing, Dali, and Xishuangbanna, indicating that these regions have higher levels of attention to scenic spots. Judging from the attention of star-rated scenic spots, the public pays the highest level of attention to 5A-level scenic spots, followed by 4A and 3A-level scenic spots. This shows that the higher the star rating of a scenic spots, the higher the quality of the tourism resources in the area, and its potential for the attraction of tourists will also become stronger, which will have a positive effect on increasing the public's online attention to high-star scenic spots.

3.1.2 Online attention of each scenic spots

Regarding the distribution of the physical and virtual spaces of scenic spots (Figure 2), there are nine 5A-level scenic spots in physical space in Yunnan Province, which are distributed in seven regions: Baoshan, Dali, Diqing, Kunming, Lijiang, Wenshan, and Xishuangbanna. In terms of virtual space, there are five 5A-level (55.56%) and six 4A-level (3.8%) scenic spots with high and relatively high attention levels. They are concentrated in Kunming, Dali, Lijiang, and Xishuangbanna. In addition, there are three 5A-level (33.33%) scenic spots, 21 4A-level (13.29%) scenic spots, and six 3A-level (1.97%) scenic spots in the study area. They have moderate attention levels and are scattered in northwest and southwest Yunnan. Regarding comprehensive online attention (Figure 2B), nine 5A-level scenic spots in Yunnan Province all have high attention to the virtual space, showing that their high level and high attention are consistent. There are 158 4A-level scenic spots in Yunnan Province, of which only 17.09% have moderate and above attention levels. More than half have low attention levels, and nearly a quarter have relatively low attention levels. This shows that the attention level of 4A-level scenic spots in Yunnan Province does not match their own influence and level. However, 98.03% of the 304 3A-level scenic spots have low and relatively low levels of attention, and only 1.97% have a moderate level of attention. This indicates that overall online attention to 3A-level scenic spots in Yunnan Province is not much different from their own levels. Regarding the four subsystems, the spatial distribution pattern of online attention of 3A level and above scenic spots in the subsystems of travel websites (Figure 2D) and search engines (Figure 2E) are similar to that of comprehensive online attention (Figure 2B). In addition, there is little difference in the number of scenic spots with
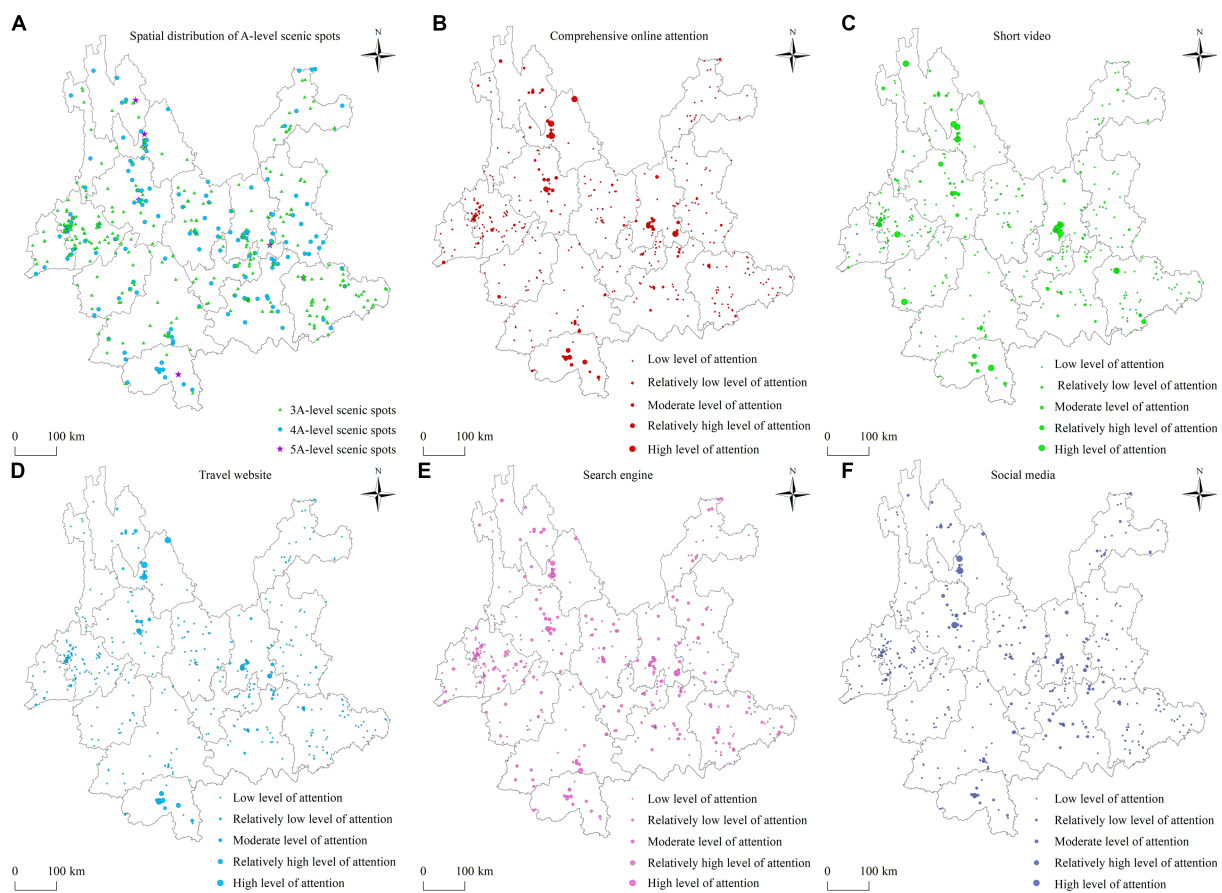
low and relatively low attention levels in the four subsystems. More than 86% of the 4A-level scenic spots have low and relatively low attention levels, and less than 9% have high and relatively high attention levels.

Overall, it can be seen that the public's attention to the network of scenic spots on the four platforms of travel websites, search engines, short videos and social media is different, and the online attention to high-quality scenic spots in Yunnan Province is unevenly distributed. That is, attention to scenic spots with higher star ratings are quite different from their star ratings and popularity, while attention to scenic spots with lower star ratings are not very different from their star ratings and popularity. We can see that the level of online attention to scenic spots in Yunnan Province is related to their star-rating levels and self-influence to certain extent.

3.2 Spatial characteristics of online attention to scenic spots

3.2.1 Spatial distribution types

Based on the natural fracture method, online attention to each scenic spots is divided into five grades. Then, the spatial distribution types of scenic spots with different attention levels are

calculated using the average nearest-neighbor tool in ArcGIS10.8 (Table 3). Regarding comprehensive online attention level, although the nearest-neighbor index R of scenic spots with relatively low attention levels is less than 1, but the p value fails to pass the test, showing that scenic spots with relatively low attention levels are randomly distributed. The nearest-neighbor index R of scenic spots with high/relatively high, moderate, and low attention levels are less than 1. The p test shows that scenic spots with high/relatively high, moderate, and low attention levels are in a state of spatial agglomeration. The spatial agglomeration level shows a trend of increasing with increased levels of attention. In summary, the number of scenic spots decreases with increased attention levels. Regarding the four subsystems, in the short video subsystem, scenic spots with high/relatively high, moderate, and relatively low attention levels are randomly distributed in space; only the scenic spots with low attention levels are clustered in space. In the travel website subsystem, the nearest-neighbor index R of scenic spots with high/relatively high, moderate, relatively low, and low attention levels is less than 1. The p test shows that the spatial structure type of scenic spots with different attention levels has always been clustered. The spatial clustering type of the search engine subsystem is the same as that of the social media subsystem. Scenic spots with high/relatively high and moderate attention

TABLE 3 Nearest-neighbor index of online attention to high-quality scenic spots in Yunnan Province.

Type	Attention level	Scenic spots number	r_E (km)	$\bar{r}$ (km)	R	Z	P	Distribution type
Online attention	High/relatively high	11	94.628	36.025	0.380701	−3.929412	0.000085	Aggregated
	Moderate	30	57.300	41.417	0.722808	−2.904501	0.003678	Aggregated
	Relatively low	52	43.523	39.103	0.898447	−1.400956	0.161227	Random
	Low	378	16.143	12.977	0.803875	−7.294721	0.000000	Aggregated
Short video platform	High/relatively high	19	72.001	66.772	0.927368	−0.605673	0.544732	Random
	Moderate	14	83.879	95.645	1.140268	1.004044	0.315357	Random
	Relatively low	41	49.015	46.892	0.956688	−0.530559	0.595724	Random
	Low	397	15.752	12.119	0.769413	−8.789443	0.000000	Aggregated
Travel website	High/relatively high	10	99.247	53.559	0.539656	−2.784925	0.005354	Aggregated
	Moderate	18	73.974	33.430	0.451907	−4.448580	0.000009	Aggregated
	Relatively low	41	49.015	34.568	0.705250	−3.610583	0.000306	Aggregated
	Low	402	15.653	12.522	0.799970	−7.672538	0.000000	Aggregated
Search engine	High/relatively high	5	14.036	18.803	1.339649	1.452936	0.146241	Random
	Moderate	17	76.119	69.334	0.910864	−0.703086	0.482002	Random
	Relatively low	162	24.658	19.356	0.784975	−5.235741	0.000000	Aggregated
	Low	287	18.526	15.638	0.844113	−5.052228	0.000000	Aggregated
Social media	High/relatively high	4	15.692	16.592	1.057361	0.219472	0.826283	Random
	Moderate	13	87.045	83.866	0.963478	−0.251916	0.801106	Random
	Relatively low	71	37.247	26.909	0.722452	−4.474023	0.000008	Aggregated
	Low	383	16.037	13.073	0.815212	−6.918384	0.000000	Aggregated

levels are randomly distributed in space, and those with relatively low and low attention levels are clustered. In addition, the spatial agglomeration of scenic spots where the social media subsystem is at low and relatively low attention levels is stronger than that of the search engine subsystem

In summary, because the number of star-rated scenic spots decreases with increased attention levels, the spatial density of 3A-level scenic spots is much higher than that of 4A and 5A-level scenic spots. This reflects the fact that scenic spots with low attention levels have always been clustered in space, whereas those with high/relatively high and moderate attention levels are mostly randomly distributed.

3.2.2 Spatial agglomeration characteristics

To further explore the spatial concentration of online attention to high-quality scenic spots in Yunnan Province, this study explores the concentration of online attention to each scenic spots using kernel density analysis in ArcGIS. Regarding comprehensive online attention (Figure 3), the high-quality scenic spots in Yunnan Province have the spatial agglomeration characteristic of multicore linkage with high density in the east and north and sub-high density in the south. In the east, Kunming is the high-density core area, spreading to Chuxiong, Qujing, Yuxi, and other neighboring regions. Among them, only Kunming has two high-level scenic spots—namely, Kunming World

Expo Park and Kunming Shilin. Kunming's popularity, transportation advantages, and location advantages help achieve linkages with the surrounding scenic spots, which is also the main reason why Kunming is a high-density core area. The online attention level in the north is characterized by spatial agglomeration, with Lijiang as the high-density core area; it decreases in the direction of neighboring regions such as Dali, Diqing, and Nujiang. The high-density gathering area of this area is much larger than that of the high-density core area in Kunming, mainly because more than 50% of the high-star-rating scenic spots are gathered in this area, including Tengchong Volcanic Rehai, Diqing Shangri-La Pudacuo, Dali Chongsheng Temple Three Pagodas, Old Town of Lijiang, and Yulong Snow Mountain. It is because of these five 5A-level scenic spots that the northern region has received a lot of attention. In the southern region, the only high-level scenic spots are Xishuangbanna Tropical Botanical Garden and China Academy of Sciences. Coupled with a lack of motivation for tourism development in Pu'er, this region has become a sub-high-density area. Regarding the four subsystems, the spatial agglomerations of scenic spots are similar in the short video platform and search engine subsystems; they all show spatial agglomeration characteristics of "one high, one relatively high, and one relatively low." However, the spatial agglomeration of each scenic spots in the travel website subsystem is similar to that of comprehensive online attention, characterized by
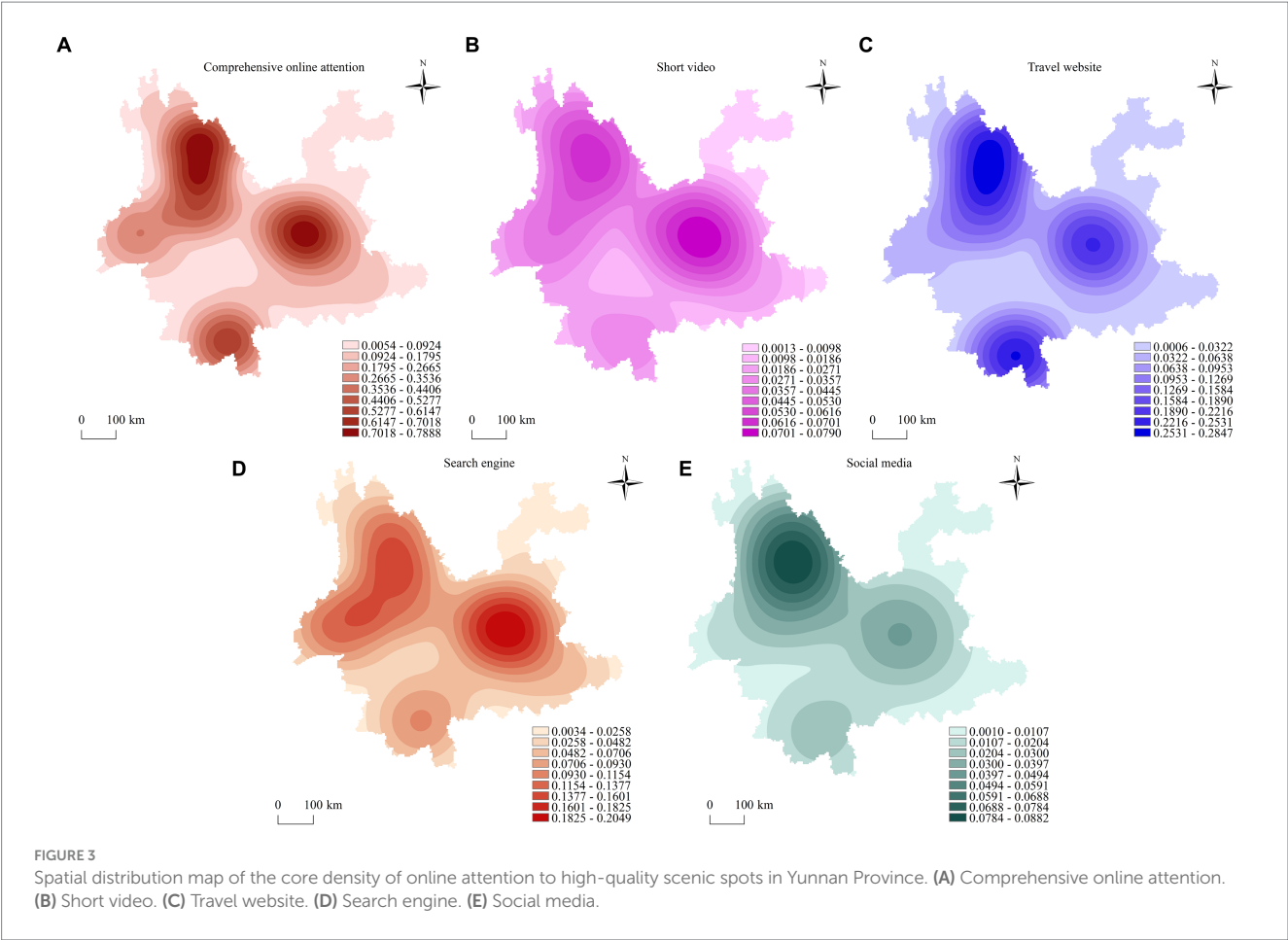
FIGURE 3
Spatial distribution map of the core density of online attention to high-quality scenic spots in Yunnan Province. **(A)** Comprehensive online attention. **(B)** Short video. **(C)** Travel website. **(D)** Search engine. **(E)** Social media.

TABLE 4 The correlation degree of each factor and the size of the correlation degree are sorted.

The name of the factor	Attention	Interest	Search	Share
$\gamma 0i$	0.987	0.976	0.61	0.999
Sort	2	3	4	1

"two high and one relatively high." In the social media subsystem, the scenic spots show spatial agglomeration characteristics of "one high, one low, and one relatively low."

Generally speaking, although the concentration centers of attention are different in different subsystems, whether it is a high-density core area or low-density core area, online attention to high-quality scenic spots in Yunnan Province has formed three high-value concentration centers of nuclear density in Kunming, Lijiang, Dali and Xishuangbanna, showing a spatial distribution pattern of "three multi-circle agglomeration areas and three core linkages." Moreover, in Zhaotong, Lincang, and Wenshan, there are weak areas of nuclear density. This shows that the core density of online attention to scenic spots varies greatly in different regions.

3.3 Analysis of tourists' purchase behavior on the AISAS model

From Table 4, it can be seen that the gray correlation degree of the four indicators is in the order of sharing experience (0.999), attracting

attention (0.987), generating interest (0.976) and searching information (0.61), and the gray correlation degree of these four indicators are above 0.5, indicating that these four independent variables have a great impact on tourists' purchase behavior.

First, share experience. In the context of the era of the Internet, more and more post-tour tourists tend to publish travel notes or reviews on major travel websites and APPs to convey their travel feelings or satisfaction. The travelogues or reviews published by real tourists are not only an important part of the tourism information source, but also greatly affect the tourists' purchase behavior of potential tourists. For example, under positive reviews, potential tourists will yearn for the tourist destination and thus generate travel purchase motivation, while under negative reviews, potential tourists' travel motivation will gradually weaken with the increase of negative reviews. Therefore, "sharing experience" has the greatest impact on tourists' purchasing behavior.

Second, attract attention. In the digital economy era where traffic is crucial, numerous niche and less popular tourist destinations have effectively captured people's interest through the Internet. Capturing attention serves as the foundation for potential tourists to develop

interest, making it essential for marketing efforts at scenic spots to first capture the attention of potential tourists. Hence, in comparison to interest, attention holds a greater influence on purchasing behavior.

Third, generate interest. With the development of the economy and the upgrading of consumption, the trend of the tourism market has gradually changed to interest-oriented personalized consumption, and potential tourists are increasingly interested in scenic spots with distinctive characteristics. Scenic spots with distinctive characteristics can stimulate the interest of potential tourists and actively generate purchasing behavior.

Fourth, search information. Potential tourists actively seek detailed information about their destination of interest. However, factors such as the timeliness and relevance of online information can influence the purchasing behavior of potential tourists. Only when the management of the scenic spot effectively promotes the tourist destination to capture the attention of potential tourists and make them interested will potential tourists discover it through their search. Therefore, the influence of "search information" on purchasing behavior is not as strong as that of "interest" and "attention."

4 Conclusions and discussions

4.1 Research findings

"Internet + tourism" is the product of the development of the tourism industry in line with the times, and the combination of the two will not only help to enhance the popularity of scenic spots, but also increase the economic benefits of scenic spots. Based on the AISAS behavior model, along with the theory of travel preference and tourism information search, this study delves into the variances in online attention toward high-quality scenic spots in Yunnan Province across four types of platforms: short video platform, travel website, search engine, and social media. It also examines the impact intensity on tourists' purchase behavior. The research reveals that the public's attention intensity toward high-quality scenic spots in Yunnan Province is the highest on travel websites, followed by search engines, short videos, and social media. This pattern is attributed to the limited nature of people's attention (March, 1994), particularly in the age of mass media, where individuals must distribute their attention across various online platforms (Lu et al., 2023), leading to areas of high concentration and attention deficits. Furthermore, scholars have noted that information search significantly influences potential tourists' purchasing decisions (Lee et al., 2007), which are influenced by factors like travel notes or reviews on prominent travel websites and apps (Wang et al., 2023), as well as the marketing strategies of tourist destinations both online and offline. Building upon the AISAS behavior model, this study further elucidates that the factors impacting potential tourists' purchase behavior include sharing experience, attracting attention, generating interest and searching information.

4.2 Theoretical contributions

In this study, we construct a logical chain of the formation mechanism of online attention from the aspects of travel preference theory and tourism information search model. The whole process of the formation of tourism online attention is a cycle between the virtual end and the real end, that is, the potential tourists from the initial virtual online attention to the real tourism flow. First of all, in the era of big data, more and more post-tour tourists tend to publish travel notes or videos on platforms such as TikTok, Xiaohongshu, and travel websites, which are gathered by short video platforms, search engines, travel websites, social media and other platforms into a rich source of tourism information (Bangwayo-Skeete and Skeete, 2015; Park et al., 2016). Then, under a certain motivation, potential tourists generate the behavior of retrieving information about relevant scenic spots, and the digital traces left by this series of behaviors are the online attention. Then, different groups of potential tourists choose destinations according to their travel preferences (Goodall, 1991). Finally, when potential tourists have a travel experience, their identity will change from potential tourists to real tourists, and some tourists will review and share on different travel websites after the travel experience (Bilgihan et al., 2016), which can not only convey the real emotions and experiences of their trip, but also further update the tourism information source, attract the attention of potential tourists on a larger scale, and start the next round of the cycle of virtual space and real space. Therefore, this study systematically explains the formation mechanism of tourism online attention, which not only enriches the logical chain of "tourism information source → potential tourists → demand-driven → information search → travel preference → destination choice → purchase decision → travel experience → real tourists → feelings after traveling → focus on feedback → tourism information source," but also broadens the application scenarios and application boundaries of travel preference theory and tourism information search behavior model to a certain extent (Figure 4).

4.3 Practical implications

The findings of this study are valuable for managers of scenic spots to utilize Internet technology in developing an effective network marketing strategy for high-quality scenic spots in Yunnan Province. The study revealed that the public pays the most attention to travel information on travel websites, indicating that the reviews on these websites have a significant impact on potential tourists' decision to make purchases (Wang et al., 2023). For instance, managers of scenic spots can enhance the visibility and appeal of the attractions through short video platforms and social media, as well as improve the filtering and intelligent recommendation systems on travel websites to enhance the credibility of the reviews, thus encouraging potential tourists to search and ultimately make a purchase.

Furthermore, we suggest optimizing the layout of promotional videos and online reviews of scenic spots on the four platforms: short videos, travel websites, search engines, and social media, to present a wide range of hashtags to potential tourists. For example, using hashtags related to travel itineraries, transportation, hotel services, food and beverages, and cultural customs. Diverse hashtags can assist potential tourists in filtering and finding the information they need more effectively and quickly. By optimizing the layout of the platforms, tailored to the different preferences of potential tourists, we can improve their perception of the information, enhance their interest,

FIGURE 4
The formation mechanism of online attention under the AISAS model.
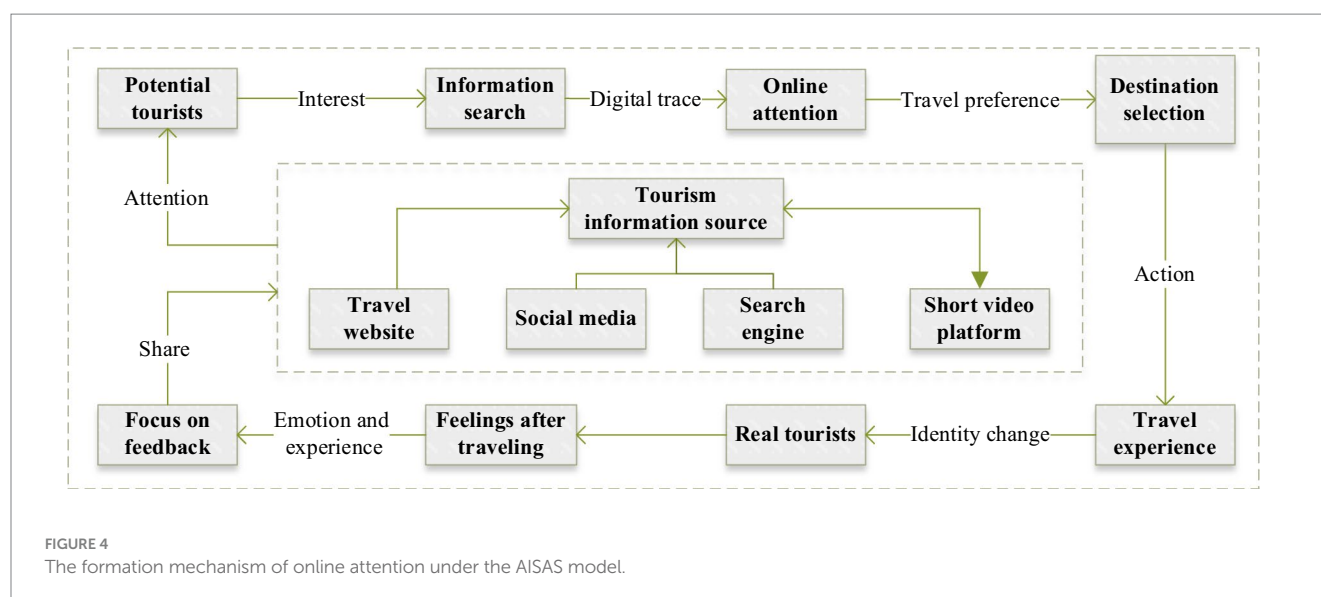
and stimulate them to conduct more searches and improve their purchasing behavior.

4.4 Research limitations and suggestions for future study

This study focuses on the influencing factors of potential tourists' purchase behavior through network data analysis, with innovative research perspectives. However, online data, as objective information, may not fully capture the impact of various platforms on potential tourists' purchasing decisions. The study does not address whether the findings are consistent or different when considering subjective questionnaire data. Therefore, future research should incorporate questionnaire surveys to assess the influence of short video platforms, travel websites, search engines, and social media on potential tourists' purchase behavior from both subjective and objective viewpoints. This approach will enhance the contextual relevance of the research findings and improve their accuracy. Furthermore, while data from four types of platforms were collected in large quantities, the analysis in this study only examines them statically. It fails to dynamically reflect the influence on tourists' purchase behavior due to the complexity of their decision-making process. Hence, future research should investigate the dynamic evolution of potential tourists' purchasing behavior by continuously tracking and supplementing data.

Data availability statement

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

Author contributions

SZ: Conceptualization, Writing – review & editing, Data curation. YK: Software, Visualization, Writing – original draft. YY: Methodology, Writing – original draft. JL: Writing – review & editing.

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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.

Publisher's note

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Social accessibility in queering code/space: Blued-based visibility and social practices of local gay people in mainland China

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As a locative media, Blued articulates physical and digital space in the form of localization, giving a mediated visibility to its users who are not visible in physical space, thus making the city a queering code/space. This can transform social accessibility and the ways that gays come together and interact in local spaces. Taking mainland China, dominated by heteronomativity, as a field, this paper focuses on the visibility negotiation and social accessibility practices in Blued-based queering code/space. Using the digital anthropology method, this study found that Blued-based visibility is essential for non-closeted gay men to gain a sense of local belonging and community inclusion. Offline accessibility is a crucial demand for Blued users, but until then they have negotiated visibility through selective disclosure of social cues. At the same time, Blued users face visibility asymmetries and risks in the pursuit of accessibility. This study then argues that in the Blued-based queering code/space, the gay men constantly reconcile accessibility with others by managing visibility in a heteronormative urban space. In addition, this paper highlights the value of the hybrid of new media and physical space for the public interaction of marginalized groups in the city.

KEYWORDS

Blued, mainland China, queering code/space, social accessibility practices, visibility negotiation

Introduction: from Dianr(点儿) to Blued-based queering cities

In China's Confucian cultural tradition, marriage, children, and family are considered essential for maintaining family lineage and heritage. Within this cultural context, homosexuality is viewed as conflicting with traditional family values, making it difficult to gain social acceptance. Additionally, the current legal system in China lacks clear regulations regarding the legal status of homosexuality. Furthermore, while increasing numbers of people have started to accept and understand homosexual individuals in recent years, this acceptance still clashes with mainstream values, and widespread societal prejudice against homosexuality persists. Chinese society remains predominantly heteronormative (Luo et al., 2022). In this environment, physical spaces, which are crucial for social interactions, remain inhospitable to homosexual individuals, preventing them from freely engaging in public areas dominated by heteronormative norms. However, the

advancement of digital communication technologies has transformed the spaces where gay men connect.

Since the reform and opening-up, the Chinese public homosexual space has evolved. Before the 1990s, "traditional public space" was representative and mainly concentrated in city center parks (often with public toilets and green spaces), squares, tea gardens, bathrooms, and dance halls for the public. After the 1990s, homosexual commercial public spaces began to flourish in bars, saunas, clubs, etc. On the one hand, traditional public space "has a low entry threshold" and "can be used with the majority of heterosexual people," meaning that identifying a member of the group can only be achieved through eye contact, actions, or conversation.[1] On the other hand, commercial public space "requires a fee to enter" and "is an exclusive space for homosexuality" (i.e., one does not have to make judgments about homosexuality in such spaces) (Wei, 2015, p. 23–24). These "public spaces where people in the circle communicate and entertain are called *Dianr*(点儿)," in which "the physical, behavioral, and social practices of homosexuality are organized, expressed, and understood" (Fu, 2012, p. 55). Leap (1999) refers to it as "public sex/gay space." Some scholars refer to it as "gay cruising spaces in China" (Qian, 2014). In China today, heterosexuality is considered a normal sexual orientation, while homosexuality is abnormal and rejected by mainstream values. The majority of gay men have not come out publicly. In this context, *Dianr* has become an essential space for gay men to avoid the risk of sexual orientation disclosure in heterosexual spaces and to interact with gay men.

Before the rise of the Internet, the urban gay community mainly used these Dianr to connect with other strange gay men in the local area (Beck, 1997, p. 105–106). In the Internet era, Douban, QQ, Tieba, etc.,[2] provide platforms for gay groups to carry out social interactions. Individuals form a community imaginary in cyberspace, but there is no distinct physical space to point to. Since offline, physically present interactions are still irreplaceable for this group, people can only make up for the de-territorialization of such social media by using hometown dating groups (e.g., X-city gay friend groups in Tieba, Douban, QQ).

An increasing number of social media platforms now incorporate geographic location information (Fitzpatrick et al., 2016). The combination of location and social media has given rise to a new form of media, specifically location-based social networking (LBSN). LBSN detects the user's location through a GPS sensor and associates social activity with the location.

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[1] For example, Fu's (2012) study highlights that eye contact is a vital physical cue for gay men to recognize and connect with each other in public spaces, facilitating interactions and conversations. In our research, interviewee D mentioned, "Gay men often exhibit certain characteristics, such as wearing makeup, having specific gestures, and displaying feminine behaviors, which typically suggest they are gay. At this point, I will intentionally look at him, and if he responds with eye contact, it's like we've established a connection, commonly known as 'gaydar.' Following this, there might be a deliberate effort to start a conversation or interact."

[2] QQ is an instant messaging software comparable to WeChat. Douban and Baidu Tieba are online communities centered around various interests. Each of these platforms includes group social features, which many gay men use to form and join communities for social interaction.

In LBSN, people not only communicate about location but also communicate through location (Frith, 2014). As a kind of LBSN, with "nearby" as its outstanding feature, Blued is the world's largest gay social app (Miao and Chan, 2020), allowing users to see a list of other users based on their geographic distance. The list may be displayed in grid or list modes. Information that users can access includes profile image, name, whether the user is verified (marked with a "V"), distance, age, height, weight, signature, etc. Users can filter and search for other users of their choice according to their needs, and can also be "seen" by more people through the setting of related filter information. Blued acts as a filter to exclude heterosexuality from the physical space, and this filtering function was previously achieved through *Dianr* (this is not to say that the "Dianr" in the city have been completely replaced by Blued, but that gay men are now able to socialize with gay men in the same city without having to go to the "Dianr"). Therefore gay men with social needs have certain visibility on Blued, and the urban space is queered in this digital form and becomes a queering space.

Modern Chinese society is dominated by "heterosexuality" (Warner, 1993, p. xxi). Many cities' institutional arrangements are produced under this framework, and the sexual and social rights of the gay community are excluded. "Public space is 'queering' by the raised visibility of the gay community, thereby they can enjoy the same citizenship as heterosexuals," which is "an important part of contemporary gay space politics." Furthermore, the city's public space "is supposed to be an area where people can use it equally, but in fact, many people are excluded from the public space." The homosexual community is one of them (Wei, 2011). In this sense, Blued's ability to make public space queering is significant for the gay community in mainland China to engage in public interaction and gain social accessibility to the gay community.

On Blued, the importance of physical space and its articulation with cyberspace are unprecedentedly prevalent. However, little existing research on Blued has been conducted in this respect. The available studies have been done in the following: the political economy of sexually affective data on Blued (Wang, 2019, 2020); how sociocultural context matters in self-presentation on Blued (Chan, 2016); communication skills on Blued (Wu and Ward, 2020); how the different life experiences of gay men shape and are shaped by the use of these applications (Miao and Chan, 2020). However the hybrid of physical and digital spaces, and the implications of this convergence for changes in urban space and the social interactions of the gay community, have not been discussed in the above studies.

This paper discusses the social interaction of gay individuals on Blued from the perspective of media and communication geography. From the perspective of spatial convergence, social accessibility, and visibility, this paper examines what features of Blued-based local communities in mainland China are, what kind of interaction space they create for gay men, and what kind of interaction practices they promote, and then asks what they mean for gay men. This study argues that Blued, as a location-based media platform, merges physical and digital spaces in a localized form, providing a mediated visibility for Blued users who are otherwise invisible in physical space. It effectively reshapes the urban environment into a space imbued with queer identity. As a result, it transforms the spatial structure of social accessibility for gay male communities within the city.

Literature review

Social accessibility: the concept and its spatio-temporal structure

The concept of social accessibility can be traced back to Simmel (1922 [1955]) with its view that it is a way of managing interpersonal relationships in a city of sensory overload. In the opinions of Quan-Haase and Collins (2008), Pieber (2021), social accessibility can be understood as an ability to reach others. In terms of reaching and being reached, social accessibility includes two aspects: on the one hand, the ability to reach the people one wants to interact with; and on the other hand, the ability to manage who, where, when, and how one can interact with oneself. From existing research, the latter has been discussed more often. For example, in the view of Milgram (1970), urban life is characterized by "large numbers, density, and heterogeneity." Milgram (1970) calls this phenomenon of overload caused by too much input for people to cope with, and argues that "adaptations to urban overload create characteristic qualities of city life that can be measured." According to Milgram's (1970) observations, ways to cope with this overload include "allocation of less time to each input," "disregard of low-priority inputs," "boundaries are redrawn in certain social transactions" and so on.

The development of information technology has also changed the social accessibility of urban people. This social accessibility has become more complex and diverse in the mobile digital age (Quan-Haase and Collins, 2008). Social visibility is managed in a variety of ways, with time being an important dimension. Zerubavel (1979) outlines a conceptual framework of social accessibility and distinguishes between private time, where individuals are legitimately inaccessible to others, and public time, where they can be reached. Quan-Haase and Collins (2008) argue that the temporal structure of social accessibility and individuals' definitions of public and private time has changed in computer-mediated communication.

In addition to time, space is also an important dimension for discussing social accessibility (Gehl, 1987). Mobile internet development has also changed the way people interact in public spaces (Humphreys, 2010). According to Carr et al. (1992, p. 45), "public places afford casual encounters in the course of daily life that can bind people together and give their lives meaning and power." The provision of public space is an important social feature of a city, in which people can interact, scrutinize, communicate, and debate with one another (Calhoun, 1986). Digital space was once considered dichotomous with physical space, but this view has since been abandoned. In Mitchell's *City of Bits*, for example, it is clear that "bits" will replace "bricks" as the dominant city (Mitchell, 1996). However, in *Placing Words*, he abandoned this dichotomy between digital and physics, arguing that the two are intertwined (Mitchell, 2005). This convergence redefines urban space and also influences the management of social accessibility for urban dwellers.

In summary, social accessibility encompasses the ability to reach others and manage others' access to oneself, and it is mainly discussed in the context of urban overload. For marginalized groups, however, the lack of communication between members scattered across the city in invisible states is often due to a lack of information. The articulation of digital and physical spaces creates the conditions for accessibility among urban minorities.

Queering code/space: Blued as locative media and hybrid space

Locative media is a digital mobile media with a location-aware function, which senses a user's specific location in physical space with positioning equipment, providing relevant information nearby (Oppegaard and Grigar, 2013; Frith, 2015, p. 2). In locative media, the significance of physical space for network communication has been emphasized. What information users learn is closely related to where these users are (Gordon and de Souza e Silva, 2011, p. 7). Locative media is a manifestation of the expansion of networked digital media in urban space, representing a "new spatialization of media as an integral part of the transformation of media into geomedia" (McQuire, 2016, p. 2). It shows the articulation between the media and urban space, changing people's ability to experience space. To highlight the interweaving of the two spaces in this mobile digital era, de Souza e Silva (2006) proposes the concept of "hybrid spaces," which emphasizes the fusion and interaction between cyberspace and physical space rather than a binary opposition. Silva (2009) believes that, in hybrid spaces, mobile technology serves as an interface, blurring traditional boundaries between physical and digital space, thereby reconstructing urban space. A continuous relationship is established among locative media, users, cyberspace, and physical space in the hybrid process. This relationship promotes a new form of space and redefines interpersonal and social relations within the space (Saker and Frith, 2019).

For the gay community, communication is increasingly mediated by mobile applications (Mowlabocus, 2008, 2010; Race, 2015). For example, Grindr, one of the most popular gay men geosocial applications in Western countries, Roth (2014), Bonner-Thompson (2017), and Miles (2017) believe that it broke the boundary between public and private space and provided a new space for queer's gender, sexual behavior, identity construction, embodiment, and performance. Following Kitchin and Dodgem's (2011) concept of "code/space," Cockayne and Richardson (2017) refer to the space created by the hybrid of gender, digital technology, and geography as "queering code/space." To Blued, it filters heterosexuality in physical space through networked and localization forms, and gay men in physical space can perceive other gay men in their surroundings digitally, thus making the city a queering space. In the process, Blued creates a digital layer on top of the physical world, allowing for new social interaction practices (Mark and Marcus, 2012) and providing new complications to the issue of social accessibility in urban spaces (Pieber, 2021).

Visibility negotiation and social accessibility practices in the queering code/space

Communication in social media is viewed as de-spatial. Regarding Blued, however, space is brought back into view in a locative way and is viewed as a self-disclosure of information by the user in the socialization process. The spatialization of self (Schwartz and Halegoua, 2015) gives rise to a new kind of visibility. Visibility can be divided into "visibility of body presence," which is predicated on the perception of physical presence, and "mediated visibility," which is realized in the form of mediation. Thompson

(1995, p. 119–148, 2005) argues that "mediated visibility" extends the spatial scope of individual visibility, characterized by non-presence, non-dialogue, unlimited openness, etc. Treem et al. (2020) find that this "communication visibility is the root affordance, or possibility for action for CMC." In Brighenti's (2012) view, visibility is associated with vision but beyond vision in that it "essentially regards the activity of introducing, establishing and negotiating thresholds that join together or separate territories" Territory is a concept closely related to visibility, which considers the change of threshold of visibility as an important motivation for domain formation (Brighenti, 2007). In this sense, the visibility brought by Blued also facilitates the process of re-territorialization of urban space. The visibility of Blued can also be seen as an act of re-territorialization of the cities. Pieber (2021) refers to locative media as a spatial filtering function, arguing that it affects visibility and social interactions of LGBTQ+ people.

However, this social accessibility should be seen as a concept of practice, emphasizing the intertwining of technology and people, nonhuman and human (Lupton, 2016) Specifically, in the field of media practice, it allows us to see media at work in many contexts and situations and understand how media practices arrange, combine, and more generally intersect with other social practices (Couldry, 2004). Mattoni and Treré (2014) argues that when following this concept of media practice, we should focus on the user interactions with media objects (such as mobile phones, laptops, pieces of paper) and media subjects (such as journalists, public relations managers, other media practitioners who are connected to the media realm). We can therefore divide this social accessibility practice into two aspects: on the one hand, we focus on the interaction between users and media technologies; on the other hand, we focus on the interaction between users and other people. An important manifestation of this social accessibility practice in the Blued-based queering code/space is that Blued provides "visibility affordances" (Flyverbom et al., 2016) for the gay community and the negotiation of visibility in the relevant cultural context.

In summary, Blued as a locative media has redefined urban space for its users, transforming the heteronormativity urban space into a queering code/space in which gay users are visible to each other, thus affecting the social accessibility of this group in the city. Nevertheless, what the significance of this visibility in queering code/space for the gay community in China is, how this visibility and social accessibility are negotiated in Chinese heteronormativity public spaces, and what social practices it engenders are the questions this paper seeks to explore next.

Method

To conduct a rigorous investigation, we employed two methods for data collection. First, we used the walkthrough method developed by Light et al. (2018). This emerging digital experience method encourages researchers to conduct detailed examinations of applications, familiarizing themselves with the platform's interface design, functional structure, content, and specific practices. It involves systematically collecting data throughout various steps of the app (from registration to everyday use and discontinuation) to comprehensively understand the platform's

ecological characteristics and how the platform system integrates with daily life practices.

The researchers in this project actively used Blued to familiarize themselves with the settings and functions of the relevant applications, gaining a perceptual understanding of these applications on a personal level. Starting from April 2, 2018, the two researchers first logged in and read the descriptions and promotions of the app in the app store and on Blued's official website. In this phase, we gained an initial understanding of its features and development history from official introductions. Subsequently, the two researchers installed Blued on their respective Android and Apple phones, used it for at least 30 min daily for a month, and collected extensive field notes, screenshots, and screen recordings.

During this participatory observation on the platform, aside from examining the basic functions and layout of the software, the researchers made additional finiidings. For instance, many users proactively greeted the researchers, often starting the conversation with questions like "May I take a look at you?" "Do you have a photo?" "What's your situation?" These interactions were consistent with the experiences shared by the interviewees later in the study. Additionally, the researchers joined several chat groups within Blued and observed the interactions among gay men in these groups. The detailed process of using Blued was carefully documented, capturing both objective digital traces from smartphones and subjective user experiences as supplementary first-hand research materials.

In addition to collecting data through the walkthrough method, we conducted in-depth interviews, carried out from May 2018 to June 2019. Blued users are distributed across all cities in China, with the majority residing in first-tier cities such as Beijing, Shanghai, Guangdong, and Zhejiang.[3] Given this context, we chose Shanghai (a first-tier city) and Zhanjiang (a third-tier city in Guangdong province) as the main locations for recruiting interviewees. We interviewed a total of 14 gay individuals (nine college students and five urban white-collar workers) through open recruitment and snowball sampling (see Appendix 1). The interviewees were mainly comprised of college students, and there were two reasons for choosing college students as the main object of observation. The first reason was the convenience of the method employed. Secondly, as a bounded area, universities are appropriate to discuss what kind of social and public interaction Blued has triggered. A further five urban white-collar workers were interviewed. Because these participants had the financial ability to enter places with consumption thresholds such as gay bars, clubs, and *Dianr*, the social environment around them is more complex than a campus, and their media experience complements that of the students. Although college students and urban white-collar workers do not represent all Blued users, data indicates that 70% of Blued users are between the ages of 18 and 35, with 30% aged 21–25 and 27% aged 26–35. These users primarily consist of college students and urban white-collar workers (see text footnote 3). Thus, this study concentrates on these two groups. Furthermore, this study aims to explore the spatial generation of Blued and its impact on social accessibility, rather than examining usage differences among

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3 https://www.octoplusmedia.com/china-key-media-blued/

various social strata and groups. Additionally, the primary objective is to investigate the spatial dynamics of Blued and its influence on social accessibility, without delving into the usage differences among various social classes and groups. Given the research goals, the chosen subjects are pertinent and meaningful for the study.

The interviews lasted an average of 35–45 min and followed a semi-structured protocol. At the beginning of each interview, the researchers asked participants to describe the homosexual dating apps they frequently use, providing a general overview and evaluation of these apps. Since all participants had experience using Blued, the researchers then focused specifically on this app. The main questions were as follows: when did you start using this app? What was your initial experience like? What significance does it hold for you? How do you find nearby users? How do you filter chat partners? What are your distance preferences and what do they mean to you? Are you concerned about being recognized by acquaintances on Blued? Have you ever been recognized? Do you usually visit physical spaces like gay bars? How do interactions in these physical spaces compare to those on Blued?

To ensure the validity of the experiential materials, researchers conducted participatory observation and in-depth interviews again from April to July 2023. We found that the interaction patterns among gay men in China have remained largely unchanged over the past 5 years. Blued continues to have a large user base and is still a popular social app among gay men. Apart from adding features similar to Douyin (TikTok) live streaming, the app's core functionalities have remained largely the same. In interviews conducted last year with two gay men about their use of Blued, the insights gained were similar to those from the study conducted 5 years ago.

The researchers then followed a grounded theory approach to deeply read and analyze the field materials. During the initial phase, the researchers employed open coding on the field materials, summarizing 11 key themes and concepts: "sense of belonging," "finding a community," "convenience," "anonymity," "meeting in person," "online-to-offline transition," "process dynamics," "disguising," "risk factors," "inequity," and "familiar strangers." Following this, the researchers performed summarization and axial coding on these themes, categorizing and comparing them to derive three primary categories: the online community of local LGBTQ+ individuals, the procedural aspects of social accessibility, and the visibility risks within Queering Code/Space. These themes also serve as the core topics regarding visibility and social accessibility within Queering Code/Space facilitated by Blued, forming the basis for subsequent analysis.

Findings

> "I am grateful but conflicted. On the one hand, Blued makes us easier to find gay friends nearby anywhere and anytime. On the other hand, the whole process of socialization from online to offline seems like a 'negotiation', and I might pay the price for it."

H said the above when commenting on the significance of Blued to his daily life. His words represent both the value of Blued's availability to this group and the fact that this value is a negotiated process that needs to be considered in a specific cultural context. Based on fieldwork materials, the following findings emerge: firstly, in Blued-based queering code/space, gay individuals who cannot reveal their identities in physical space and chat with one another see each other in cyberspace. This visibility creates a user-centric, distance-oriented community within the region, filtering out the eyes of heterosexuals and becoming important for gay people, especially those who are not out of the closet, resistant to the *Dianr* or have unconditional access to the *Dianr*, to integrate into the local gay community. Secondly, in queering code/space, most users seek offline accessibility, such as meeting the netizens, dating, etc. Nevertheless, before that, they will negotiate visibility through selective disclosure of social cues. Finally, in the queering space based on *Blued*, there exists a paradox. On the one hand, Blued users hope to be searched by people nearby and establish a certain kind of relationship on this platform. However, on the other hand, some Blued users are afraid of being seen by acquaintances because of the actual relationship generated by the proximity of physical space. This asymmetry between seeing and being seen can be regarded as a paradox and risk of Blued-based visibility. The following sections discuss these aspects in detail using the specific experiences of participants.

"A necessary threshold to enter the local gay community": a Blued-based sense of place and queer community inclusion

The activities of Chinese homosexuals in a physical space dominated by heterosexual values are not recognized, either on an official or folk level. For example, at GMY University, in 2018, some gay individuals spontaneously established a "Rainbow Group" and created a WeChat official account. The group regularly held meetings outside the school. The reason for choosing off-campus meetings was that the use of on-campus space (such as classrooms, etc.) was subject to application, and the school could not approve this group. Their activities ranged from watching classic gay-themed movies together to talking about gay-related issues. However, when the school learned of the group's existence, it was ordered to disband, shut down its official accounts, and cancel movie-watching events. In addition to school authorities, gay individuals face pressure from traditional family values and social circles. On various social occasions, gay men such as B are reluctant to expose their sexual orientation to others. He said: "You should disguise yourself as straight to the largest extent possible; on the one hand, you don't know if the other person is gay. On the other hand, you also fear they'll tell someone else, which is embarrassing."

Therefore, most gay individuals are in a state of a deep closet, meaning that they are invisible. Just as A states: "Our group wants to find the same kind of people, but we are afraid of being discovered by our classmates, friends, or other gay individuals."

By filtering out heterosexuals and anonymization, Blued seems to have solved this paradox by allowing gay individuals to interact with other gay men without revealing their real identities. Later, according to the needs, the users will carry out de-anonymization in the interaction process.

In the past, in the same city, if gay individuals wanted to get to know one another, they may need to use one of the following methods: meetings arranged through friends; going to a gay bar; finding the city's QQ or Douban group, or private chat. However, there are some drawbacks for GMY students, as explained by E:

> It is not realistic to strike up a conversation, even if you meet someone who looks gay on the street. You are unlikely to ask directly if they're gay and whether they like to friend you on WeChat. If you want to get a referral from a friend, you should have a friend or social circle. My friends are always in the same social circle as me; gay bars are impossible because none in my city, and my friends say they're messy. There are many kinds of people in QQ Gay groups in my city. I just want to find students, not people from society.

A is a senior at GMY University. He identifies as a bisexual and used Blued for the first time in his dormitory. He recalled the scene and feelings at that time:

> I was shocked when I read how they spoke. One of the things that impressed me most was people on Blued were very close to me, some even at zero kilometers. I didn't know that there were so many gay youths in our school; when you scroll down, you find that there are many people within three kilometers.

Based on distance alone, A stated that fellow users belong to the university or even the same dormitory compound; a distance of fewer than three kilometers means that these people are likely to be students from GMY University.

C is a junior at the Dongguan University of Technology who has used Blued and Tantan since the second year of high school. C later also used Aloha, Forfun, Jackd, etc. When he first entered university, C said that he was shocked when he tried Blued in his dormitory for the first time: "Holy sh*t! There are so many gay youths in my dorm!"

Gay individuals get a new sense of place based on Blued. In general, a "sense of place" refers to people's subjective and emotional attachment to space, which is a feeling based on personal experience. This "nearby" function on Blued makes gay individuals visible. This kind of visibility, in addition to the traditional *Dianr*, allows for *Dianr* everywhere. This sense of place is important for gay men to enter their local social circle. As E stated: "Only with Blued did I enter the local circle. It's hard to get to know people without that. It's a kind of a barrier to entering the local gay community."

Some people, including participants like D, E, and H, view Blued merely as an app for hooking up—designed primarily for finding sexual partners and engaging in sexual activities rather than for making friends or seeking emotional companionship—thereby making it a breeding ground for HIV. This notion, however, is a misunderstanding. When talking about the stigma of Blued, J said: "Blued is regarded as an app for sexual hook-up in most people's eyes, but everyone uses it for different purposes."

This study found that social interactions on Blued were used for much more than meetings or sexual encounters. Blued users can also develop their relationships and build friendships with other people in the gay community, as stated by H: "It did help me with demand for sex. However, I made some friends there. I met friends who played volleyball with me through Blued and even some friends who are so nice that I can get along with them for years." From the perspective of social network construction, this kind of friendship can enhance the social capital of both sides. As J stated: "We don't necessarily use Blued in that way (for sex); we also use it for friendships. I'm a student who stays on campus and see my classmates every day. Blued is a good way to enlarge my friend circle." L, a doctorate student from Shanghai, also disagrees that Blued users are only for casual sex. L said he had recognized people who were "helpful" to him through the application. Helpful here refers to a person who can guide a user's life and study.

Negotiation of visibility: accessibility as a process

Reproducing the value of physical space in online social interactions is a crucial feature of Blued. In localization, Blued users in the physical space have a certain degree of visibility online. Although some users, like E, use Blued for "chatting" and "killing time." F stated the following:

> One of the primary purposes for me to use Blued is to find people around me and have offline interactions with them rather than chatting online. If I only wanted small talk, I'd go for Aloha, Fangkaka, etc. On Blued, at some point, two people will ask to meet offline if they have a good conversation or are interested in each other online. If you feel good when meeting, you might want to continue the offline relationship. If you don't feel good, you might want to stay online or just stop talking.

Therefore, it may be defined that, in the Blued-based queering code/space, offline communication is always an "ultimate pursuit." This purpose is also a key objective of choosing to chat with people nearby, highlighting the importance of physical presence in communication.

Mian Ji (meeting a net friend offline) is an internet buzzword in mainland China in recent years. The term *Ji* originally meant "bromance" or "homosexual." Although the meaning of the word "bromance" and *Mian Ji* have been broadened beyond the limited description of gay relationships and now refers to friends and netizen gatherings, *Mian Ji* is an important part of gay culture. *Mian* here refers to communication happening in the physical space instead of the intermediary and represents the conversion of online communication to offline relationships.

On Blued, the transition from online interaction to offline generally requires a process, and this process is surprisingly consistent for most interviewees. Some users drew a flow chart presenting the process from "online chat on Blued" to *Mian Ji* (as shown in Figures 1, 2), including steps such as opening the application, browsing lists of people nearby (which are generally filtered based on the user's preferences), and looking at photos and information (such as age, height, weight, etc.). If no real photos are
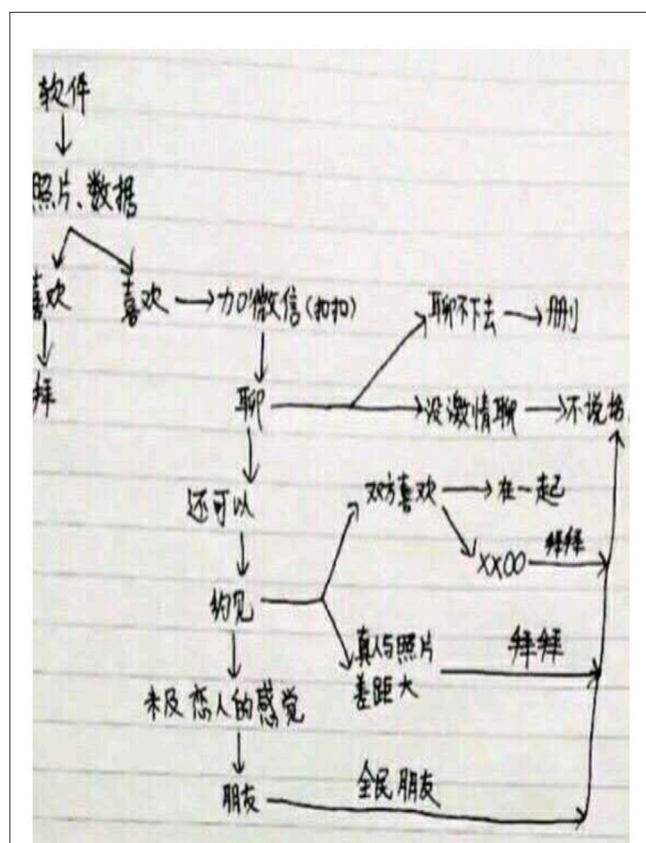
FIGURE 1
Process from Blued-based online chat to Mian Ji.

FIGURE 2
Process from Blued-based online chat to *Mian Ji* (in English).

seen, a user may ask for photos. The conversation may stop if one user finds the other user's appearance or information unsatisfying. The user may add another user's QQ or WeChat *or* maintain contact on Blued. If one of the users feels that the conversation is lacking, he may delete the other user or just end the conversation. For users who find a conversation interesting, the next stage should be having an offline meeting and then falling in love or having a sexual encounter. Whether they will get into a closer relationship or be normal friends depends on impressions at this meeting. From asking for photos to chatting on WeChat to face-to-face, the visibility of Blued users gradually deepened. In this process, mediated visibility becomes embodied visibility. If the other party is dissatisfied with the content disclosed in one of the steps, the next step of the relationship may be put on hold.

G usually speaks to others actively: "for example, if somebody's profile is attractive, I will proactively speak to him, but only if I'm bored." When choosing whether greet or reply to others, B values height and age, and G stated the following:

> These are the two most important factors. If somebody's height and age are to my taste, I will chat with him openly. I like being with a taller partner; if they are shorter than me, I may not be interested. When responding to others, I will always return to say hello, unless something is particularly busy or there is no time to return, I will return next time I respond to whoever talks to me. I will also look through his information and judge whether he deserves to have conversation according to his age
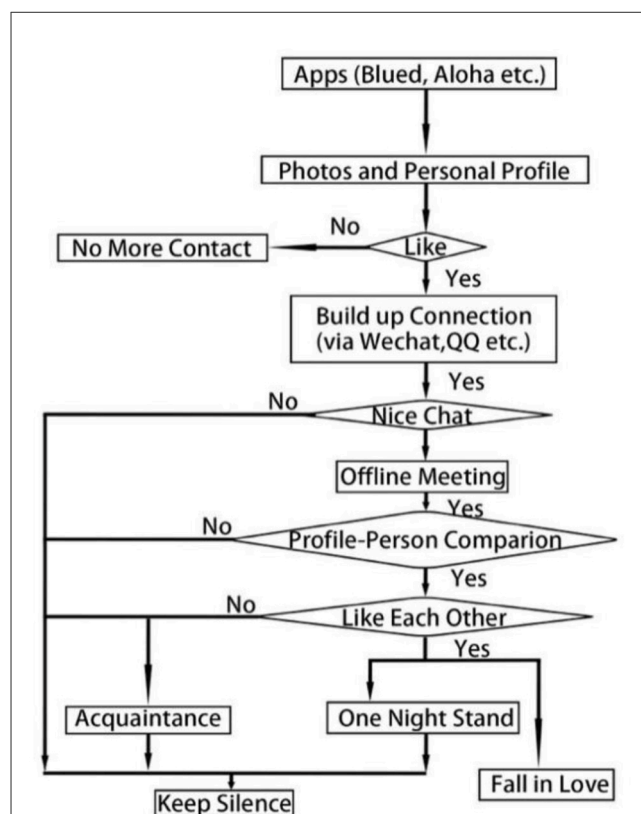
and height. In terms of interactions, I've had video calls, which is the most intimate behavior that I've done. For someone even more attractive, I might ask for a date.

The process of *Mianji* is the process of transferring online accessibility to offline accessibility. In this process the impressions formed by online visibility are checked against the impressions formed during the offline interaction. If the offline impression is consistent with the online or the offline impression is better than the online, it will facilitate a deeper engagement. Otherwise, it will force the engagement to end. B and his first boyfriend met through this form:

> "I was the one who first took the initiative to say hello to him. Although he did not put a real photo on Blued, the information on his profile, such as height, weight, age, is quite in line with my standards. After talking a few sentences, we sent each other photos, read and burn kind of, and both of us feel good. After chatting a few times, we met offline for a meeting and I think it went on well. I often encounter people who send me some false photos and information, but he did not. The impression I got of him after the meeting was no different from that I got when we talked online. After that, we added WeChat, and after a while, We became lovers."

Some users are specifically picking the kind of impression is better, but some users such as G think:

> "As long as I don't feel very bad when chatting online, I can meet them offline. The relationship between us mainly depends on the impression after meeting If the impression is good, try to pursue, if the impression is average to do ordinary friends is also very good."

However, many users do not establish a relationship through offline meetings. One important reason is that the impressions formed during online interactions collapse when encountering offline visibility because many Blued users manage their online impressions with the help of fake photos, beauty filters, etc. F once experienced this contrast between online and offline.

> "Once I had a good conversation with a guy online, and he showed me his picture, I was satisfied. After that, I made an appointment with him to meet in front of the school gate. I went a little late, and he was already waiting for me at the entrance. I took a look from afar, and the impression gap between online and offline is quite big, so I slipped away. Although this is quite rude, I feel that this person is dishonest, and there is no need to continue the relationship."

The cost of social accessibility: asymmetrical visibility and risk

As a kind of self-presentation, the location information on Blued is an essential reference for users to judge one other's identity. This presentation and the interaction between users, interwoven with the "familiarity" brought about by the proximity of geographical location, allows users to match their online identity to their offline identity. This presentation has negative consequences for the gay community. Among these consequences, there is a kind of right inequality between seeing and being seen. This results in what Hatuka and Toch (2017) call "asymmetrical visibility."

Many interviewees, particularly those who had not come out publicly, were reluctant to let people around them know their gay identity. However, these gay men still need to socialize with others. This interaction is also an important reason why many gay men use Blued, not only because they want to find other gay men but also they want to be found. Blued users will do a lot to reach this goal, particularly deciding which personal information to share. For example, a user may put high-quality profile photos and a particular name, making an effort to reach standardized height and weight. Paradoxically, users are also afraid of being discovered, especially by people who know them in real life. On Blued, "although you can see others, others can also see you." When a user finds someone close to him, he always guesses who he is in the physical spaces. As D revealed:

> If showing zero kilometers, it means that this person is quite close to me; because he's right next to me, so I'd like to know who he is. Since gay men all have something in common, if I find someone zero kilometers away from me, when I'm in places like the library, I would raise my head and look around. Maybe I was too bored.

The presentation of the self on Blued is an essential clue for guessing who the user is. The clues include a profile photo, height, weight, age, photos, and distance. In the field study, both the researchers and the interviewees had the experience of judging "who is he?" through users' self-presentations. For A, it was unpleasant to be recognized.

A has worked in the Students' Union at both a college level and university level, allowing him to become acquainted with many people. Since A is the director of the College's Learning Department of Students' Union, he organizes various competitions, making him a celebrity at his college. However, A's position in the Students' Union also confines him. Due to his worry of being recognized, he does everything carefully on Blued, ensuring not to upload accurate information. The account name is XX, age 24, 178 in height, and 68 kg in weight. His signature is "How it feels to like a person." The rest of the information on his profile includes "constellation (Pisces)," "Figure (neat)." All of the above information is untrue except his age. A hides in this way, stating the following: "Nothing but the age on Blued is real. I used to set my weight at 200 and my height at 200 deliberately. Using this method, people can't guess who you are at all. Even if they suspect who you are, they do not have proof and cannot figure it out." For family reasons, A took a year off in the fourth year and returned as a senior. He took a job in Hangzhou during his year off from school. At his company, A does not use Blued; furthermore, his fear of exposure prevents him from opening Blued or logging in. N also met people that think in this way, stating the following: "I did not want to be recognized in a space like a school through the means that we've mentioned. I still don't want to come out but want to see other users."

In the face of these risks, Blued users always take various measures to disguise themselves from others. However, in the close range, because of mutual acquaintance and the fact that users will reveal some information intentionally or unintentionally in the process of chatting, some users are often recognized by people who know them in real life. For example, A has been recognized by others and has recognized others as well. A and Jiang (for the sake of convenience, a pseudonym is used in this article) met when they were freshmen in military training and had added one another on WeChat. Although the two men were from the same college, their interaction was rare because they were from different majors. It was not until the summer vacation of their sophomore year when the two competed together for the position of freshman class assistant that they started to have contact during their role as a class assistant when a new term began. Coincidentally, A downloaded Blued at that time and happened to "find" Jiang:

> His profile photo on Blued was a man in military uniform, but he didn't show his head; it was covered by something. I remembered that there was a time when I was holding an event, I happened to meet him while he was participating in the game. The picture he used for the competition was the profile photo on Blued. I thought of him and recognized that it was him.

A is an Engineering major whose class is composed mainly of boys; they all live in the same dormitory compound made up of two buildings, with the distance between the two buildings at ∼20 m. According to the distance shown on Blued, it is easy for these

students to determine if they are from the same college. It is easy to be recognized by others if they are from the same college along with frequent social activities.

A had also had the experience of being recognized by others on Blued but did not know whom they were, making A depressed:

> There was a guy who should also be our senior. I don't know who he is, but, based on that distance and other information, I'm sure he's from our college. He kept trying to guess who I was for a few days, and then I told him straight. Later, he responded, 'It's been good to chat so far and we have to end it' and blocked me. I don't feel good; I hate that other people know exactly who I am while I don't know anything about them.

A similar case happened to C, who found an acquaintance on Blued. C had uninstalled Blued for a while in college because he was too busy with university communities and departments to consider using the application. C then downloaded Blued again when he was free and found a man one day at a distance of 0 km, causing him to examine his profile information more closely:

> He didn't have an avatar on his account, but he took a picture of his leg with my bed in the picture's background! I'd had doubts about his sexuality before but wasn't sure, and he hadn't mentioned it to me. Since we can see the record of visitors on Blued, I saw that he had found me and blocked me. I might have been recognized by him since my ID on Blued is also the name of my official account on WeChat, which is often seen by others. (C)

In the above case, Jiang was a "familiar stranger" to A, and C's roommate was also a "familiar stranger" to C. On Blued, the ideal state is "all strangers"; everyone on Blued should be anonymous. However, the familiarity generated from proximity, coupled with the unintentional revelation of identity on Blued, interrupts the mutual anonymity. As in A's case, there is an asymmetry of visibility between seeing and being seen. This asymmetry is the cost of accessibility. As N says, "Without coming out publicly, if you still want to date gay friends, you still have to pay some price, right?"

Conclusion and discussion

In China, the public space for homosexual interaction in the past existed either in the marginalized physical space in gay bars, bathhouses, etc., or in the digital community. However, the gay community's imagination is organized by Blued based on the location of the user. Gay individuals can project the physical location of their bodies into cyberspace on Blued. Through the mediation of this digital interface, a queering code/space is created through the hybrid of physical space and digital space in the form of a locative structure. This system overcomes the limitations of traditional Dianr by making it public in a visual form and transforming the physical space dominated by heterosexual norms—where hand-holding, hugging, and kissing between men and women are considered normal, but between men are deemed abnormal—into a hybrid space for homosexual interaction. With

the help of spatial filtering, gay individuals in an area can "see"each other within this space and engage in related social activities. To some extent, the modern city has become a place where "*Dianr* is everywhere."

In the Chinese context, this means of communication has particular significance for most gay individuals. Much of the gay community in China is in the deep closet. Despite a growing number of individuals are coming out, many are too afraid to do so. These individuals want to know people of similar sexual orientations close to them but experience difficulties in a physical space dominated by heterosexuality. Blued cuts off heterosexual interactions, allowing gay men with social needs to see one another within a region. As a result, many subjects in the field study were surprised when they first used Blued to find so many people of their sexual orientation within such proximity. The visibility and accessibility based on *Blued* refresh the users' sense of place, contributing to a local group belonging and having important significance for Blued users to integrate into the local gay men. Although the social communication based on Blued is a hybrid communication that combines online and offline, the online behavior of Blued users mostly has a clear offline direction. The convenience of realizing these online relationships offline is Blued's unique advantage. The interaction of this hybrid space is initially carried out online. If one user wants to have a further relationship with another online, the interaction will immediately be extended to the offline in the form of a meeting or sexual encounter. Furthermore, Blued allows gay men to develop close friendships, extending their social network beyond that of heterosexuals and allowing them to "help" and "support" one another. Most Blued users are anonymous, which means that visibility on the application is limited. However, it is this limited visibility that allows gay men close to one another to be visible while also maintaining a "comfortable distance" (i.e., to remain anonymous and not be recognized by others). However, the hybrid of physical space and online social cues creates "familiar strangers," in which there exists asymmetry between the seeing and being seen.

These interactions refer to gay individuals' public life in the heterosexual-dominated urban space. From traditional *Dianr* to Blued-based queering code/spaces, gay individuals in cities have been pursuing rights in the urban community. This right is highlighted at the spatial level in how to create a public space for queer interaction in a heteronormativity physical space, and how to enter, meet, date, interact in this space. The visibility of Blued has changed the definition of traditional *Dianr* within the city and weakened its role in meetings between members of the gay community (especially in physical spaces such as public toilets, parks, bathhouses, etc.). Therefore, it may be argued that the queering code/space provided on Blued is connected with the construction of the gay community in the urban public space, as well as with the gay community's rights in urban public space in the Chinese mainland.

Lefebvre (1996) believes that the current urban space is deeply influenced by the logic of capital, which causes problems such as alienation and isolation of urban space and leads to problems such as deprivation of participation. In this process, differences are marginalized. This urban right consists of comfortable residence, participation in decision making, space using, etc. Inheriting Lefebvre's view of urban rights, McQuire (2016) believes that the

connotation and realization path of residents' rights to cities have undergone fundamental changes because of the conditions of new technologies. According to McQuire (2016) geomedia has become an important medium for different groups to realize urban rights at present. As a geomedia, Blued is also related to the spatial rights of the gay community. The space rights of the gay community are manifested in many aspects. This paper explicitly discusses the rights of the gay community to see and be seen in the daily living space and to carry out social communication. Platform improvements can be enacted through adjustments to platform configurations, aimed at bolstering the social inclusivity of the gay male community. These enhancements may involve implementing strategies to alleviate inequalities and discrepancies in visibility on the platform, granting users increased autonomy over their visibility, and concurrently addressing the propagation of misinformation. Such measures could significantly contribute to facilitating the Chinese gay male community in attaining greater visibility and agency within urban environments.

However, this publicity and these spatial rights are limited, reflected in three aspects: firstly, the queering code/space is about the visibility between gay groups, relatively closed visibility that insulates its members from heterosexuality. The gay community still lacks a broad social identity in real life. Secondly, this visibility is intraregional and constrained by geospatial distance, which is different from the open public space of online forums. Thirdly, the visibility between homosexuals and within the region has a particular ambiguity level, which is manifested in the uncertainty of geographical location (only distance is shown, whereas the specific location is not clear) and the selective display of online information (false information can be disclosed). Despite these limitations, Blued breaks through the limitations of the original interaction of gay men in mainland China and opens up new possibilities for local community integration and interaction of gay men, reflecting the significance of digital media for the social interaction of marginalized urban groups.

The issues and findings of this paper help promote research on social interaction between members of the gay community and public life in the digital age and are meaningful in theory to the binary opposition between reality and virtuality, physics and digital, etc. In the choice of research objects, this paper focuses on university students and urban white-collar workers who have just entered the job market, which has age and class limitations. For example, issues such as how middle-aged and elderly gay men use Blued, how people with limited education use Blued, the kinds of social interactions and group identities that these groups have established through Blued require further discussion.

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

The studies involving humans were approved by Guangdong Ocean University and Fudan University. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

TX: Conceptualization, Data curation, Investigation, Methodology, Writing—original draft, Writing—review & editing. YZ: Data curation, Formal analysis, Investigation, Writing—review & editing.

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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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Appendix

TABLE A1 Interviewee information.

A	Student (senior)	Zhanjiang	Male	In-depth Interview	2019/4/29
B	Student (junior year)	Zhanjiang	Male	In-depth Interview	2019/5/8
C	Student (senior)	Dongguan	Male	Voice Call on WeChat	2019/5/18
D	Student (junior year)	Zhanjiang	Male	In-depth Interview	2018/6/13
E	Student (junior year)	Zhanjiang	Male	In-depth Interview	2018/11/11
F	Student (junior year)	Zhanjiang	Male	WeChat Message	2018/11/22
G	Urban White-collar Workers	Shanghai	Male	In-depth Interview	2018/12/04
H	Urban White-collar Workers	Shanghai	Male	In-depth Interview	2019/01/05
I	Urban White-collar Workers	Shanghai	Male	In-depth Interview	2019/01/23
J	Student (Year 3 of High School)	Shanghai	Male	In-depth Interview	2019/01/27
K	Urban White-collar Workers	Shanghai	Male	In-depth Interview	2019/01/29
L	Student (Doctorate)	Shanghai	Male	Voice Call on WeChat	2019/02/22
M	Student (senior)	Zhangjiang	Male	In-depth Interview	2023/4/3
N	Urban White-collar Workers	Beijing	Male	In-depth Interview	2023/7/12

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