Behaviour & Information Technology

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/tbit20

Impacts of different interactions on viewers' sense of virtual community: an empirical study of live streaming platform

Dandan He, Zhong Yao, Pengfei Tang & Yuanhong Ma

To cite this article: Dandan He, Zhong Yao, Pengfei Tang & Yuanhong Ma (2022): Impacts of different interactions on viewers' sense of virtual community: an empirical study of live streaming platform, Behaviour & Information Technology, DOI: 10.1080/0144929X.2022.2053884

To link to this article: https://doi.org/10.1080/0144929X.2022.2053884

Published online: 22 Mar 2022.

BEHAVIOUR & INFORMATION TECHNOLOGY
https://doi.org/10.1080/0144929X.2022.2053884

Impacts of different interactions on viewers' sense of virtual community: an empirical study of live streaming platform

Dandan He, Zhong Yao, Pengfei Tang and Yuanhong Ma

School of Economics and Management, Beihang University, Beijing, China

ABSTRACT

With the rapid development of the Internet and the widespread adoption of mobile devices, live streaming has become a new social medium in the last few years. Hence, the continuous usage of live streaming platforms has become an important issue. Based on social exchange theory, this study investigates how different kinds of interactions affect viewers' sense of virtual community (SOVC) and in turn facilitate their continuous watching intention. Empirical results ($N = 423$) reveal that both viewer-broadcaster interaction and viewer-viewer interaction positively affect viewers' SOVC, which further enhances their stickiness. Furthermore, viewer-platform interaction positively moderates the effects of interactions between viewers and broadcasters on their SOVC, whereas the moderating role of gift-giving behaviour is insignificant. Finally, the effects of viewer-broadcaster interaction and viewer-viewer interaction on stickiness are partially mediated by SOVC. This study contributes to in-depth research on the relationships between different specific interactions and viewers' continuous watching intention, which enriches the existing study on live streaming and deepens our understanding of viewers' stickiness. The empirical findings of this study suggest that social media developers and managers take actions to encourage interactions that increase viewers' stickiness.

ARTICLE HISTORY
Received 17 December 2020
Accepted 10 March 2022

KEYWORDS
Interaction; sense of virtual community; stickiness; PLS-SEM; social media

1. Introduction

Live streaming is a special social medium whereby video is recorded and broadcast in real time via the Internet (Wongkitrungrueng and Assarut 2020). Through a live streaming platform, broadcasters can share video games, product experiences, talent shows, life sharing, dining events, sports events, or other content, and viewers can watch various kinds of live streams anytime and anywhere. Recently, many live streaming platforms such as Douyu, YY Live, Yizhibo, and TikTok in China have become very popular due to the rapid development of the Internet (Giertz et al. 2021). Live streaming has attracted a large number of users. According to TwitchTracker 2021, Twitch, one of the world's most widely used live streaming websites, had a total of 9.52 million broadcasters and 2.95 million concurrent viewers on average in February 2021. Nevertheless, China's live streaming market has grown faster than the markets of the rest of the world (Li et al. 2020). As reported, more than 50% of Chinese Internet users have installed live streaming platforms, the number of which is approximately 617 million in 2021 (CNNIC 2021). In this fiercely competitive setting, it is vital for every live streaming platform to attract and retain users.

More importantly, compared to traditional video systems, live streaming focuses more on the real-time interaction between broadcasters and viewers. On live streaming platforms, broadcasters and viewers can communicate with each other through discussion boards, chat rooms, danmaku systems, or private messages or by sending gifts (Long and Tefertiller 2020). These interactions can be divided into four types: viewer-broadcaster interaction, viewer-viewer interaction, viewer-platform interaction, and the special interaction of gift giving (Giertz et al. 2021). Furthermore, interpersonal relationships form between broadcasters and viewers via these real-time interactions. In this way, viewers can develop a sense of belonging by participating in group communication and may become immersed. Therefore, this study explores how to achieve viewers' continuous usage of live streaming platforms by creating a sense of membership and immersion, which belongs to a sense of virtual community (SOVC).

Unlike the previous literature, this work makes several contributions that fill the research gap. First, this study investigates the effects of various specific interactions (i.e. viewer-broadcaster interaction, viewer-viewer interaction, viewer-platform interaction, and

CONTACT Zhong Yao iszhyao@buaa.edu.cn School of Economics and Management, Beihang University, 37#Xueyuan Road, Haidian District, Beijing 100191, China

gift giving) on viewers' SOVC. On the one hand, although interactions have been broadly explored across different contexts, such as e-learning, social networks, and other social media, most studies have considered such interactions as a whole. The current research empirically examines the impacts of specific interactions on viewers' SOVC. Although some literature on live streaming platforms has studied the effects of interactions, such as viewer-broadcaster interaction and gift-giving behaviour, no prior research has systematically assessed the impacts of specific interactions on SOVC. Investigating the effects of specific interactions systematically in the live streaming context can enhance our understanding of which interactions on earth affect SOVC and consequently enhance viewers' stickiness. Such knowledge can enable practitioners to optimise the communication functions of live streaming platforms to guarantee the spread of interactions. Second, although some studies have investigated interactions under the background of live streaming platforms, they have mainly concentrated on social interactions (i.e. viewer-broadcaster interaction, viewer-viewer interaction, and gift giving), and few discuss interactions at the system or technical level. In contrast to previous studies, viewer-platform interaction is examined in this work. A deep understanding of viewer-platform interaction can be helpful in improving user interfaces, navigation structures, and response time. Third, although gift-giving behaviour has been widely discussed, many scholars have mainly focused on the antecedents and consequences of gift giving, and little research has taken a broader view of interactions by considering the moderating role of gift giving in understanding viewers' SOVC. Therefore, the moderating effect of gift giving, which is defined as the commoditization of a viewer's social interaction, is explored in the present work. From this work, practitioners can determine whether to strengthen or attenuate the gift-giving function to enhance viewers' SOVC and consequently their stickiness. Finally, SOVC is introduced to relate various specific interactions to users' stickiness. Although viewers' usage and continuous watching intention of live streaming have been studied, the current work focuses on the impact of SOVC on their stickiness, which the extant research has studied little. In doing so, we can better understand which aspects of SOVC have a stronger effect on viewers' stickiness such that practitioners can manipulate them and further foster viewers' stickiness.

The remainder of this paper is organised as follows. First, the literature is reviewed and the theoretical background is described, followed by the development of our hypotheses and the research model. Subsequently, we explain our research method and present the empirical results. Furthermore, a discussion of the findings and theoretical and practical implications are provided. Finally, we present the study's limitations with future avenues for research and conclude the paper.

2. Literature review and theoretical background

2.1. Literature review

2.1.1. Live streaming and live streaming platform

Live streaming is a way to access mass media through the Internet, allowing individuals to watch, create and share videos in real time, a bit like TV. The key difference between live streaming and TV or video-on-demand is that streaming and content consumption occur in real time (Guo, Zhang, and Wang 2022). This facilitates real-time social interaction between broadcasters and viewers. Meanwhile, viewers on a specific streamer's channel can communicate with each other through live chat features as well. Hence, compared with TV or video-on-demand, live streaming focuses more on the real-time interaction between broadcasters and viewers, and viewers and viewers. On the other hand, live streaming encompasses a wide variety of topics, such as video games, professional sports, talent shows. Moreover, live streaming platforms are video hosting solutions that allow broadcasters to broadcast video content to their audience.

2.1.2. The effect of interaction on sense of virtual community (SOVC)

Some studies have confirmed that interaction can enhance users' sense of community or SOVC. For instance, Chang, Hsieh, and Fu (2016) found social interactions, which allow members to exchange information and share emotions with others, are positively and significantly related to SOVC. Luo, Zhang, and Qi (2017) affirmed student-instructor interaction and student-student interaction have a significant positive effect on students' sense of community. Tang (2018) demonstrated the interaction among group members could significantly strengthen participation in group behaviours through the mediation of SOVC. Hudson et al. (2019) reported person-environment interaction has a positive effect on immersion, and social interaction positively affects users' satisfaction and loyalty in a VR experience. As suggested by Sriram et al. (2020), student and faculty interaction plays a primary role in the positive impact of living-learning communities and promotes students' sense of belonging. Hsu (2020) indicated parasocial interactions positively

affect consumers' sense of belonging under scenarios of YouTube. Minton and Liu (2021) pointed out the sense of belonging varies with the daily changes of social interaction. Nevertheless, these studies only focus on other social media or e-learning, and little is known about the effects of interactions, especially specific interaction types, on SOVC in the live streaming environment. Investigating the roles of these four interactions in improving viewers' SOVC is essential for their continuous watching intention of live streaming.

2.1.3. Users' stickiness behaviour

The existing literature investigating users' stickiness behaviour is categorised into two major streams in this current study. The first research stream focuses on the effect of SOVC on users' stickiness. On the one hand, many prior studies examine this effect from the perspective of users' sense of belonging and immersion respectively. For example, as Kang and Shin (2016) suggested, members in a virtual brand community who feel a sense of belonging show more loyalty. Ryu and Suh (2020) argued the sense of belonging to a crowdfunding platform is positively associated with platform loyalty. Kaur et al. (2021) identified sense of belonging positively correlates with intending to continue using LINE (a kind of mobile instant messaging). Moreover, according to Shin, Biocca, and Choo (2013), immersion, one dimension of SOVC, is a key feature and plays an important role in users' adoption behaviour in 3D-enabled virtual learning environments. Yang, Yang, and Men (2021) indicated immersion has a positive and significant effect on users' loyalty intention in the Danmu-enabled rec-vlog setting. Shi, Ma, and Zhu (2021) pointed out immersion experience plays a mediating role between emotional labour and user stickiness, which means immersion experience has a significant positive effect on users' stickiness in the live streaming environment. In Song et al.'s (2021) study, the empirical results suggest immersion is positively associated with users' continuous usage intention of short video apps to obtain health information. On the other hand, some extant literature explores the effect by regarding SOVC as a whole. Specifically, Feng et al. (2018) indicated members' SOVC is positively associated with their participation in a virtual brand community. Naranjo-Zolotov et al. (2019) showed continuous usage of e-participation is affected by users' SOVC through the mediator of use behaviour, indicating SOVC plays an important role in continuous intention to use e-participation over time. According to Alagarsamy, Mehrolia, and Singh (2021), one of the primary effects of brand loyalty is the sense of community.

The second part is limited to users' stickiness behaviour in the field of live streaming. A rich stream of research has explored the factors that influence the usage intention of live streaming (Chen and Lin 2018) and continuous watching intention (Hu, Zhang, and Wang 2017; Hou et al. 2020; Lim et al. 2020; Singh et al. 2021). Specifically, Chen and Lin (2018) examined the factors that induce viewers to watch live-streaming events from the angle of flow, entertainment, social interaction, and endorsement. Hu, Zhang, and Wang (2017) presented that viewers' identification with broadcasters and viewer groups positively affects their continuous watching intention. According to Hou et al. (2020), the continuous watching intention is influenced by interactivity and humour appeal in general, but these effects vary across different categories of live streaming (i.e. event, education, and personal sharing). Moreover, Lim et al. (2020) revealed both wishful identification and emotional engagement indirectly affect viewers' behavioural loyalty through parasocial relationships. Singh et al. (2021) investigated viewers' continued usage of live streaming considering perceived value, product-related attributes, and addiction to heavy viewing. However, the factors that drive viewers' intention to keep on watching live streaming from the perspective of SOVC and various interactions have not attracted enough attention. Therefore, this study aims to explore the effects of different interactions on viewers' continuous watching intention to live streaming via SOVC. The following sub-sections will attempt to introduce the relevant theories, namely SOVC and social exchange theory.

2.2. Theoretical background

2.2.1. Sense of virtual community (SOVC)

The concept of SOVC is derived from the construct of sense of community, which was first put forward by McMillan and Chavis (1986). Sense of community refers to 'a feeling that members have of belonging, a feeling that members matter to one another and to the group, and a shared faith that members' needs will be met through their commitment to be together' (McMillan and Chavis 1986). There are four elements of the definition of sense of community, namely membership, influence, integration and fulfilment of needs, and shared emotional connection. However, the definition of SOVC is in dispute, and the diverse definitions of SOVC are presented in Table 1. Regarding the measurement of SOVC, to develop a more suitable one for virtual community, Koh and Kim (2003) initially proposed the construct of SOVC consisting of three dimensions: membership, influence, and immersion, which reflect the affective, cognitive, and behavioural

Table 1. Previous studies on SOVC definition.

Work	Definition of SOVC	Investigated domain
Koh and Kim (2003)	'Individual's feelings of membership, influence, and immersion toward a virtual community.'	Diverse online communities
Blanchard (2007)	'Members' feelings of membership, identity, belonging, and attachment to a group that interacts primarily through electronic communication.'	Diverse online communities
Tsai, Cheng, and Chen (2011)	'Members' feelings of belonging, identity, and attachment to each other in computer-mediated communication.'	Online group buying
Tonteri et al. (2011)	'Human experience of a community feeling in a virtual environment.'	Newspaper's online discussion forum

aspects of members respectively. Then the SOVC construct was applied and studied in various types of virtual communities. Different from Koh and Kim (2003), some studies (Obst, Zinkiewicz, and Smith 2001; Blanchard 2007; Gibbs, Kim, and Ki 2019; Trehan and Sharma 2020) point out that influence might not be as essential in the context of virtual communities as in traditional communities. On the other hand, Blanchard and Markus (2004) found that membership of SOVC, including members' feelings of identity, is not the same as that for sense of community, which is consistent with Obst and his colleagues' findings (2001). Nevertheless, Peñarroja et al. (2019), Kim, Kim, and Kim (2020), and Waqas, Hamzah, and Salleh (2021) use the traditional four dimensions of sense of community proposed by McMillan and Chavis (1986) to measure SOVC, including membership, influence, fulfilment of needs, and emotional connection.

SOVC is the degree of affective attachment to a given virtual community that is mediated by information technology, such as live streaming technology in our study. Though recognition of the importance of SOVC, limited attention has been paid to the factors that underpin SOVC in the context of live streaming. For our study, in light of Maslow's hierarchy of needs, lower-order needs include the need for safety and love or belonging. Membership creates a feeling of belonging and of being a part of a group; hence, it can be classified into Maslow's lower-order category (Cheung et al. 2021). Therefore, following the extant research, a sense of membership, which involves identification with the live streaming platform, is considered in our study. In addition, enjoyability is a characteristic of virtual communities, especially of the live streaming platform, which provides a variety of entertaining and exciting content to meet various viewers' preferences and force continuous usage. Hence members of a platform tend to display immersive or addictive behaviour (Singh et al. 2021). Thus, immersion is adopted in our study. Based on the above analysis, we operationalise SOVC on two different dimensions, namely, membership and immersion. Specifically, membership refers to viewers' feelings of belonging to and identification with a live streaming platform; immersion refers to viewers' immersive or addictive behaviour and the state of flow viewers may experience while using a live streaming platform (Shin 2019a; Shin 2019b).

2.2.2. Social exchange theory

Social exchange theory was first proposed by Homans (Homans 1958), who argued that all human behaviours are dominated by some kind of exchange activity that can bring rewards. Blau (1964) later extended social exchange theory from microstructures to macrostructures. The present study mainly refers to the social exchange theory developed by Homans (1958), and one of the core concepts of this theory is reciprocity. Based on reciprocity, exchanges between individuals not only involve tangible benefits, such as rewards or promotions, but also involve intangible benefits, such as reputation, care, respect, understanding, comfort, etc. (Kankanhalli, Tan, and Wei 2005). As a mature theory, social exchange theory has been widely used in various fields such as knowledge sharing (Yan et al. 2016), online gifting behaviour (Kim, Kankanhalli, and Lee 2018), sharing economy (Davlembayeva, Papagiannidis, and Alamanos 2020), customer-employee exchange (Kim and Qu 2020), organisational crisis (Cortez and Johnston 2020), and especially user behaviour in online communities or virtual communities (e.g. Lee and Suzuki 2020). Specifically, Luo, Zhang, and Qi (2017) revealed that the interactions between students and instructors and between students and other students positively impact students' sense of community according to social exchange theory. Leclercq et al. (2020) assessed the impact of in-gamification perceived justice on members' contributions through the lens of social exchange theory in online communities. Urbonavicius et al. (2021) investigated the effect of involvement in social media on the willingness of consumers to disclose personal data in online purchasing marketing grounded in social exchange theory. In addition, Lee and Suzuki (2020) illustrated that reciprocity plays a significant role in motivating information exchange in virtual communities; more concretely, people share important information with others only if the benefits of doing so are expected to outweigh the cost of offering information to others.

In the current study, in the context of live streaming, viewers can obtain intangible benefits, such as feelings of belonging, pleasure, satisfaction, and understanding, from interacting with broadcasters or other viewers. Thus, SOVC here can be regarded as the benefit obtained from these interactions of a live streaming platform. If viewers want to continuously stay at the platform, they will measure the benefits of this decision from all perspectives. Viewers will remain in a virtual community only if the benefits of doing so meet their psychological expectations. Therefore, to retain viewers, we apply social exchange theory to explore the antecedents and consequences of SOVC.

3. Research model and hypotheses

Previous research mainly focuses on viewer-broadcaster interaction and viewer-viewer interaction, and studies their effects on users' engagement behaviour (Giertz et al. 2021) or usage behaviour (Chen and Lin 2018). On the other hand, in the e-learning environment, there are three types of interaction, namely, student-instructor interaction, student-content interaction, and student-student interaction (Moore 1989). Drawing on e-learning contexts, members' interactions on live streaming platforms can be divided into four modalities: viewer-broadcaster interaction, viewer-viewer interaction, viewer-platform interaction, and gift giving, a special interaction that differs from e-learning. Definitions of the constructs and literature utilised in our model are presented in Table 2.

Table 2. Construct definitions.

Construct	Definition	Reference
Viewer-broadcaster interaction	The degree of online interaction between viewers and broadcasters via the communication tools of a live streaming platform.	(Cheng 2013)
Viewer-platform interaction	The degree to which a viewer perceives control over the content, timing, and sequence of communication via a live streaming platform; the naturalness of live streaming platform navigation; and the responsiveness of the live streaming platform.	(Hoffman and Novak 1996)
Viewer-viewer interaction	The degree of online interaction between viewers and other viewers via the communication tools of a live streaming platform.	(Cheng 2013)
Gift-giving behaviour	A special kind of behaviour whereby viewers buy virtual gifts from the live streaming platform for broadcasters with real money, which can be regarded as a unique communication channel.	(Zhou et al. 2019)
Membership	Feelings of belonging to a given virtual community.	(Koh and Kim 2003)
Immersion	Experiencing a state of flow during virtual community navigation.	(Koh and Kim 2003)
Stickiness	Viewers' willingness to revisit the live streaming platform and prolong their length of stay on this platform.	(Hsu and Liao 2014; Hu et al. 2020)

3.1. Effects of viewer-broadcaster interaction and viewer-viewer interaction on SOVC

3.1.1. Viewer-broadcaster interaction and SOVC

In offline communities, members interact with each other regularly, and this phenomenon occurs in virtual communities as a means to share common interests. Extant studies view interaction as one of the most important characteristics of virtual communities (Jones 1997). Furthermore, interactions between members contribute to the development of SOVC. More importantly, members of virtual communities actively interact with each other, thus displaying emotional attachment (Brown and Duguid 2000). Moreover, as Yang and Shim (2020) revealed, the intensity of online interaction is positively associated with the perceived SOVC. Some extant research has examined this mechanism through the lens of sense of belonging (a facet of sense of membership) and immersion respectively. On the one hand, regarding membership, Luo, Zhang, and Qi (2017) revealed that student-instructor interaction is positively associated with students' sense of membership. As indicated by Sriram et al. (2020), the interaction between students and faculty plays an important role in the positive impact of living-learning communities, and could further promote students' sense of belonging. On the other hand, in terms of immersion, Fang et al. (2019) claimed that learner-instructor interaction in MOOCs exerts a significant positive effect on learners' sense of immersion. The e-learning literature has also identified a positive influence of student-teacher interaction on students' emotional engagement (Molinillo et al. 2018).

For live streaming platforms, the development of virtual communities also closely relates to interactions between each viewer and broadcaster. A live streaming platform enables viewers to connect and communicate with broadcasters, and these interactions will increase viewers' SOVC. Therefore, participating in online interactions is an effective means to maintain viewers' SOVC. Specifically, viewers can directly communicate with broadcasters in real time through chat rooms, by sending private messages, or through danmaku systems (Fei et al. 2021). If viewers can freely contact broadcasters and receive quick and friendly feedback, advice, or support via a live streaming platform, they may experience a feeling of belonging (Scheibe, Fietkiewicz, and

Stock 2016). When broadcasters respond to viewers' needs and encourage interactions between viewers and broadcasters, this may cause viewers to immerse themselves in these interactions, allowing them to experience flow (Choi, Kim, and Kim 2007). Furthermore, when viewers have follow-up questions, they can also pose them to broadcasters, and broadcasters will then provide further answers. Direct communications between viewers and broadcasters give viewers a warm and friendly impression, enabling viewers to focus their attention on live streaming, which further generates a sense of immersion (Sun et al. 2019). Considering the abovementioned factors, we expect viewer-broadcaster interaction to have a positive effect on viewers' sense of membership and immersion.

H1a: Viewer-broadcaster interaction has a positive impact on viewers' sense of membership.

H1b: Viewer-broadcaster interaction has a positive impact on viewers' sense of immersion.

3.1.2. Viewer-viewer interaction and SOVC

The real-time interactions between viewers and viewers on live streaming platforms will enhance their SOVC (membership and immersion). More concretely, prior research on e-learning demonstrates that student-student interaction plays a positive role in students' sense of membership (Luo, Zhang, and Qi 2017). Moreover, Hsu (2020) illustrated that parasocial interaction has a positive effect on consumers' sense of belonging in the context of YouTube. As such, it is reasonable to expect viewer-viewer interaction to be positively associated with their sense of membership. On the other hand, viewer-viewer interaction can facilitate viewers' sense of immersion, and the extant literature has confirmed a positive effect of this type of interaction on immersion in different contexts. For instance, Riva et al. (2007) verified that users feel more immersed in a virtual environment if their interactions with each other are realistic. As suggested by Fang et al. (2019), learner-learner interaction in MOOCs is positively associated with learners' sense of immersion. Furthermore, Molinillo et al. (2018) found that student-student interaction has a positive impact on students' emotional engagement.

In practice, similar to viewer-broadcaster interaction, viewers can also communicate with each other in real time via live communication tools (Payne et al. 2017; Fei et al. 2021). If viewers can easily exchange opinions or information with other viewers, they may develop a sense of intimacy with these viewers, and their sense of loneliness may then be alleviated. On the other hand, this kind of interaction can offer viewers a sense of connectedness and a feeling of caring about (Molinillo et al. 2018), fostering their emotional attachment and sense of immersion. Therefore, viewer-viewer interaction can immerse viewers in chats via a live streaming platform. As such, we expect viewer-viewer interaction to have positive effects on viewers' sense of membership and immersion.

H2a: Viewer-viewer interaction has a positive impact on viewers' sense of membership.

H2b: Viewer-viewer interaction has a positive impact on viewers' sense of immersion.

3.2. Effects of SOVC on viewers' stickiness

Stickiness has been widely investigated in IS field. According to Zott, Amit, and Donlevy (2000), a website's stickiness refers to its ability to attract and retain users. This concept is applied not only to describe a website's ability to attract and retain users but also its ability to motivate repeated visits (Hsu and Liao 2014). The term is also considered interchangeable with the term of loyalty (Wang, Wang, and Liu 2016). A live streaming platform has stickiness when viewers visit it repeatedly and dedicate more time and effort to the live streaming platform than the other viewers do (Hsu and Liao 2014). Therefore, in the present research, stickiness is defined as viewers' willingness to revisit a live streaming platform and prolong their length of stay on this platform (Hu et al. 2020).

3.2.1. Membership and viewers' stickiness

Membership in the current study refers to viewers' feelings of belonging (McMillan and Chavis 1986; Koh and Kim 2003), including their identification with a live streaming platform and its members (Blanchard and Markus 2004). On the one hand, some literature has investigated the positive effect of membership from the perspective of SOVC and has identified that SOVC increases members' satisfaction, which is the essential prerequisite to continuous usage (Luo, Zhang, and Qi 2017) and engagement behaviour (Hilvert-Bruce et al. 2018). This phenomenon has been confirmed in free software communities (Casalo, Flavian, and Guinaliu 2010) and online learning communities (Rovai 2002). Regarding stickiness, Kim, Lee, and Hiemstra (2004) demonstrated that SOVC (membership, influence and relatedness, integration and fulfilment of need, and shared emotional connection) leads members to become loyal to online communities. In addition, Naranjo-Zolotov et al. (2019) revealed that SOVC (membership, immersion, and influence) positively affects citizens' continuous intention to engage in e-

participation via use behaviour. On the other hand, some extant research has explored the relationship between membership and stickiness from the perspective of a sense of belonging. When members of a virtual community show a greater sense of belonging, their loyalty to this virtual community can be increased (Lin 2008), and their engagement can also be encouraged (Hsu and Liao 2014).

From a practical point of view, when viewers register with a platform, they regard themselves as members of this virtual community, creating a sense of belonging. This can help viewers overcome feelings of isolation and loneliness (Hsu 2020). Thus, membership has a positive effect on viewers' intention to remain on a live streaming platform. From the above analysis, we hypothesise the following.

H3: Viewers' sense of membership of a live streaming platform has a positive effect on their stickiness.

3.2.2. Immersion and viewers' stickiness

Immersion refers to members' feelings of a state of flow (Shin 2019a; Shin 2019b), which implies that members tend to display addictive behaviours. For instance, Naranjo-Zolotov et al. (2021) found that of the three measurements of SOVC, only immersion has a significant positive association with users' addiction to social media use in the public unrest environment. In support of this notion, previous studies have explored the relationship between immersion and stickiness or loyalty from the perspective of virtual reality, location-based AR games, websites, brand loyalty, etc. Specifically, loyalty in a VR setting was found to be positively and significantly affected by immersion (Hudson et al. 2019). Similarly, in an AR game environment, flow can increase users' stickiness. Moreover, as suggested by Cuny, Fornerino, and Helme-Guizon (2015), immersion shows a positive effect on e-loyalty to a website through the mediating role of aesthetic experience. Alagarsamy, Mehrolia, and Singh (2021) found sense of community is a primary influencer of brand loyalty. Based on the results of pertinent research, we expect that the relationship between immersion and stickiness in the live streaming setting is positive and significant.

In the live streaming context, viewers can watch talent shows, online games or news, or chat with other viewers and broadcasters about these contents (Lu et al. 2021); thus, they are more likely to spend more time watching live streaming content and then display sticky behaviour (Singh et al. 2021). In other words, when viewers watch live streaming content, they are more likely to ignore their immediate surroundings, concentrate more on the live streaming content, care more about interactions with broadcasters or other viewers, and experience immersion (Shin and Biocca 2018). Accordingly, viewers are more likely to discuss live content and exchange their opinions with broadcasters or other peers, and they are more inclined to seek assistance or help others and then may become immersed in the live streaming platform, thus fostering stickiness. In line with the above analysis, viewers' sense of immersion is expected to facilitate a greater degree of stickiness to live streaming platforms. We, therefore, propose the following hypothesis.

H4: Viewers' sense of immersion of a live streaming platform has a positive effect on their stickiness.

3.3. Moderating role of viewer-platform interaction

According to the definition of machine interactivity (Hoffman and Novak 1996), viewer-platform interaction is defined as the extent to which viewers perceive having a sense of control over content, time, and communication; the experience of navigation; and the response to their needs via the platform. Different types of information presentation formats can influence users' interactions with the system and use intention (Tang et al. 2020). The extant literature confirms that web interface design can trigger ambient belonging (Metaxa-Kakavouli et al. 2018). In addition, Monea (2020) pointed out that an educational platform can generate a sense of community when features of popular social media sites are included. Consistent with prior research on human–computer interaction, we propose that the level of viewer-platform interaction may strengthen both the effect of viewer-broadcaster interaction and viewer-viewer interaction on viewers' SOVC.

In practice, viewer-platform interaction is the most basic form of interaction (Luo, Zhang, and Qi 2017). If a live streaming platform enables viewers to control and get access to live content, freely communicate with other viewers or broadcasters, and obtain a quick response, they may be more willing to take part in and spend more time on the platform (Singh et al. 2021), which may strengthen viewers' perceptions of membership and immersion via this interactive function (Cheng 2013). Furthermore, if a live streaming platform offers a well-designed structure and clear instructions, viewers can easily navigate the live information and content (Cho, Cheng, and Lai 2009), allowing viewers more conveniently to interact with other viewers or broadcasters and feel more comfortable (Ho and Yang 2015), ultimately facilitating viewers' SOVC (membership and immersion) of the platform.

Thus, we hypothesise that in the formation of SOVC (membership and immersion), both the viewer-broadcaster interaction and viewer-viewer interaction rely on the level of viewer-platform interaction. As such, we propose the following.

H5a: Viewer-platform interaction positively moderates the effect of viewer-broadcaster interaction on viewers' sense of membership.

H5b: Viewer-platform interaction positively moderates the effect of viewer-broadcaster interaction on viewers' sense of immersion.

H6a: Viewer-platform interaction positively moderates the effect of viewer-viewer interaction on viewers' sense of membership.

H6b: Viewer-platform interaction positively moderates the effect of viewer-viewer interaction on viewers' sense of immersion.

3.4. Moderating role of gift-giving behaviour

As a major source of revenue (excluding advertisement revenue), paid gifts created by Chinese live streaming companies have been adopted by many firms (Lu et al. 2021). Viewers can buy different kinds of virtual gifts for broadcasters with real money while watching live streaming content (Li et al. 2020). In the real world, gifting is a behaviour of exchange and reciprocity between gift-givers and recipients (Sherry 1983), which is consistent with social exchange theory. Belk (1976) found that gifting has four functions, namely, communication, social exchange, economic exchange, and socialisation, among which the importance of exchange is emphasised. In virtual communities, status seeking serves as the fundamental motivation for gift giving (Lu et al. 2021). For example, Goode et al. (2014) found a strong correlation between gifting and future enhancements of the rewarder's social status. Accordingly, if viewers send gifts to broadcasters, they are more likely to receive quick responses, support, or suggestions from the broadcasters, facilitating viewer-broadcaster interaction. In addition, once a viewer sends a gift, his or her nickname and gift information are displayed for other viewers of the same channel to see (Fei et al. 2021). Then, the viewer may be mentioned by the broadcaster, enhancing his or her status (Lu et al. 2021), and ultimately resulting in a greater sense of membership and immersion via the above viewer-broadcaster interaction. Finally, Lu et al. (2018) indicated that some viewers send gifts just as a creative danmaku, which are similar to emojis or stickers, to express nuanced emotions. This may stimulate viewer-viewer interaction, further leading to a greater sense of membership and immersion.

On the other hand, gift-giving behaviour involves the commoditization of viewers' social interactions (Witkowski et al. 2016). Hence, gift giving is a special kind of interactive behaviour. Moreover, as Gros et al. (2017) asserted, the money and time viewers spend on live streaming platforms are highly correlated. This means that if viewers send virtual gifts to broadcasters, they may spend more time and effort on a platform. This is also in line with sunk cost theory (Arkes and Blumer 1985). More concretely, when viewers send a gift, they devote a sunk cost, so they are more willing to participate in both viewer-broadcaster interaction and viewer-viewer interaction. Such viewers may then spend more time on the platform and feel a stronger sense of belonging, and thus SOVC.

In light of the above analysis, we hypothesise that the relationship between viewer-broadcaster interaction and SOVC (membership and immersion) and that between viewer-viewer interaction and SOVC (membership and immersion) are moderated by gift-giving behaviour.

H7a: Viewers' gift-giving behavior positively moderates the effect of viewer-broadcaster interaction on viewers' sense of membership.

H7b: Viewers' gift-giving behavior positively moderates the effect of viewer-broadcaster interaction on viewers' sense of immersion.

H8a: Viewers' gift-giving behavior positively moderates the effect of viewer-viewer interaction on viewers' sense of membership.

H8b: Viewers' gift-giving behavior positively moderates the effect of viewer-viewer interaction on viewers' sense of immersion.

3.5. Control variables

To control for extraneous effects, four control variables (i.e. age, gender, education, and perceived value) that may affect stickiness as suggested by the extant literature are included in our research model. For instance, according to Lee, Chiang, and Hsiao (2018), male and older players show a higher level of stickiness when playing location-based AR games. Education level may have a significant influence on viewers' stickiness to live streaming platforms; therefore, we control for this variable as well. Furthermore, perceived value, which is defined as the overall utility value of a product or service that users perceive on the basis of a cost–benefit trade-off (Singh et al. 2021), may also have a potential effect on viewers' stickiness, as suggested by previous literature. For instance, Chen, Tsai, and Ke (2019) indicated that perceived value positively affects consumers' stickiness

to online brand communities. As Hsu and Lin (2016) reported, perceived value exerts a significant effect on users' stickiness to entertainment and leisure-oriented apps via affective responses (attitude and satisfaction). Hence, to determine the effects on viewers' stickiness, age, gender, education level, and perceived value are included in our model as control variables.

Based on the proposed hypotheses above, our research model is depicted in Figure 1.

4. Methodology

4.1. Research setting

The current research chose the users of TikTok as target respondents. We study the TikTok platform for three reasons. First, TikTok (Douyin in Chinese) is one of the most popular live streaming platforms not only in China but also overseas. With the ubiquitous use of mobile devices and the rapid development of the Internet, the number of daily active users of TikTok exceeded 600 million in August 2020 (ByteDance 2021). Moreover, as reported, TikTok was available in more than 150 countries and supported 75 different languages in 2020.

Second, TikTok offers two different services, namely, live streaming and short-form video. For live streaming, TikTok provides multiple mobile services such as discussion boards, chat rooms, and gift-giving functions, which help viewers easily interact with broadcasters and other viewers. More importantly, unlike Douyu, which offers free and paid gifting services (Li et al. 2020), TikTok only allows for paid gifts. Thus, viewers can only purchase virtual gifts with real money to reward broadcasters to attract attention or seek status. This is consistent with social exchange theory and sunk cost theory referenced in Hypotheses 7a-8b.

Finally, to further identify the appropriate live streaming platform, a pretest was conducted with 15 graduate students. The students were asked to write down the live streaming platforms they used most (Park and Lin 2020). TikTok was identified as the leading platform, which is in line with the data report of ByteDance (ByteDance 2021). Therefore, given TikTok's characteristics and the pretest results, we regarded TikTok as a representative platform for testing our research hypotheses.

4.2. Instrument

The measurement items for all latent constructs were obtained and refined from prior measures used in the pertinent literature. We invited 3 researchers in IS field and 5 doctoral students to examine the appropriateness and readability of each item. Then we translated the English instruments into Chinese and translated them back with their help. After refining, the questionnaire covers six constructs and includes respondents' demographics (gender, age, and education) and their usage of live streaming platforms (length of use, perceived value, gift giving to broadcasters, and the amount of money gifted). More concretely, viewer-broadcaster interaction, viewer-viewer interaction, and viewer-platform interaction were measured by three items based on Cheng (2013) with some modifications and adjustments to fit the live streaming context. The measurement items pertaining to SOVC, namely membership and immersion, were modified and adjusted from Luo, Zhang, and Qi (2017) and Koh and Kim (2003) respectively. In measuring stickiness, we adopted a four-item scale from Hsu and Liao (2014) and Luo, Zhang, and Qi (2017). The seven-point Likert scale was employed to measure all of the items (1: 'strongly disagree' and 7: 'strongly agree'). The specific constructs and items used are presented in Appendix A.

4.3. Data collection

To empirically test the proposed research model, we collected data from an online questionnaire targeting TikTok users in China. Following prior studies, we adopted the Chinese professional online survey website 'SO JUMP' (wjx.cn) to send invitation messages. The URL of the final questionnaire was distributed on social media platforms such as TikTok, WeChat, QQ, MicroBlog, and the special questionnaire service of 'SO JUMP'. The respondents could access and complete the online questionnaire by clicking on the hyperlink. We administered the online questionnaire in two stages. In the first stage, we distributed the questionnaire from May 27th to June 27th, 2020 through TikTok, WeChat, QQ, and MicroBlog. In the second stage, we collected data from April 15th to May 4th, 2021 with the assistance of SO JUMP questionnaire service which can distribute questionnaires to target respondents more precisely. Entry into a lottery upon completion of the questionnaire was offered to encourage participation. In addition, to prevent repeated survey participation from the same respondent, we enabled only one entry from a given IP address so that each respondent could submit the questionnaire only once.

In total, we collected 424 questionnaires in the first stage and 65 questionnaires in the second stage. However, 66 questionnaires were excluded totally due to respondents reporting never using TikTok before. Finally, a total of 423 valid questionnaires were remained (rate of return: 86.50%). The respondents

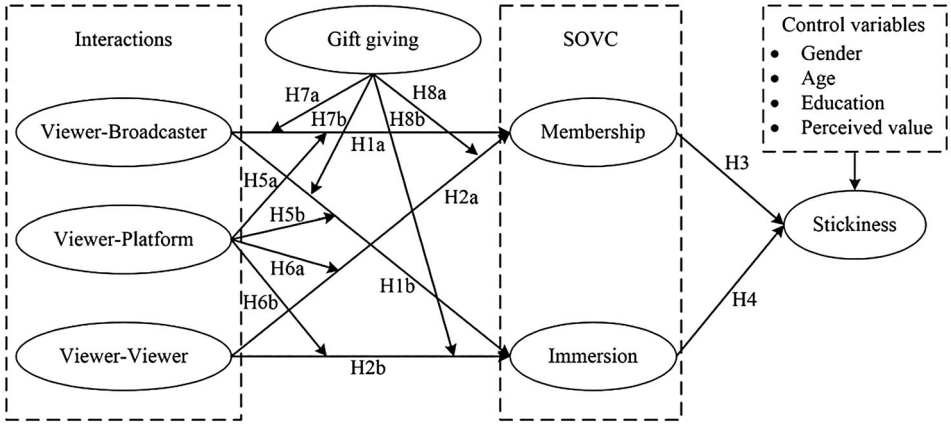

Figure 1. Research model.

were relatively balanced in gender. Specifically, among the 423 respondents, 52.5% were males, and 47.5% were females. A total of 86.3% of respondents were 18–35 years of age; 6.6% were over 35 years of age; and the rest were below 18 years of age. Over half of the respondents had used the live streaming platform for more than 6 months. Furthermore, a minority (34.5%) had sent gifts to broadcasters, and among them, most (79.4%) had paid less than 200¥. A summary of the sample's demographic information and usage of the live streaming platform is presented in Table 3.

5. Data analysis and results

We applied Partial Least Squares-Structural Equation Modeling (PLS-SEM) to assess the measurement and structural model, and adopted SmartPLS 3.2 for data analysis. We utilise the PLS-SEM method for three reasons. First, PLS-SEM is suitable for exploratory research and theory development (Chin 1998). Second, we conducted the one-sample Kolmogorov–Smirnov normality test (Lee et al. 2016) to identify our data distribution, and the results showed a nonnormal distribution. Compared with covariance-based structural equation modeling (CB-SEM), which has minimal demands in terms of measurement scale, sample size, and residual distributions, PLS-SEM can handle nonnormal distributions relatively well (Hair et al. 2019). Considering this aspect, PLS-SEM was deemed for this study. Finally, Chin, Marcolin, and Newsted (2003) implemented PLS-SEM to examine moderating effects according to the product indicator method developed by Kenny and Judd (1984). PLS-SEM can provide more accurate estimates of moderating effects (Chin 1998), and it can estimate measurement model, structural model, and moderating effect at the same time (Xiao and Mou 2019). Considering the above analyses, PLS-SEM was utilised in the current study.

For the PLS-SEM analysis, a two-step analysis procedure involving measurement model and structure model was conducted. Additionally, the common method variance (CMV), moderating effects, and mediating effects were evaluated and reported.

Table 3. Respondents' demographics and usage of live streaming platform.

Measures	Categories	Frequency	Percent
Gender	Male	222	52.5
	Female	201	47.5
Age	Under 18	30	7.1
	18–25	173	40.9
	26–30	125	29.6
	31–35	67	15.8
	Over 35	28	6.6
Education	High school or below	16	3.8
	Junior college	128	30.2
	University	203	48.0
	Postgraduate or above	76	18.0
Length of use	Less than 3 months	58	13.7
	3–6 months	132	31.2
	6–12 months	153	36.2
	More than 1 year	80	18.9
Sending gifts to broadcasters	Yes	146	34.5
	No	277	65.5
Amount of money for gift giving	Under 50¥	33	22.6
	50–100¥	57	39.0
	100–200¥	26	17.8
	200–500¥	15	10.3
	Over 500¥	15	10.3

5.1. Measurement model test

During the inspection of the measurement model, the validity and internal consistency reliability were tested. Internal consistency reliability can be evaluated utilising Cronbach's α and composite reliability (CR), both of which have to be greater than 0.7 (Chin 1998). Table 4 shows that the Cronbach's α values of all constructs are between 0.859 and 0.893 and CR values range

Table 4. Factor loadings and construct reliability and validity.

Constructs	Items	Factor loadings	Average variance extracted (AVE)	Composite reliability (CR)	Cronbach's α
Viewer-broadcaster interaction (VBI)	VBI1	0.851	0.780	0.914	0.859
	VBI2	0.894			
	VBI3	0.903			
Viewer-viewer interaction (VVI)	VVI1	0.857	0.786	0.917	0.864
	VVI2	0.909			
	VVI3	0.893			
Membership (MEM)	MEM1	0.906	0.808	0.927	0.881
	MEM2	0.895			
	MEM3	0.895			
Immersion (IMM)	IMM1	0.926	0.823	0.933	0.893
	IMM2	0.895			
	IMM3	0.900			
Stickiness (STI)	STI1	0.866	0.712	0.908	0.866
	STI2	0.826			
	STI3	0.859			
	STI4	0.823			

from 0.908 to 0.933, indicating favourable reliability. The validity consists of convergent validity and discriminant validity. First, we adopted the factor loading and average variance extracted (AVE) to evaluate the convergent validity. The validity will be fulfilled if the factor loadings are greater than 0.7 and the AVE is larger than 0.5 (Fornell and Larcker 1981). Table 4 indicates that both the values of factor loadings and AVE exceed the thresholds, denoting satisfactory convergent validity.

Furthermore, the discriminant validity of the measurement model was tested through the criterion proposed by Fornell and Larcker (1981) and the cross-loadings of the indicators. On the one hand, Table 5 demonstrates that the square root of each construct's AVE is larger than the inter-construct correlations, indicating satisfactory discriminant validity. On the other hand, in Table 6, the results show that the factor loadings of each item on their own construct are higher than those on other constructs, once again providing support for discriminant validity.

5.2. Cmv test

CMV may be a potential problem when the data are collected from the same respondents. We adopted two statistical analyses to ensure that CMV was not a serious concern in our work. First, Harman's one-factor test was conducted, and the result shows there are 6 factors with eigenvalues greater than one, and the common variance explained by the largest one is 44.23%, which is lower than 50% (Teo et al. 2015), confirming that CMV is not a serious problem. We also applied another method proposed by Liang et al. (2007). As presented in Table 7, the ratio of the average substantive variance to the average method variance is 113:1. Furthermore, all of the substantive factor loadings are statistically significant at $p < 0.001$ level, and most of the method factor loadings are insignificant. Considering the above analyses, CMV is not a serious issue in this study.

Table 5. Correlation of constructs.

Constructs	VBI	VVI	MEM	IMM	STI
VBI	***0.883***				
VVI	0.428	***0.886***			
MEM	0.499	0.492	***0.899***		
IMM	0.559	0.495	0.607	***0.907***	
STI	0.508	0.450	0.426	0.451	***0.844***

Note: Diagonal elements (in italics and bold) are the square root of AVEs for each construct.

5.3. Structural model test

In the structure model of PLS-SEM, paths are regarded as the standardised coefficients in the regression analysis (Chin 1998). The results of the estimated structural model with standardised coefficients and their significance are presented in Figure 2, and 30.9% of the variance in stickiness can be explained. Additionally, 34.4% and 39.3% of the variance are explained by viewers' sense of membership and immersion, respectively.

Table 6. Indicator loadings and cross-loadings.

	VBI	VVI	MEM	IMM	STI
VBI1	***0.851***	0.346	0.440	0.455	0.379
VBI2	***0.894***	0.401	0.393	0.517	0.497
VBI3	***0.903***	0.385	0.485	0.508	0.469
VVI1	0.342	***0.857***	0.369	0.400	0.328
VVI2	0.416	***0.909***	0.483	0.452	0.432
VVI3	0.374	***0.893***	0.447	0.461	0.427
MEM1	0.477	0.448	***0.906***	0.579	0.435
MEM2	0.436	0.430	***0.895***	0.525	0.342
MEM3	0.430	0.449	***0.895***	0.529	0.366
IMM1	0.592	0.506	0.612	***0.926***	0.448
IMM2	0.467	0.425	0.509	***0.895***	0.363
IMM3	0.447	0.407	0.519	***0.900***	0.410
STI1	0.383	0.378	0.338	0.421	***0.866***
STI2	0.372	0.346	0.289	0.377	***0.826***
STI3	0.437	0.399	0.373	0.370	***0.859***
STI4	0.507	0.390	0.420	0.357	***0.823***

Table 7. CMV analysis.

Constructs	Items	Substantive factor loadings (R1)	$R1^2$	Method factor loadings (R2)	$R2^2$
IMM	IMM1	0.917***	0.841	−0.058	0.003
	IMM2	0.901***	0.812	0.174***	0.030
	IMM3	0.905***	0.819	−0.098	0.010
MEM	MEM1	0.900***	0.810	−0.085	0.007
	MEM2	0.900***	0.810	−0.049	0.002
	MEM3	0.897***	0.805	−0.099	0.010
STI	STI1	0.880***	0.774	0.024	0.001
	STI2	0.850***	0.723	0.132**	0.017
	STI3	0.847***	0.717	0.017	0.000
	STI4	0.800***	0.640	0.038	0.001
VBI	VBI1	0.852***	0.726	−0.103**	0.011
	VBI2	0.897***	0.805	0.060	0.004
	VBI3	0.899***	0.808	0.037	0.001
VVI	VVI1	0.869***	0.755	0.087	0.008
	VVI2	0.903***	0.815	−0.061	0.004
	VVI3	0.888***	0.789	−0.028	0.001
Average		***0.8816***	***0.7780***	***−0.0008***	***0.0069***

Note: ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$, $^{(*)}p < 0.1$, ^{IS} Insignificant at the 0.1 level.

Specifically, viewer-broadcaster interaction is positively associated with viewers' sense of membership ($\beta = 0.353$, $p < 0.001$) and immersion ($\beta = 0.425$, $p < 0.001$), which supports H1. As expected, viewer-viewer interaction can significantly enhance viewers' sense of membership ($\beta = 0.341$, $p < 0.001$) and immersion ($\beta = 0.314$, $p < 0.001$), supporting H2. However, the effect of viewer-broadcaster interaction on viewers' membership and immersion is stronger than that of viewer-viewer interaction. Furthermore, both membership ($\beta = 0.124$, $p < 0.001$) and immersion ($\beta = 0.250$, $p < 0.001$) exert significant positive effects on stickiness. Thus, H3 and H4 are supported. Finally, the relationships between the demographic variables (gender, age, and education) and stickiness are insignificant; nevertheless, perceived value ($\beta = 0.295$, $p < 0.001$), one of the control variables, has a significant positive influence on stickiness, just as we expected.

5.4. Moderation analysis

We investigated the moderating roles of viewer-platform interaction and gift-giving behaviour, respectively. First, viewer-platform interaction is a continuous variable; thus, we tested the moderating effect of viewer-platform interaction directly using SmartPLS 3.2. Second, we performed a multi-group analysis to examine the moderating effect of gift giving via SmartPLS 3.2 for the reason that gift giving is a binary variable.

The results of the moderating effect of viewer-platform interaction are presented in Table 8. On the one hand, the empirical findings reveal that viewer-platform interaction positively moderates the relationship between viewer-broadcaster interaction and viewers' sense of membership and immersion, thus supporting H5a and H5b. On the other hand, the impacts of viewer-viewer interaction on viewers' sense of membership and immersion are significantly stronger for high viewer-platform interaction than for low viewer-platform interaction, supporting H6a and H6b.

The moderating effect of viewers' gift-giving behaviour is shown in Table 9. The empirical findings indicate that all of the path coefficients are insignificant, suggesting that there are no moderating effects of gift-giving behaviour on the relationship between viewer-broadcaster interaction and viewers' membership and immersion or the relationship between viewer-viewer interaction and viewers' membership and immersion.

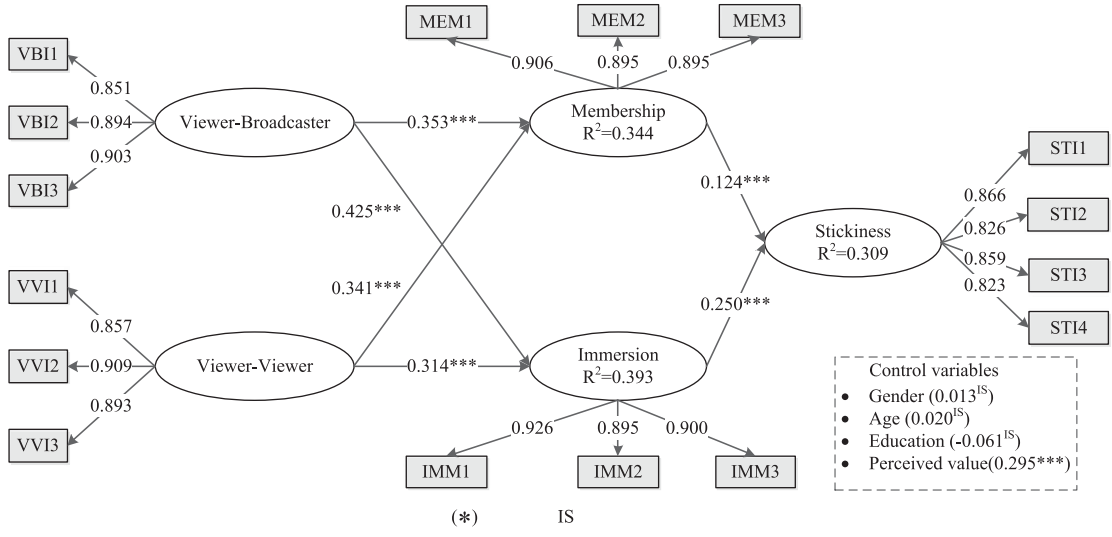

Figure 2. Results of the structural model estimation.

Note: ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$, $^{(*)}p < 0.1$, ^{IS}Insignificant at the 0.1 level.

Table 8. Results of the moderating effect of viewer-platform interaction.

H	Relationships	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	*P* Values
H5a	VBI*VPI-> MEM	0.177	0.173	0.052	3.428	0
H5b	VBI*VPI-> IMM	0.150	0.147	0.043	3.496	0
H6a	VVI*VPI-> MEM	0.172	0.171	0.043	3.992	0
H6b	VVI*VPI-> IMM	0.203	0.203	0.034	6.036	0

Hence, H7a to H8b are rejected. There may be three reasons for this phenomenon. First, gift giving is a special behaviour involving real money, and status seeking is the main reason for gift giving in virtual communities (Zhou et al. 2019; Lu et al. 2021), resulting in the insignificant moderating effect of gift giving. Second, our questionnaire was mainly distributed and collected during the COVID-19 pandemic, when viewers might have used live streaming services to pass time. Considering the amount of money paid, we suspect that the respondents had only sent gifts once or twice, reflecting a tentative behaviour. Therefore, gift giving does not boost viewers' sense of membership and immersion. Third, broadcasters can focus on either community communication or content communication (Giertz et al. 2021). When broadcasters emphasise interaction with viewers by responding to questions and requests (i.e. community-focused communication), donations will be reduced. On the contrary, content-focused communication drives donations. These two opposite effects may result in the insignificant moderating effect of gift giving.

5.5. Mediation analysis

To examine whether membership and immersion mediate the relationship between different interactions and stickiness, we further conducted the mediation analysis according to the guidelines prescribed by Hayes (2009) in SmartPLS. We used 5000 bootstrap replications with bias-corrected percentile bootstrapping within 95% confidence interval. Table 10 reports the mediation analysis results. As shown, all the path relationships have passed the mediation test at the 95% confidence interval (Preacher and Hayes 2008). Furthermore, we calculated Variance Accounted For (VAF) according to Hair et al. (2019) to examine the specific mediation mechanism (full or partial mediation). As shown in Table 10, all the VAFs vary in proportion from 20% to 80%, indicating partial mediating effects. As a result, we conclude that membership and immersion act as partial mediators in this research framework.

Table 9. Results of the moderating effect of gift giving.

H	Relationships	Path Coefficients-diff (Gift – No-gift)	*p*-Value (Gift vs No-gift)
H7a	VBI -> MEM	0.002	0.487
H7b	VBI -> IMM	0.029	0.374
H8a	VVI -> MEM	−0.110	0.864
H8b	VVI -> IMM	−0.102	0.850

Note: Gift denotes viewers' gift-giving behaviour; No-gift denotes viewers not sending gifts to broadcasters.

6. Discussion and implications

6.1. Discussion of findings

The current study offers fresh insights into how various interactions affect viewers' stickiness under the background of live streaming. We do this by introducing the concept of SOVC to our research model, which provides a theoretical basis to investigate the associations of different interactions with viewers' continuous usage intention in the context of live streaming. Most of the hypotheses are supported except for H7–H8, and several findings are obtained.

First, previous research mainly focuses on the influence of interactions on sense of community and SOVC through the lens of other social media or e-learning platforms (Luo, Zhang, and Qi 2017; Tang 2018). For instance, Luo, Zhang, and Qi (2017) indicated that both student-instructor interaction and student-student interaction positively affect students' sense of community in an e-learning environment. Tang (2018) found that the interaction between group members could

Table 10. Results of mediation analysis with bootstrapping.

Mediation Path	Coefficient (O)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	*P* Values	Bootstrap Bias-corrected Percentile 95% CI	VAF	Mediating Effect
VBI→IMM→STI	0.106	0.028	3.790	0.000	[0.052,0.162]	38.4%	PM
VBI→MEM→STI	0.044	0.022	2.008	0.045	[0.006,0.091]	20.6%	PM
VVI→IMM→STI	0.078	0.022	3.599	0.000	[0.041,0.125]	32.8%	PM
VVI→MEM→STI	0.042	0.021	2.008	0.045	[0.006,0.091]	20.8%	PM

Notes: *P* values are estimated with 5000 bootstrap replications and bias-corrected percentile confidence intervals are presented. PM denotes partial mediation.

significantly strengthen their SOVC. However, the present work empirically explores the effect of two specific interactions (viewer-broadcaster interaction and viewer-viewer interaction) on SOVC in the live streaming context. The results imply that viewer-broadcaster interaction and viewer-viewer interaction are two significant antecedents of viewers' sense of membership and immersion. That is, even though the research environment of our study differs from others, the observed positive effects of interactions on sense of community or SOVC are consistent. However, the findings demonstrate that these two different types of interaction do not have an equally strong influence on the two facets of SOVC (membership and immersion). Specifically, compared to viewer-viewer interaction, viewer-broadcaster interaction has a stronger impact on both membership and immersion.

Second, extant research has investigated viewers' continuous watching or usage intention (Hou et al. 2020; Komutanont, Nuangjamnong, and Dowpiset 2020; Lim et al. 2020; Singh et al. 2021). However, this work explores viewers' continuous watching intention from the perspective of SOVC (membership and immersion). Although the same research model has not been proposed by prior studies, this research perspective is in line with the existing literature showing that SOVC plays a positive role in customers' continuous use intention (e.g. Naranjo-Zolotov et al. 2019), online group buying intention (e.g. Tsai, Cheng, and Chen 2011), and so on. The empirical findings suggest that both viewers' sense of membership and immersion jointly contribute to their stickiness to the live streaming platform, affirming the importance of SOVC for viewers' continuous usage of this platform. However, immersion is revealed to be the key driver of viewers' stickiness.

Third, the findings of the current research further verified that the moderating effect of viewer-platform interaction is positive and significant. Viewer-platform interaction is found to positively moderate the relationships of viewer-broadcaster interaction and viewer-viewer interaction with viewers' SOVC (membership and immersion), extending the research on various interactions to a different focus. More concretely, when viewer-platform interaction is stronger, the effects of both viewer-broadcaster interaction and viewer-viewer interaction on viewers' SOVC (membership and immersion) are significantly stronger than when such interaction is less pronounced. The possible reason is that viewers can take control of their watching content and choose community-focused communication or content-focused communication freely on TikTok, enabling viewers to interact actively with broadcasters or their peers, finally influencing their experience in the live streaming environment. In addition, TikTok exhibits a clear and organised structure, and viewers can conveniently navigate the content and easily find live streaming, thus providing great convenience for interaction activities, ultimately promoting their sense perceived from TikTok.

Fourth, contrary to our expectations, we found no moderating effects of gift-giving behaviour on the relationships of viewer-broadcaster interaction and viewer-viewer interaction with viewers' SOVC (membership and immersion), a new phenomenon that differs from other studies of live streaming. This insignificant result may be attributed to three factors. First, as a special interaction, viewers may send gifts mainly for status-seeking purposes (Lu et al. 2021). When a viewer sends a gift, information such as the viewer's nickname and the type and value of the gift is displayed to the broadcaster and other channel viewers (Zhou et al. 2019). Thus, this gift-giving behaviour can enhance one's social image (Lu et al. 2021). Then, a viewer may not pay attention to viewer-broadcaster interaction or viewer-viewer interaction, resulting in an insignificant moderating effect of gift giving. The insignificant result may also be due to our data mainly being collected during the COVID-19 pandemic, when people stayed at home and may have used live streaming just for passing time. Most of the viewers gave gifts less than 200¥. It can thus be inferred that most of the respondents sent gifts tentatively or to try the behaviour out. Third, broadcasters' communication is categorised into two types: community-focused communication and content-focused communication. If a broadcaster provides social interactions via high community-focused communication, viewers might not give gifts because they may not regard this kind of communication as a complex and costly task. Viewers are inclined to donate to a broadcaster with a content focus for the reason that they encourage the broadcaster to provide such helpful content continuously (Giertz et al. 2021). The opposite effects of communication type may lead to an insignificant effect of gift giving.

Finally, the current study obtains new research findings by uncovering the mediation mechanism of SOVC between social interactions and stickiness. As reported in the mediation test results, both the impacts of viewer-broadcaster interaction and viewer-viewer interaction on viewers' stickiness are partially mediated by SOVC. In brief, in addition to the direct positive effects of viewer-broadcaster interaction and viewer-viewer interaction on stickiness, these variables can also induce positive SOVC and indirectly affect viewers' stickiness. Specifically, membership helps viewers

overcome feelings of isolation (Hsu 2020). Immersion makes viewers spend more time on the live streaming platform and display sticky behaviour (Singh et al. 2021). All of these factors contribute to viewers' continuous usage of the live streaming platform. Overall, these empirical findings are consistent with extant studies indicating that SOVC plays an important role in users' engagement, sticky, or addictive behaviour (Naranjo-Zolotov et al. 2019; González-Anta et al. 2021; Naranjo-Zolotov et al. 2021). These findings may encourage managers to prioritise interaction functions to improve viewers' stickiness to live streaming platform.

6.2. Theoretical implications

This work contributes to extant live streaming literature. Overall, the current study adds to our understanding of viewers' behaviour in online social interactions in the following aspects.

First, from a theoretical perspective, previous studies explain SOVC in the environment of other social media or e-learning settings, and little is known about the effects of interactions, especially of specific types of interactions (i.e. viewer-broadcaster interaction, viewer-viewer interaction, viewer-platform interaction, and gift giving), on SOVC in the live streaming environment. The extant literature mainly considered social interaction as a uniform construct and focused on the influence of social interaction on users' engagement behaviour (Fang et al. 2019), flow experience (Hsu 2020), or technology adoption (Bonan et al. 2021). While on live streaming platform, viewers can obtain membership and immersion through communicating with broadcasters or other viewers. Therefore, investigating the roles of these four interactions in improving viewers' SOVC is essential to continuous watching intention. Hence, the current study specifies four kinds of interactions and then explores their effects on SOVC under the background of live streaming. More concretely, viewer-broadcaster interaction has a stronger impact on both membership and immersion than that of viewer-viewer interaction, indicating that community-focused communication of a broadcaster rather than content-focused broadcaster can foster viewers to establish membership and immersion (Giertz et al. 2021).

Second, to the best of our knowledge, this study is among the first to explore viewers' stickiness to live streaming platform from the SOVC perspective. Although viewers' continuous watching intention or usage intention have been widely tested (Hou et al. 2020; Komutanont, Nuangjamnong, and Dowpiset 2020; Lim et al. 2020; Singh et al. 2021), few studies have investigated the potential relevance of viewers' SOVC for understanding the antecedents of viewers' stickiness to the platform. Furthermore, we empirically examine the separate influences of the two dimensions of SOVC on viewers' continuance intention. Specifically, both membership and immersion exert significant positive effects on viewers' stickiness, which is consistent with the extant studies that have demonstrated SOVC plays an important role in community members' satisfaction, participation, addiction, trust, and commitment toward online communities (Chang, Hsieh, and Fu 2016; Gibbs, Kim, and Ki 2019; Naranjo-Zolotov et al. 2019; Naranjo-Zolotov et al. 2021). However, immersion has a stronger effect than that of membership on viewers' stickiness. This is consistent with prior research that emphasises the importance of immersion to users' behaviour (Shin and Biocca 2018; Hudson et al. 2019; Shin 2019a; Shin 2019b; Naranjo-Zolotov et al. 2021). While in this specific context, the factors influencing immersion may be viewers' perceptions of attractiveness of live streaming, ease of use of live video streaming platform, or the interaction with broadcasters and other viewers. This study verifies the effects of viewer-broadcaster interaction and viewer-viewer interaction. Furthermore, when viewers get immersed, they are more inclined to display sticky behaviour. The research findings can enrich our understanding of immersion from a live streaming perspective.

Third, the present study reveals the moderating effects of viewer-platform and gift giving on the relationship between social interactions and membership as well as immersion. On the one hand, prior studies have discussed social interactions in various contexts, and little attention has been paid to interactions at the system or technical level. By conducting moderation analysis, we find that the relative effects of social interaction on viewers' SOVC are contingent upon viewer-platform interaction. Specifically, the more fluent viewer-platform interaction is, the stronger sense of membership and immersion viewers can experience. On the other hand, although previous studies have investigated gift-giving behaviour, they mainly explored its antecedents and consequences. Whereas, this study examines the moderating role of gift giving, which fits the new situation of live streaming and extends the scope of extant literature. It is worth mentioning that the moderating effect is insignificant, indicating that viewers' gift-giving behaviour cannot enhance viewers' SOVC by boosting social interaction. The findings of this work can enhance our understanding of the moderating effects of viewer-platform interaction and gift giving in the context of live streaming.

Finally, our study contributes to work on social exchange theory. In considering SOVC as a benefit of diverse interactions, viewers balance between these interactions and benefits, and they will stay at the platform only if the corresponding benefits meet their psychological expectations, expanding the realm of social exchange theory. Most of the hypotheses are confirmed, suggesting that social exchange theory, which can explain viewers' sticky behaviour in live streaming settings, is robust.

6.3. Practical implications

From a managerial perspective, understanding the role of diverse interactions in SOVC and viewers' stickiness may offer competitive advantages to developers and broadcasters. First, as revealed, both viewer-broadcaster interaction and viewer-viewer interaction have significant positive effects on viewers' sense of membership and immersion. Therefore, the developers and managers should continue to make communication functions convenient and effective, and take some incentive steps to encourage interactions between viewers and broadcasters to improve viewers' sense of membership and immersion. For instance, viewers in the same channel who send messages most will be rewarded with 10 Douyin coins (about $ 0.16) to facilitate interactions. On the other hand, social interaction should be valued by broadcasters to enhance viewers' SOVC. More concretely, broadcasters should take full advantage of the communication tools on live streaming platform, for example, referencing chat messages, welcoming new viewers to this channel, to respond to viewers' questions and needs as soon as possible. In other words, broadcasters can offer quick and effective responses to solve problems from viewers and convey rich information about their problems. In addition, broadcasters can also promote interactions by raising some hot topics to discuss. This steady interaction can effectively make viewers feel like part of the community and immerse themselves in the stream. Then their need for relatedness can be satisfied, and internal motivation to view the streams more can be further spurred (Giertz et al. 2021).

Second, SOVC is verified to have a positive impact on stickiness and mediate the relationship between social interaction and stickiness. As such, we advise developers and managers to dedicate thought and resources to exploiting programmes that build viewers' SOVC, which influences their stickiness to the platform. For instance, TikTok allows users to group their friends or fans into cliques, facilitating the process of sending streaming information or message to a specific group of members. Furthermore, members, with the same interests in the clique, can share something in common, thus building steady relationships. Therefore, the more viewers interact, the more likely they stay at the live streaming platform, as they perceive that they have close relationships with broadcasters and other viewers, and experience membership and immersion. Consequently, their continuous watching intention can be fostered.

Finally, our findings suggest that viewer-platform interaction moderates the relationship between two specific interactions (viewer-broadcaster interaction and viewer-viewer interaction) and SOVC (membership and immersion). Thus, the platform developers and managers need to recognise the importance of viewer-platform interaction in retaining users. When developers and managers develop live streaming platform, they should focus on providing technological functions such as effective user interfaces, good navigation structures, and quick responses. For example, categories of live content and search buttons should be provided to help viewers find their interesting content. However, the moderating effect of gift giving fails to obtain statistical significance, indicating gift-giving function cannot foster viewers' membership and immersion while the social interaction is higher. Thus, developers and managers could keep the gift-giving function unchanged and pay less attention. With regard to broadcasters, gift giving, as their major source of income, ought to be emphasised, though the moderating effect is not significant. Specifically, they can provide skill-building resources such as the skills of Photoshop, Microsoft Office, cooking, for interested users except for communicating with their viewers to stimulate gift giving.

7. Limitations and future research

Several limitations are included in this study though there are some theoretical and practical implications of our empirical findings. First, the data were collected from TikTok users in mainland China. It is reasonable to assume that different live streaming platforms with various cultural backgrounds may have diverse results, which limits the generalizability of our findings. Therefore, samples from more platforms or countries are needed in future research. Second, this study investigated the moderating role of gift giving. However, as a special interaction, gift-giving behaviour is considered as the commoditization of a viewer's social interaction, which is also regarded as a kind of sunk cost for viewers. Hence future research can explore its moderating effect from the perspective of economic mechanisms such as the amount of money gifted. Third, we only investigated the moderating role of gift giving and viewer-platform

interaction in this current study, ignoring their mediating effects. Therefore, the mediating effects need to be explored in future research to find some interesting results. Finally, we adopted cross-sectional data and PLS-SEM for our data analysis. Future studies can employ panel data and econometric models to fully understand viewers' SOVC and stickiness over time.

8. Conclusions

The goal of this research is to ascertain how different interactions affect viewers' SOVC in a live streaming environment. The results of our PLS-SEM analysis reveal the following. First, both viewer-broadcaster interaction and viewer-viewer interaction show significant positive effects on viewers' SOVC (membership and immersion), and thereby affect viewers' stickiness to the live streaming platform. Whereas, viewer-broadcaster interaction has stronger effects on both membership and immersion. Second, viewer-platform interaction positively moderates the relationship between the two specific types of interaction and viewers' SOVC (membership and immersion), whereas the moderating role of gift giving is insignificant. Third, our mediation test results confirm that the impact of interactions on viewers' stickiness is partially mediated by membership and immersion. That is, both viewer-broadcaster interaction and viewer-viewer interaction can not only improve viewers' stickiness through a sense of membership and immersion but can also directly foster their stickiness. These results suggest that managers should provide relevant mechanisms to encourage interactions on live streaming platform to drive viewers' continuous usage.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported by the National Natural Science Foundation of China [grant numbers 71671011, 71332003 and 71271012].

ORCID

Pengfei Tang http://orcid.org/0000-0003-1077-3827

References

Alagarsamy, S., S. Mehrolia, and B. Singh. 2021. "Mediating Effect of Brand Relationship Quality on Relational Bonds and Online Grocery Retailer Loyalty." *Journal of Internet Commerce* 10 (1): 1–27.

Arkes, H. R., and C. Blumer. 1985. "The Psychology of Sunk Cost." *Organizational Behavior and Human Decision Processes* 35 (1): 124–140.

Belk, R. W. 1976. "It's the Thought That Counts: A Signed Digraph Analysis of Gift-Giving." *Journal of Consumer Research* 3: 155–162.

Blanchard, A. L. 2007. "Developing a Sense of Virtual Community Measure." *CyberPsychology & Behavior* 10 (6): 827–830.

Blanchard, A. L., and M. L. Markus. 2004. "The Experienced Sense of a Virtual Community: Characteristics and Processes." *ACM SIGMIS Database: the DATABASE for Advances in Information Systems* 35 (1): 64–79.

Blau, P. M. 1964. *Exchange and Power in Social Life*. New York, NY: John Wiley & Sons.

Bonan, J., P. Battiston, J. Bleck, P. LeMay-Boucher, S. Pareglio, B. Sarr, and M. Tavoni. 2021. "Social Interaction and Technology Adoption: Experimental Evidence from Improved Cookstoves in Mali." *World Development* 144: 105467.

Brown, J. S., and P. Duguid. 2000. *The Social Life of Information*. Boston, BSN: HBS Press.

ByteDance, Data report of Douyin in 2020. 2021. Accessed April 9, 2021. https://www.bytedance.com/zh/news/60489e2c5dc4ed02d13cb3b9.

Casalo, L. V., C. Flavian, and M. Guinaliu. 2010. "Relationship Quality, Community Promotion and Brand Loyalty in Virtual Communities: Evidence from Free Software Communities." *International Journal of Information Management* 30 (4): 357–367.

Chang, H. H., P. H. Hsieh, and C. S. Fu. 2016. "The Mediating Role of Sense of Virtual Community." *Online Information Review* 40 (7): 882–899.

Chen, C. C., and Y. C. Lin. 2018. "What Drives Live-Stream Usage Intention? The Perspectives of Flow, Entertainment, Social Interaction, and Endorsement." *Telematics and Informatics* 35 (1): 293–303.

Chen, M., K. Tsai, and Y. Ke. 2019. "Enhancing Consumers' Stickiness to Online Brand Communities as an Innovative Relationship Marketing Strategy." *International Journal on Semantic Web and Information Systems* 15 (3): 16–34.

Cheng, Y. M. 2013. "Exploring the Roles of Interaction and Flow in Explaining Nurses' e-Learning Acceptance." *Nurse Education Today* 33: 73–80.

Cheung, C., M. Takashima, H. Choi, H. Yang, and V. Tung. 2021. "The Impact of COVID-19 Pandemic on the Psychological Needs of Tourists: Implications for the Travel and Tourism Industry." *Journal of Travel & Tourism Marketing* 38 (2): 155–166.

Chin, W. W. 1998. "Issues and Opinion on Structural Equation Modeling." *MIS Quarterly* 22 (1): 7–16.

Chin, W. W., B. L. Marcolin, and P. R. Newsted. 2003. "A Partial Least Squares Latent Variable Modeling Approach for Measuring Interaction Effects: Results from a Monte Carlo Simulation Study and an Electronic-Mail Emotion/Adoption Study." *Information Systems Research* 14 (2): 189–217.

China Internet Network Information Center (CNNIC). Statistical Report on Internet Development in China.

2021. Accessed March 18, 2021. http://cnnic.cn/gywm/xwzx/rdxw/20172017_7084/202102/t20210203_71364.htm.
Cho, V., T. C. E. Cheng, and W. M. J. Lai. 2009. "The Role of Perceived User-Interface Design in Continued Usage Intention of Self-Paced e-Learning Tools." *Computers & Education* 53 (2): 216–227.
Choi, D. H., J. Kim, and S. H. Kim. 2007. "ERP Training with a web-Based Electronic Learning System: The Flow Theory Perspective." *International Journal of Human-Computer Studies* 65 (3): 223–243.
Cortez, R. M., and W. J. Johnston. 2020. "The Coronavirus Crisis in B2B Settings: Crisis Uniqueness and Managerial Implications Based on Social Exchange Theory." *Industrial Marketing Management* 88: 125–135.
Cuny, C., M. Fornerino, and A. Helme-Guizon. 2015. "Can Music Improve e-Behavioral Intentions by Enhancing Consumers' Immersion and Experience?" *Information & Management* 52 (8): 1025–1034.
Davlembayeva, D., S. Papagiannidis, and E. Alamanos. 2020. "Sharing Economy: Studying the Social and Psychological Factors and the Outcomes of Social Exchange." *Technological Forecasting and Social Change* 158: 120143.
Fang, J., L. Tang, J. Yang, and M. Peng. 2019. "Social Interaction in MOOCs: The Mediating Effects of Immersive Experience and Psychological Needs Satisfaction." *Telematics and Informatics* 39: 75–91.
Fei, M., H. Tan, X. Peng, Q. Wang, and L. Wang. 2021. "Promoting or Attenuating? An eye-Tracking Study on the Role of Social Cues in e-Commerce Livestreaming." *Decision Support Systems* 142: 113466.
Feng, N., Z. Su, D. Li, C. Zheng, and M. Li. 2018. "Effects of Review Spam in a Firm-Initiated Virtual Brand Community: Evidence from Smartphone Customers." *Information & Management* 55 (8): 1061–1070.
Fornell, C., and D. F. Larcker. 1981. "Structural Equation Models with Unobservable Variables and Measurement Error: Algebra and Statistics." *Journal of Marketing Research* 18 (3): 382–388.
Gibbs, J. L., H. Kim, and S. Ki. 2019. "Investigating the Role of Control and Support Mechanisms in Members' Sense of Virtual Community." *Communication Research* 46 (1): 117–145.
Giertz, J. N., W. H. Weiger, M. Törhönen, and J. Hamari. 2021. "Content Versus Community Focus in Live Streaming Services: How to Drive Engagement in Synchronous Social Media." *Journal of Service Management* 33: 1757–5818.
González-Anta, B., V. Orengo, A. Zornoza, V. Peñarroja, and V. Martínez-Tur. 2021. "Understanding the Sense of Community and Continuance Intention in Virtual Communities: The Role of Commitment and Type of Community." *Social Science Computer Review* 39 (3): 335–352.
Goode, S., G. Shailer, M. Wilson, and J. Jankowski. 2014. "Gifting and Status in Virtual Worlds." *Journal of Management Information Systems* 31: 171–210.
Gros, D., B. Wanner, A. Hackenholt, P. Zawadzki, and K. Knautz. 2017. World of streaming motivation and gratification on Twitch." The 9th International Conference on Social Computing and Social Media, Vancouver, Canada, July 9–14.
Guo, Y., K. Zhang, and C. Wang. 2022. "Way to Success: Understanding top Streamer's Popularity and Influence from the Perspective of Source Characteristics." *Journal of Retailing and Consumer Services* 64: 102786.
Hair, J. F., J. J. Risher, M. Sarstedt, and C. M. Ringle. 2019. "When to use and how to Report the Results of PLS-SEM. Eur." *Business Review* 31 (1): 2–24.
Hayes, A. F. 2009. "Beyond Baron and Kenny: Statistical Mediation Analysis in the new Millennium." *Communication Monographs* 76 (4): 408–420.
Hilvert-Bruce, Z., J. T. Neill, M. Sjblom, and J. Hamari. 2018. "Social Motivations of Live-Streaming Viewer Engagement on Twitch." *Computers in Human Behavior* 84: 58–67.
Ho, C. T., and C. H. Yang. 2015. A study on behavior intention to use live streaming video platform based on TAM model." The Fifth Asian Conference on Psychology and Behavioral Sciences Osaka, Japan.
Hoffman, D. L., and T. P. Novak. 1996. "Marketing in Hypermedia Computer-Mediated Environments: Conceptual Foundations." *Journal of Marketing* 60 (3): 50–68.
Homans, G. C. 1958. "Social Behavior as Exchange." *American Journal of Sociology* 63 (6): 597–606.
Hou, F., Z. Guan, B. Li, and Y. L. Chong. 2020. "Factors Influencing People's Continuous Watching Intention and Consumption Intention in Live Streaming: Evidence from China." *Internet Research* 30 (1): 141–163.
Hsu, C. L. 2020. "How Vloggers Embrace Their Viewers: Focusing on the Roles of Para-Social Interactions and Flow Experience." *Telematics and Informatics* 49: 101364.
Hsu, C. L., and Y. C. Liao. 2014. "Exploring the Linkages Between Perceived Information Accessibility and Microblog Stickiness: The Moderating Role of a Sense of Community." *Information & Management* 51 (7): 833–844.
Hsu, C. L., and C. C. Lin. 2016. "Effect of Perceived Value and Social Influences on Mobile app Stickiness and in-app Purchase Intention." *Technological Forecasting and Social Change* 108: 42–53.
Hu, L., Q. Min, S. Han, and Z. Liu. 2020. "Understanding Followers' Stickiness to Digital Influencers: The Effect of Psychological Responses." *International Journal of Information Management* 54: 102169.
Hu, M., M. Zhang, and Y. Wang. 2017. "Why do Audiences Choose to Keep Watching on Live Video Streaming Platforms? An Explanation of Dual Identification Framework." *Computers in Human Behavior* 75: 594–606.
Hudson, S., S. Matson-Barkat, N. Pallamin, and G. Jegou. 2019. "With or Without you? Interaction and Immersion in a Virtual Reality Experience." *Journal of Business Research* 100 (6): 459–468.
Jones, Q., 1997. Virtual Communities, Virtual Settlements & Cyber-Archaeology: A Theoretical Outline. *Journal of Computer-Mediated Communication* 3 (3): 331.
Kang, M., and D. Shin. 2016. "The Effect of Customers' Perceived Benefits on Virtual Brand Community Loyalty." *Online Information Review* 40 (3): 298–315.
Kankanhalli, A., B. C. Y. Tan, and K. K. Wei. 2005. "Contributing Knowledge to Electronic Knowledge Repositories: An Empirical Investigation." *MIS Quarterly* 29: 113–143.

Kaur, P., A. Dhir, S. Chen, and R. Rajala. 2021. "Attitudinal and Behavioral Loyalty Toward Virtual Goods." *Journal of Computer Information Systems* 61 (2): 118–129.
Kenny, D. A., and C. M. Judd. 1984. "Estimating the Nonlinear and Interactive Effects of Latent Variables." *Psychological Bulletin* 96 (1): 201–210.
Kim, H. W., A. Kankanhalli, and S. H. Lee. 2018. "Examining Gifting Through Social Network Services: A Social Exchange Theory Perspective." *Information Systems Research* 29 (4): 805–828.
Kim, J., H.-M. Kim, and M. Kim. 2020. "The Impact of a Sense of Virtual Community on Online Community: Does Online Privacy Concern Matter?" *Internet Research* 31 (2): 519–539.
Kim, W. G., C. Lee, and S. J. Hiemstra. 2004. "Effects of an Online Virtual Community on Customer Loyalty and Travel Product Purchases." *Tourism Management* 25 (3): 343–355.
Kim, H., and H. Qu. 2020. "Effects of Employees' Social Exchange and the Mediating Role of Customer Orientation in the Restaurant Industry." *International Journal of Hospitality Management* 89 (4): 102577.
Koh, J., and Y. G. Kim. 2003. "Sense of Virtual Community: A Conceptual Framework and Empirical Validation." *International Journal of Electronic Commerce* 8 (2): 75–94.
Komutanont, C., C. Nuangjamnong, and K. Dowpiset. 2020. Major factors influencing watching game streaming in Thailand: A case study of multiplayers online battle arena (MOBA) game and what motivates people spectating their play. Available at SSRN 3790549.
Leclercq, T., I. Poncin, W. Hammedi, A. Kullak, and L. D. Hollebeek. 2020. "When Gamification Backfires: The Impact of Perceived Justice on Online Community Contributions." *Journal of Marketing Management* 36 (5-6): 550–577.
Lee, C. H., H. S. Chiang, and K. L. Hsiao. 2018. "What Drives Stickiness in Location-Based AR Games? An Examination of Flow and Satisfaction." *Telematics and Informatics* 35 (7): 1958–1970.
Lee, V. H., A. T. L. Foo, L. Y. Leong, and K. B. Ooi. 2016. "Can Competitive Advantage be Achieved Through Knowledge Management? A Case Study on SMEs." *Expert Systems with Applications* 65: 136–151.
Lee, G., and A. Suzuki. 2020. "Motivation for Information Exchange in a Virtual Community of Practice: Evidence from a Facebook Group for Shrimp Farmers." *World Development* 125: 104698.
Li, R., Y. Lu, J. Ma, and W. Wang. 2020. "Examining Gifting Behavior on Live Streaming Platforms: An Identity-Based Motivation Model." *Information & Management* 58 (6): 103406.
Liang, H., N. Saraf, Q. Hu, and Y. Xue. 2007. "Assimilation of Enterprise Systems: The Effect of Institutional Pressures and the Mediating Role of top Management." *MIS Quarterly* 31 (1): 59–87.
Lim, J. S., M. J. Choe, J. Zhang, and G. Y. Noh. 2020. "The Role of Wishful Identification, Emotional Engagement, and Parasocial Relationships in Repeated Viewing of Live-Streaming Games: A Social Cognitive Theory Perspective." *Computers in Human Behavior* 108: 106327.
Lin, H. F. 2008. "Determinants of Successful Virtual Communities: Contributions from System Characteristics and Social Factors." *Information & Management* 45 (8): 522–527.
Long, Q., and A. C. Tefertiller. 2020. "China's new Mania for Live Streaming: Gender Differences in Motives and Uses of Social Live Streaming Services." *International Journal of Human–Computer Interaction* 36 (14): 1314–1324.
Lu, Z., H. Xia, S. Heo, and D. Wigdor. 2018. You watch, you give, and you engage: a study of live streaming practices in China." Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems, Montréal, Canada, April, 21–26.
Lu, S., D. Yao, X. Chen, and R. Grewal. 2021. "Do Larger Audiences Generate Greater Revenues Under pay What you Want? Evidence from a Live Streaming Platform." *Marketing Science* 40 (5): 964–984.
Luo, N., M. L. Zhang, and D. Qi. 2017. "Effects of Different Interactions on Students' Sense of Community in e-Learning Environment." *Computers & Education* 115: 153–160.
McMillan, D. W., and D. M. Chavis. 1986. "Sense of Community: A Definition and Theory." *Journal of Community Psychology* 14 (1): 6–23.
Metaxa-Kakavouli, D., K. Wang, J. A. Landay, and J. Hancock. 2018. Gender-inclusive design: Sense of belonging and bias in web interfaces." Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems, Montréal, Canada, April, 21–26.
Minton, E. A., and R. L. Liu. 2021. "Religiosity and Consumer Belonging: Influences on Product Evaluations." *Journal of Consumer Behaviour* 20 (1): 32–47.
Molinillo, S., R. Aguilar-Illescas, R. Anaya-Sánchez, and M. Vallespín-Arán. 2018. "Exploring the Impacts of Interactions, Social Presence and Emotional Engagement on Active Collaborative Learning in a Social web-Based Environment." *Computers & Education* 123 (8): 41–52.
Monea, B. 2020. "Looking at Screens: Examining Human-Computer Interaction and Communicative Breakdown in an Educational Online Writing Community." *Computers and Composition* 58 (2): 102605.
Moore, M. G. 1989. "Editorial: Three Types of Interaction." *American Journal of Distance Education* 3 (2): 1–7.
Naranjo-Zolotov, M., T. Oliveira, S. Casteleyn, and Z. Irani. 2019. "Continuous Usage of e-Participation: The Role of the Sense of Virtual Community." *Government Information Quarterly* 36 (3): 536–545.
Naranjo-Zolotov, M., O. Turel, T. Oliveira, and J. E. Lascano. 2021. "Drivers of Online Social Media Addiction in the Context of Public Unrest: A Sense of Virtual Community Perspective." *Computers in Human Behavior* 121: 106784.
Obst, P., L. Zinkiewicz, and S. G. Smith. 2001. "Sense of Community in Science Fiction Fandom, Part 2: Comparing Neighborhood and Interest Group Sense of Community." *Journal of Community Psychology* 30 (1): 105–117.
Park, H. J., and L. M. Lin. 2020. "The Effects of Match-ups on the Consumer Attitudes Toward Internet Celebrities and Their Live Streaming Contents in the Context of Product Endorsement." *Journal of Retailing and Consumer Services* 52: 101934.
Payne, K., M. J. Keith, R. M. Schuetzler, and J. S. Giboney. 2017. "Examining the Learning Effects of Live Streaming

Video Game Instruction Over Twitch." *Computers in Human Behavior* 77: 95–109.

Peñarroja, V., J. Sánchez, N. Gamero, V. Orengo, and A. M. Zornoza. 2019. "The Influence of Organisational Facilitating Conditions and Technology Acceptance Factors on the Effectiveness of Virtual Communities of Practice." *Behaviour & Information Technology* 38 (8): 845–857.

Preacher, K. J., and A. F. Hayes. 2008. "Asymptotic and Resampling Strategies for Assessing and Comparing Indirect Effects in Multiple Mediator Models." *Behavior Research Methods* 40 (3): 879–891.

Riva, G., F. Mantovani, C. S. Capideville, A. Preziosa, F. Morganti, D. Villani, A. Gaggioli, C. Botella, and M. Alcañiz. 2007. "Affective Interactions Using Virtual Reality: The Link Between Presence and Emotions." *CyberPsychology & Behavior* 10 (1): 45–56.

Rovai, A. P. 2002. "Sense of Community, Perceived Cognitive Learning, and Persistence in Asynchronous Learning Networks." *The Internet and Higher Education* 5 (4): 319–332.

Ryu, S., and A. Suh. 2020. "Online Service or Virtual Community? Building Platform Loyalty in Reward-Based Crowdfunding." *Internet Research* 31 (1): 315–340.

Scheibe, K., K. J. Fietkiewicz, and W. G. Stock. 2016. "Information Behavior on Social Live Streaming Services." *Journal of Information Science Theory and Practice* 4 (2): 6–20.

Sherry, J. J. F. 1983. "Gift Giving in Anthropological Perspective." *Journal of Consumer Research* 10 (2): 157–168.

Shi, Y., C. Ma, and Y. Zhu. 2021. "The Impact of Emotional Labor on User Stickiness in the Context of Livestreaming Service—Evidence from China." *Frontiers in Psychology* 12: 698510.

Shin, D. 2019a. "How Does Immersion Work in Augmented Reality Games? A User-Centric View of Immersion and Engagement." *Information, Communication & Society* 22 (9): 1212–1229.

Shin, D. 2019b. "How do Users Experience the Interaction with an Immersive Screen?" *Computers in Human Behavior* 98: 302–310.

Shin, D., and F. Biocca. 2018. "Exploring Immersive Experience in Journalism." *New Media & Society* 20 (8): 2800–2823.

Shin, D., F. Biocca, and H. Choo. 2013. "Exploring the User Experience of Three-Dimensional Virtual Learning Environments." *Behaviour & Information Technology* 32 (2): 203–214.

Singh, S., N. Singh, Z. Kalinic, and F. J. Liebana-Cabanillas. 2021. "Assessing Determinants Influencing Continued use of Live Streaming Services: An Extended Perceived Value Theory of Streaming Addiction." *Expert Systems with Applications* 168: 114241.

Song, S., Y. C. Zhao, X. Yao, Z. Ba, and Q. Zhu. 2021. "Short Video Apps as a Health Information Source: An Investigation of Affordances, User Experience and Users' Intention to Continue the use of TikTok." *Internet Research* 31 (6): 2120–2142.

Sriram, R., C. Haynes, J. Cheatle, C. P. Marquart, J. L. Murray, and S. D. Weintraub. 2020. "The Development and Validation of an Instrument Measuring Academic, Social, and Deeper Life Interactions." *Journal of College Student Development* 61 (2): 240–245.

Sun, Y., X. Shao, X. Li, Y. Guo, and K. Nie. 2019. "How Live Streaming Influences Purchase Intentions in Social Commerce: An IT Affordance Perspective." *Electronic Commerce Research and Applications* 37: 100886.

Tang, L. 2018. "Social Capital, Sense of Virtual Community, and Network Group Behavior: An Empirical Study Based on Virtual Community Users." *Revista de Cercetare si Interventie Sociala* 62 (9): 231–253.

Tang, P., Yao, Z., Luan, J., Xiao, J., 2020. How Information Presentation Formats Influence Usage Behaviour of Course Management Systems: Flow Diagram Navigation Versus Menu Navigation. *Behaviour & Information Technology*. doi:10.1080/0144929X.2020.1813331

Teo, A. C., G. W. H. Tan, K. B. Ooi, and B. Lin. 2015. "Why Consumers Adopt Mobile Payment? A Partial Least Squares Structural Equation Modeling (PLS-SEM) Approach." *International Journal of Mobile Communications* 13 (5): 478–497.

Tonteri, L., M. Kosonen, H. K. Ellonen, and A. Tarkiainen. 2011. "Antecedents of an Experienced Sense of Virtual Community." *Computers in Human Behavior* 27 (6): 2215–2223.

Trehan, D., and R. Sharma. 2020. "What Motivates Members to Transact on Social C2C Communities? A Theoretical Explanation." *Journal of Consumer Marketing* 37 (4): 399–411.

Tsai, M., N. Cheng, and K. Chen. 2011. "Understanding Online Group Buying Intention: The Roles of Sense of Virtual Community and Technology Acceptance Factors." *Total Quality Management & Business Excellence* 22 (10): 1091–1104.

TwitchTracker, Twitch Statistics and Charts. 2021. Accessed March 18, 2021. https://twitchtracker.com/statistics.

Urbonavicius, S., M. Degutis, I. Zimaitis, V. Kaduskeviciute, and V. Skare. 2021. "From Social Networking to Willingness to Disclose Personal Data When Shopping Online: Modelling in the Context of Social Exchange Theory." *Journal of Business Research* 136: 76–85.

Wang, W. T., Y. S. Wang, and E. R. Liu. 2016. "The Stickiness Intention of Group-Buying Websites: The Integration of the Commitment–Trust Theory and e-Commerce Success Model." *Information & Management* 53 (5): 625–642.

Waqas, M., Z. L. Hamzah, and N. A. M. Salleh. 2021. "Customer Experience with the Branded Content: A Social Media Perspective." *Online Information Review* 45 (5): 964–982.

Witkowski, E., D. Recktenwald, J. Manning, and Z. Ge. 2016. Livestreaming in theory and practice: four provocations on labor, liveness and participatory culture in games livestreaming." The Proceedings of the 22nd International Symposium on Electronic Art ISEA, Hong Kong, China.

Wongkitrungrueng, A., and N. Assarut. 2020. "The Role of Live Streaming in Building Consumer Trust and Engagement with Social Commerce Sellers." *Journal of Business Research* 117: 543–556.

Xiao, L., and J. Mou. 2019. "Social Media Fatigue-Technological Antecedents and the Moderating Roles of Personality Traits: The Case of WeChat." *Computers in Human Behavior* 101: 297–310.

Yan, Z., T. Wang, Y. Chen, and H. Zhang. 2016. "Knowledge Sharing in Online Health Communities: A Social Exchange Theory Perspective." *Information & Management* 53 (5): 643–653.

Yang, A., and K. J. Shim. 2020. "Antecedents of Microblogging Users' Purchase Intention Toward Celebrities' Merchandise: Perspectives of Virtual Community and fan Economy." *Journal of Psychological Research* 2 (2): 11–26.

Yang, T., Yang, F., Men, J., 2021. The Impact of Danmu Technological Features on Consumer Loyalty Intention Toward Recommendation Vlogs: A Perspective from Social Presence and Immersion. *Information Technology & People*. doi:10.1108/ITP-01-2021-0008

Zhou, J., J. Zhou, Y. Ding, and H. Wang. 2019. "The Magic of Danmaku: A Social Interaction Perspective of Gift Sending on Live Streaming Platforms." *Electronic Commerce Research and Applications* 34: 100815.

Zott, C., Amit, R., Donlevy, J., 2000. Strategies for Value Creation in e-Commerce: Best Practice in Europe. *European Management Journal*. 18 (5), 463–475.

Appendix A. Constructs and items

Constructs	Items	Measures	Sources
Viewer-broadcaster interaction (VBI)	VBI1	I interact with broadcasters by chatting, sending gifts, or sending private messages on this live streaming platform.	(Cheng 2013)
	VBI2	I can receive fast and kind responses from broadcasters on this live streaming platform.	
	VBI3	The broadcaster can support and counsel me on this live streaming platform.	
Viewer-platform interaction (VPI)	VPI1	The live streaming platform can allow me to take control of my streaming content.	(Hoffman and Novak 1996)
	VPI2	The live streaming platform can provide a user-friendly interface and good navigation structures.	
	VPI3	The live streaming platform is very quick to respond to my requests.	
Viewer-viewer interaction (VVI)	VVI1	I interact with other viewers by chatting or sending private messages on this live streaming platform.	(Long and Tefertiller 2020)
	VVI2	I share live information with other viewers on this live streaming platform.	
	VVI3	I exchange live content with other viewers on this live streaming platform.	
Membership (MEM)	MEM1	I see myself as a part of this live streaming platform's community.	(Luo, Zhang, and Qi 2017)
	MEM2	I have good relationships with the members of this live streaming platform.	
	MEM3	I feel the members of this live streaming platform have similar needs and goals.	
Immersion (IMM)	IMM1	I spend a considerable amount of time online on this live streaming platform.	(Koh and Kim 2003)
	IMM2	I spend more time than I expect navigating this live streaming platform.	
	IMM3	I feel as if I am addicted to this live streaming platform.	
Stickiness (STI)	STI1	I intend to prolong my stay on this live streaming platform.	(Hsu and Liao 2014; Luo, Zhang, and Qi 2017)
	STI2	I would visit this live streaming platform frequently in the future.	
	STI3	I do not want to move to a similar live streaming platform because I am already familiar with the system of this platform.	
	STI4	If I could not use this live streaming platform anymore, it would be a pity.	