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To cite this article: Jiaming Fang, Lei Chen, Chao Wen & Victor R. Prybutok (2018) Co-viewing Experience in Video Websites: The Effect of Social Presence on E-Loyalty, International Journal of Electronic Commerce, 22:3, 446-476, DOI: [10.1080/10864415.2018.1462929](https://doi.org/10.1080/10864415.2018.1462929)

To link to this article: <https://doi.org/10.1080/10864415.2018.1462929>



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Published online: 08 Jun 2018.



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# Co-viewing Experience in Video Websites: The Effect of Social Presence on E-Loyalty

Jiaming Fang, Lei Chen, Chao Wen, and Victor R. Prybutok 

**ABSTRACT:** Video website operators work in a highly competitive market and, thus, cultivating evangelists who keep coming back and spreading positive word-of-mouth (WOM) referrals is important to retain market share and boost sustainability. This study empirically tests a model proposing that social presence elicited by the emerging bullet screen (“DanMu” in Chinese or “Danmaku” in Japanese) system in video websites serially affects immersive experience and perceived benefits, which in turn influence viewers’ e-loyalty. Data collected from 523 participants provide strong support for the proposed model. The results indicate that compelling immersive experience and perceived benefits are important mediators explaining the theoretical mechanism of how social presence affects loyalty. The presence of moderators such as group identification reinforces the influence of social presence on immersion. In addition, this study also suggests that perceived benefits differentially affect the two facets of e-loyalty (i.e., revisit intention and positive WOM). Specifically, revisit intention is mainly driven by the perceived hedonic benefit while positive WOM likelihood is largely determined by the utilitarian and social benefits. This study is the first to provide theoretical insights into understanding how increased social presence triggered by DanMu comments inspires the desired e-loyalty responses.

**KEY WORDS AND PHRASES:** Co-creation, DanMu comments, e-loyalty, group identification, immersive experience, social presence, S-O-R framework, video websites.

Online video consumption is one of the most popular Internet activities worldwide on desktop and mobile devices. Recent studies have reported that online video usage has become a near-universal phenomenon in a number of leading online markets, and more than 30 percent of global Internet users watch online video every day [67]. A report by eMarketer [15] showed that people now spend more time with digital video (online and mobile) than with social media. It is expected that online video will continue to grow exponentially. According to Cisco [11], Internet video streaming will account for more than 81 percent of all consumer Web traffic by 2021.

A majority of online video websites nowadays are trying to adapt and integrate social media characteristics into their platforms and start offering real-time interactive technologies to meet visitors’ increasing appeal for social interaction in e-service environments [54, 61]. The past few years have witnessed an emerging new feature, named bullet screen (“DanMu” in Chinese or “Danmaku” in Japanese) on online video websites. DanMu is a commentary subtitle system featuring the real-time viewers’ comments overlaid directly onto the video itself. It was first popularized by a Japanese animation, comic, and games (ACG) video-sharing website named Niconico. DanMu-enabled videos are becoming widely popular, especially in Asian

countries. In fact, it has been so popular that the DanMu feature is available in most of the video-streaming apps and software in China, and even several movie theaters in China have started to experiment the feature in a special screen that displays streams of text messages sent in by the audience.

Traditionally, the experience of watching online video may be viewed as lacking human warmth and sociability, which is apparently different from the online game websites and social networking sites. Online video operators face a significant challenge in making their websites socially rich to fulfill users' innate needs to socialize. By using DanMu system, viewers are able to actively read and post their commentary subtitles (DanMu comments) onto the screen while watching videos and these comments are also synchronized to a specific playback time. With the help of the DanMu system viewers not only can interact with the video, but they also can interact with other viewers by reading and referring their simultaneously broadcast comments [29, 38]. Because commentary subtitles are simultaneously broadcast to all viewers in real time, the DanMu-enabled video creates a co-viewing experience in which viewers feel like watching and playing with other peers [38]. As such, DanMu system enables each video to become an interactive and social platform for video viewers, and thus enables video sites to deliver a unique collaborative and social experience to the viewers. Therefore, DanMu comments are likely to instill a feeling of social presence that refers to the extent to which participants are aware of their interaction with another person conveyed through and within a medium [40].

Thus, an important question is "How does the feeling of social presence affect viewers' loyalty in the context of DanMu comments?" *Loyalty* in this study is defined as a deeply held willingness and commitment to revisit an online video website and to recommend the website. Such knowledge is critical, considering that although the revenue models of online video websites can be generally classified into advertising, subscription, pay-per-view, and merchandise, gaining sufficient traffic is the prerequisite for successfully implementing all of these models. However, online video website operators work in a highly competitive market, where the number of websites rapidly increases. In the United States alone, there are more than 300 video-sharing sites [73]. The competition to engage and excite users is incredibly fierce. As such, cultivating evangelists who keep coming back and spreading positive word-of-mouth (WOM) referrals is extremely important for online video websites to retain market share and boost sales.

Surprisingly, relatively few researchers have studied the DanMu phenomenon, and academics and practitioners suffer from limited knowledge about the impacts of DanMu comments on users' loyalty. A careful scrutiny of the literature on DanMu suggests that little existing research pays attention to the outcome effects of implementing DanMu systems, and no notice (to the best of our knowledge) has been taken of the underlying processes through which the DanMu comment possibly affects viewers' loyalty. Instead, three recent conference articles reported the adoption behavior of DanMu-enabled videos [8, 18, 55]. Chen, Gao,

and Rau [8] conducted an exploratory study to investigate the reasons for watching DanMu videos through focus group studies. They showed that entertainment, seeking information, the feeling of companionship, and the sense of belonging compel users to use DanMu video sites. Peng, Zhao, and Teo [55] reported that perceived coolness has a positive effect on young people's adoption of a DanMu video website, and ACG culture moderates the effect. Fan, Lu, Zhao, and Pan [18] proposed that the technological features of DanMu, including pseudosynchronicity, perceived proximity, and comment-content congruency, increase users' coexperience.

In addition, although an increasing number of studies have demonstrated positive impact of social interaction on continuance intention in the context of e-services such as social commerce and social virtual world (e.g., [83]), no studies (to date) have systematically examined how the social presence elicited by the DanMu system in online video websites affects viewers' e-loyalty. As such, it is unclear whether we can generalize what we already know to the new context of DanMu. In light of the unique interactive and social components of the DanMu system (e.g., DanMu provides users both simultaneous and playback interactive experiences, and social interaction and parasocial interaction coexist at the same time), it is also necessary to go beyond the current literature and investigate how social presence elicited by the DanMu comments affects e-loyalty in online video websites.

To address these gaps in the literature, this article specifically focuses on empirically exploring the effects of the DanMu system to enrich perceptions of social presence and its subsequent influencing mechanisms on viewers' loyalty. In so doing, researchers and practitioners can make more informed decisions pertaining to how to efficiently and effectively capitalize on the DanMu system to best manage relationships with their users. Accordingly, this study aims to address the following research question:

**Research Question:** How does the social presence elicited by the DanMu comment affect viewers' e-loyalty

Drawing on the Stimulus-Organism-Response (S-O-R) framework from environmental psychology, this study proposes that immersion and perceived benefits would serve as two important mediators explaining the theoretical mechanism of how social presence as an environmental social cue affects a viewer's loyalty. Further, we propose that the impact of social presence is contingent on viewers' identification with the DanMu-posting peer group.

## Theoretical Model and Hypotheses

Our conceptual model (see [Figure 1](#)) begins with the link between DanMu comment and social presence. The model then illustrates a series of

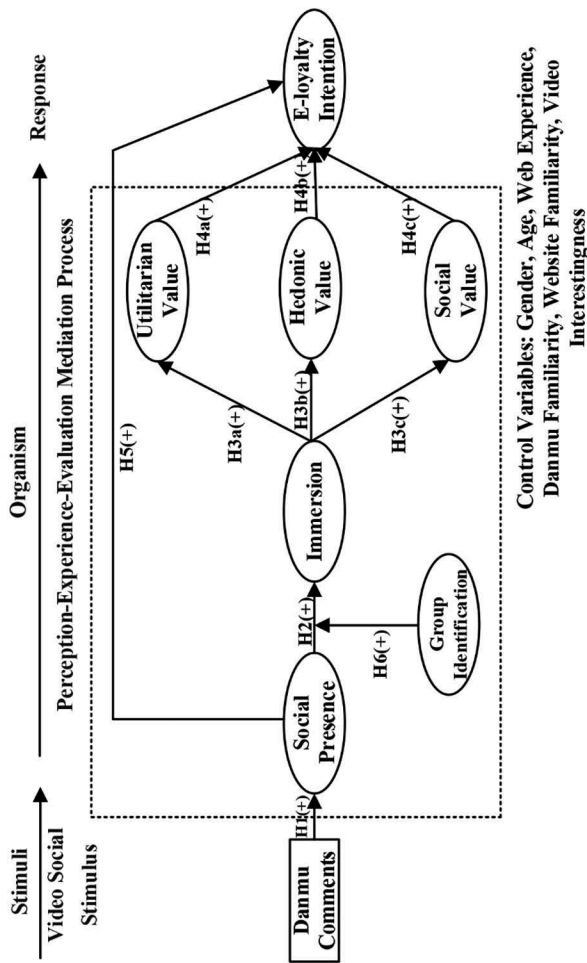


Figure 1. Research Model

relationships that we propose to explain the mediation process between social presence and e-loyalty.

### ***The S-O-R Framework***

The need to understand how social presence elicited by the DanMu system affects users' loyalty leads us to the S-O-R framework. Although the S-O-R model takes a rather broad approach, it provides an adequate theoretical framework for the purposes of this study. According to the S-O-R framework, environmental prompts are the starting point of an intentional or unintentional psychological or behavioral process [35, 49, 75, 78]. Specifically, stimuli from environmental prompts affect individuals' internal cognitive and affective states, including their perceptions, experiences, and evaluations, which in turn affect their behavior. The S-O-R framework has been widely adopted to examine the impact of environmental stimuli on consumer responses in online settings (see online Appendix A for more information). Our review results suggest that online shopping is the main research context (e.g., [48, 66, 74]), and nearly all the existing research has examined the utilitarian online systems except Huang, Ali, and Liao [36] who investigated the user behavior in online games. Further, the results also show that no research has applied the S-O-R model to explain user behavior in online video websites even though the online video website is regarded as one of the most popular types of e-commerce websites. Our study extends the extant literature by applying the S-O-R model to the hedonic-dominant online video website context and investigating the underlying mechanism about how the social presence elicited by the DanMu comments in the online videos affects viewers' e-loyalty.

Stimuli are contextual cues external to an individual that attract his or her attention, and manifest themselves in several forms, for instance, as various website characteristics (see [2, 6]). It is generally accepted that website interactivity is an important environmental stimulus that invokes the psychological processes leading to individuals' responses [39, 61, 65]. Given that DanMu comment works as an important social interactivity environmental stimulus that provides viewers unique interactive and social experiences, it is logical to apply S-O-R model as the theoretical framework for studying this phenomenon [39]. In general, the S-O-R model provides a parsimonious and structured guidance to build an integrated model demonstrating how DanMu contributes to users' loyalty.

### ***Perception-Experience-Evaluation Process***

The DanMu system provides a real-time commentary subtitle on screen, which creates a virtual co-viewing environment and facilitates viewers' awareness of the other person. Accordingly, DanMu comments shape the high levels of viewers' perceptions of social presence. According to social presence theory, social presence is considered a prerequisite for effective

communication [60], and high levels of social presence exert a positive contribution to a communication experience and interpersonal involvement [23]. The impact of social presence during a communication affects the feeling of closeness between the people in the relationship that has a positive effect on the individuals' affective experience such as immersion and engagement. Because feelings of closeness could boost attentional processing and facilitate an absorbing atmospheric experience [23, 53]. In other words, the sensation of social presence is likely to foster subjective immersive experiences. In the context of online video, social presence elicited by the DanMu system fulfills viewers' deep innate biological needs for intimacy, genuine connection, and socialization that increase viewers' temptations to devote more attention to the video, facilitating a compelling immersive experience. As such, we included immersion as an organism experience resulting from the social presence perception.

We define the *immersion* as a sense of being wholly involved or emotionally engaged in a mediated world and neglecting the real or ordinary world around the people [4]. Prior research has reported that psychological engagement occurs when users interact with their engaging objects to fulfill their intrinsic motivations and needs [43]. The objects' ability to deliver engaging experiences coming from the fulfillment of users' utilitarian, hedonic, and social motivations and needs affects users' cognitive evaluation of perceived benefits from interacting with these objects [17, 43]. *Perceived benefit* is defined as the evaluation of the actual perception of the positive consequences that are caused by using the DanMu system. From this perspective, immersive experience derived from interacting with the engaging objects (the DanMu system in this study) determines the cognitive evaluation of the perceived benefits. Indeed, users may even perceive DanMu comments as noises that interrupt and distract their attention from the videos if they cannot be immersed into the DanMu comments. As such, the levels of viewers' perceived benefits should be determined by the levels of immersive experience. Supporting this argument, previous empirical investigations have reported that engaging experience results in the evaluation of perceived values (e.g., [2, 7, 17, 59, 75]). Together, we assume that social presence perception leads to immersive experience that, in turn, influences the evaluation of perceived benefits. Immersion experience should fully mediate the relationship between social presence and perceived benefits.

### **DanMu and Social Presence**

Social presence is concerned about "warmth," and a medium is considered to be warm if it delivers a sense of human contact, sociability, and sensitivity [27, 44, 51, 80]. Prior studies have reported that social presence could be enhanced by providing channels for actual interaction with other humans or stimulating the imagination of interacting with other humans [26, 27]. Text-based asynchronous online systems and online video websites are traditionally considered as low in social presence since these environments lack human warmth and sociability [27, 31]. Different from these

environments, the DanMu system in a video website enables a viewer to submit and add comments that are simultaneously broadcast to all viewers in real time, creating a sharing experience in which users feel like watching and playing with others. Moreover, the DanMu system offers users various personalized comment controls, including style, font, format, and move directions, which can further enhance the perception of social interactivity [64]. As such, the interactive and social features of DanMu offer a channel for video viewers to form an interpersonal connection with other peers, and experience high feelings of social presence. Accordingly, it is reasonable to infer that, in the context of video websites, DanMu can enhance viewers' perceptions of the social presence:

***Hypothesis 1:*** The presence of DanMu increases the level of perceived social presence of a video website.

### ***Social Presence, Immersion, and Perceived Benefits***

Previous research has reported inconsistent results on the relationship between social presence and perceived value. For example, Hassanein and Head [27] and Shen [64] observed a significant relationship between social presence and utilitarian value while this link was not supported in Gefen and Straub [22]. Similarly, Hassanein and Head [27] and Hassanein, Head, and Ju [28] reported that presence significantly influences hedonic value while Yun and Sung [79] did not provide evidence to support the relationship. The inconsistent findings make it necessary to investigate the underlying mechanisms through which social presence influences perceived benefits. In this investigation, we propose that immersion experience mediates the relationship between social presence and perceived benefits. The empirical investigation of the relationship between social presence and immersion in the hedonic information systems is limited. For instance, only Cairns et al. [5] documented the existence of a link between these two variables in the context of online gaming. However, the e-learning literature strongly supports the causal effect of social presence and immersion (e.g., [41]). A general finding of research in the e-learning field is that a lack of social presence in e-learning environments may result in low levels of engagement and immersion, and even withdrawal from the online environment.

The DanMu system provides a way for video viewers to read, post, and review comments in real time. When other viewers watch the video and see the comments, they are building a connection through these comments, and thus it creates a sense of co-viewing experience. Therefore, online video becomes rich, warm, and filled with socioemotional content, and viewers are more likely to be immersed into such an environment [4, 57, 81]. As such, we hypothesize:

***Hypothesis 2:*** The feeling of social presence elicited by DanMu is positively related to immersion.



Based on the prior e-service literature (e.g., [12, 82, 83]), we specify three types of perceived benefits of using the DanMu system: utilitarian value, hedonic value, and social value. It is claimed that perceived value is positively evaluated by people who have attained the state of immersion or those who have experienced episodes of immersion [7]. As such, immersion experience could facilitate users to identify with the value and benefits that they gain from an activity.

In this study, *utilitarian value* refers to users' cognitive evaluation of the utility of using the DanMu system in terms of purpose fulfillment and problem solving. Conceptually, utilitarian value is closely akin to perceived usefulness [34, 76, 83], and in some studies perceived usefulness was even regarded as a surrogate of utilitarian benefits [34, 82]. As we stated above, the objects' ability to deliver engaging experiences coming from the fulfillment of users' utilitarian, hedonic, and social motives and needs influences users' cognitive assessment of perceived benefits from interacting with these objects. Therefore, perceived benefits should be affected by the immersive feelings. Along this line of reasoning, immersion occurs when users experience a seamless process of addressing their innate utilitarian motivations and needs such as actor introduction, subtitle translation, and broadcasting their own opinions to all viewers by interacting with DanMu comments. This engaging experience coming from the utilitarian goal fulfillment (i.e., developing and extending their understanding of the video content) should have a positive effect on perceived utilitarian value regarding the DanMu system [17, 43, 75]. Thus, it is reasonable to expect that the more the viewers get immersed in the DanMu system, the more utilitarian benefit of DanMu (i.e., getting information and knowledge from other viewers and the DanMu system broadcasting service) will be perceived. Prior research has provided support for this reasoning. For example, Charfi [7] reported that enhanced immersive experience generated from virtual reality websites has a salient influence on the perceived utilitarian benefits of the visit experience. Collectively, we hypothesize that:

**Hypothesis 3a:** The level of immersion is positively related to perceived utilitarian value.

*Hedonic value* is defined as users' positive emotions or feelings (e.g., enjoyment and playfulness) that result from the gratitude of an experience for its own sake, rather than from any performance consequences [71, 82]. Immersion affects the production of emotional reactions associated directly with the pertinent experiential surroundings [20]. Users experience more intense emotions (enjoyment and stimulation) when they are more immersed in an entertaining activity [13]. The DanMu system is mainly a pleasure-oriented information system, and viewers in general focus on the hedonic aspect of using the system. When watching DanMu-enabled videos, viewers can express themselves and interact with other peers by reading and referring their real-time broadcast comments. DanMu somehow forms a chat onto video itself to entertain viewers [38]. The viewers are likely to find resonance in reading the comments posted

by other peers [29]. They can, thus, temporarily escape from their mundane world and immerse themselves in the sharing watching environment, consequently developing their perceived enjoyment [68]. Previous studies have provided evidence of positive link between intensity of immersion in the experiential environment and intensity of emotions. For instance, Cuny, Fornerino, and Helme-Guizon [13] reported that a user immersed in an esthetic environment experiences enjoyment and stimulation provoked by and related to the context. Charfi [7] also observed that virtual reality websites generate immersive experience, which has an impact on the hedonic value of the visit experience. Thus, it is expected that the levels of immersion will influence the viewers' hedonic experience. Based on these reasons, we propose:

**Hypothesis 3b:** The level of immersion is positively related to perceived hedonic value.

In addition to utilitarian and hedonistic features, the social interaction aspect of a DanMu-enabled online video should be highlighted because of the high degree and salience of social and parasocial interaction in the DanMu system. Previous research has demonstrated that fulfilling the need for connectedness via online interactions is an important motivation for individuals to use hedonic information systems such as social virtual world [82, 83], social networking sites (SNS; [51]), and online games [33, 50]. Similar to the users' behavior patterns in SNS, viewers on online video platforms might be active users (interacting with other viewers by referring their broadcast comments) or passive users (generally reading DanMu comments posted by other peers). Posting and referring DanMu comments is an interpersonal social interaction while reading others' DanMu comments can be generally considered as a one-sided parasocial interaction. Social interaction and parasocial interaction lead to perceived social value that refers to the appraisal of the values resulting from the fulfillment of communicative purposes and social/parasocial interaction.

Immersion in an experiential environment can lead to strong interactions with others [20], which leads to the formation of weak or strong relationships that in turn results in the expansion of their bridging and bonding social capital [44]. As such, immersion experience could increase users' perceived social value derived from social interactions. The DanMu system offers a potential means to establish and extend users' social networks and relations with other peers. By enabling relationship building and extension, the DanMu system helps fulfill users' innate needs to socialize.

On the other hand, the level of immersion should also be positively related to perceived social value derived from the *parasocial relationship* that is defined as a one-sided intimate relationship a viewer forms with other viewers on an online video website [72, 77]. Parasocial relationship is based on perceived affective ties and emotional attachment with these peers [32]. In the DanMu context, some shared texting language and signs such as "23333," "666666," and "hhhhhh" have been developed as a subculture. The subculture brings together like-minded users who feel neglected by societal mainstreams and makes these users more likely to find resonance

in reading the comments posted by other peers [29, 38], which allows them to develop a sense of attractiveness, similarity, and identity [30]. The DanMu subculture thus can effectively enrich communications among users and further build the connection among viewers, which helps these viewers reduce their isolation feelings and increase the perceived similarity and mutual attractiveness.

Collectively, DanMu comments unite people with the same interests to express their thoughts on the same subjects. The attractiveness or the perceived similarity between viewers can be readily perceived when they are involved in the DanMu system. Thus, the more intensely the viewers are immersed in the sharing watching environment, the more likely they will experience emotional attachments to the DanMu-posting peers, and the stronger social value they will perceive. Accordingly, the following hypothesis is proposed:

**Hypothesis 3c:** The level of immersion is positively related to perceived social value.

### ***Perceived Benefits and Loyalty***

Maintaining customer loyalty is an important strategic objective for all online vendors [9, 70]. Consumers' perceived benefit or value is the core construct and foundation in all relational exchange activities [16]. It is a primary factor in predicting customer loyalty [16, 83]. Previous studies have provided ample evidence on the relationship between the perceived benefits and loyalty. For instance, utilitarian factors, such as perceived usefulness and utility, can positively influence consumers' intention to continuously use the system (e.g., [68]). Perceived enjoyment is an important predictor of the users' intention to use a hedonic-oriented information system such as SNS and online games [46], and users have a stronger motivation to continue using it if they perceive more intense enjoyment from it [68]. Cyr, Hassanein, Head, and Ivanov [14] also documented that the perceived usefulness and enjoyment positively affect loyalty. Charfi [7] and Cui, Lai, and Lowry [12] confirmed that the mediating effects of the utilitarian and hedonic factors between the immersion and visitors' revisit intention and WOM. Consistent with the consensus reached in prior literature, we expect that:

**Hypothesis 4a:** Viewers' perception of utilitarian value is positively related to their loyalty.

**Hypothesis 4b:** Viewers' perception of hedonic value is positively related to their loyalty

Similarly, if viewers can attain social value from the DanMu-enabled videos, they are expected to exhibit loyalty to the website to maintain and promote social relations [45]. In support of this notion, some empirical studies have suggested that social value positively affects loyalty. Hsiao and Chiou [33]

reported that social value affects users' continuance intention in online games. Sun, Liu, Peng, Dong, and Barnes [68] showed that users' social value derived from social interaction in an online SNS positively influences their online SNS continuance intention. Pentina, Gammoh, Zhang, and Mallin [56] also documented that high levels of social value facilitate future intentions to continue using an online brand network and recommend it to others. Likewise, Tsotsou [72] observed that parasocial and social relationships in SNSs increase consumers' intention to continue their membership in the SNS, and recommend it to others. We therefore propose the following hypothesis:

**Hypothesis 4c:** Viewers' perception of social value is positively related to their loyalty.

### ***Direct Effect Between Social Presence and Loyalty***

Besides the indirect effect of social presence on loyalty through immersion and perceived benefits, we also claim that increased level of social presence is likely to form loyalty directly. Some existing studies have provided empirical evidence to support this relationship between the two variables. Cyr et al. [14] observed that higher perceived social presence directly results in higher loyalty toward an e-services website. Choi, Lee, and Kim [10] demonstrated that greater social presence increases the individual's intention to re-use recommender systems. Lee, Chung, and Lee [46] also reported that social presence significantly influences consumers' continuous play intention to use virtual golf simulators. One exception is Joo, Lim, and Kim [40] who reported that social presence does not exert a significant impact on online learners' persistence intention. However, as argued by Joo et al. [40], the insignificant relationship between social presence and persistence revealed in their study should be attributed to the research design (using part-time learners) rather than the genuine relationship between these two variables. Collectively, we expect viewers' perception of social presence elicited by the DanMu will affect their loyalty intention of revisit and WOM toward an online video website. Hence, we propose:

**Hypothesis 5:** The feeling of social presence elicited by DanMu is positively related to loyalty.

### ***Moderation Effect of Group Identification***

From a social identity perspective [69], we argue that social presence of peer groups with whom individuals identify is more likely to influence immersion than the social presence of distal groups. *Group identification* has been defined as feeling closer connections to a particular social group [52]. When people identify with a group, they typically develop feelings

of attachment, belongingness, and commitment to the group [1, 37, 69]. Piyathasanan, Mathies, Wetzels, Patterson, and Ruyter [57] argued that the presence of sociality and member connections are essential to gain a communal experience that involves interactivity, mutual interdependence, and a state of immersion in an online community. Group identification is also positively associated with behavioral involvement and engagement [37]. The social psychological research has suggested that the peer groups to which individuals are closely connected by identification have greater influence on perceptions and behavior than peer groups to which individuals are distal connected [52]. Kelly [42] also argued that group identification facilitates participation in collective action, which in turn feeds back to affect the individual's attitudes and social identity. Consistent with this line of reasoning, empirical evidence has further supported the positive relationship between group identification and behavioral engagement (e.g., [37, 52]).

In the current investigation, DanMu connects people with the same interests to share their thoughts. It is expected that when viewers perceive being together with other DanMu-posting peers, and they identify with the group to which these peers belong, they are likely to develop the sense of attachment and belongingness to the group, and engage in group activities such as reading and referring other peers' comments. These activities, in turn, lead to more chances of getting involved in the sharing watching environment. As such, group identification should moderate the relationship between social presence and immersive experiences. Specifically, the level of identification with DanMu-posting peer group should be positively associated with the degree (strength) of the relationship between perceived social presence and immersion.

**Hypothesis 6:** The higher level of group identification results in a stronger effect of social presence on immersion.

### **Control Variables**

In our model, to isolate the effect of DanMu, viewers' gender, age, Web experience, DanMu familiarity, website familiarity, and video interestingness were included as control variables. Previous research has reported that demographic variables, such as gender, age, and Internet background including Web experience and familiarity, might potentially influence social presence, immersion, and loyalty (e.g., [13, 16, 82]). Meanwhile, we note that video interestingness might impel viewers to exclusively focus on the video itself and neglect the DanMu comments, thus it might have an influence on viewers' perceived social presence, co-viewing immersion experience, and loyalty. As such, we also included it in the model as a control variable.

## Methodology

### *Survey Design*

To test our hypotheses, an experimental survey was conducted. We implemented this research design because of practical considerations. By default, DanMu video websites, including the website we used in the study, display DanMu comments automatically and the viewers have to turn off the DanMu system manually if they are not interested in the DanMu. Thus, it is difficult, if not impossible, to test whether DanMu are able to improve the levels of social presence (H1) since in the default case everyone uses DanMu. We recruited the students from a large university to take part in the experimental survey by announcing it on student WeChat groups and through classroom announcements by teachers. We deemed the use of a student sample appropriate for this study based on the following considerations. First, college students represent a large portion of Web users, and are likely to represent typical users on online video websites. Second, most of the participants (91.78 percent) in our research were between 18 and 24 years old (average age = 21.65), and 56.6 percent of the participants were men. A study by a well-known market research company in China reported that the majority of DanMu users (73.1 percent) were between the ages of 18 and 24 years old, and 63.9 percent were men [3]. As such, the sample used in our study is not significantly different from the broader population.

To test the influence of DanMu on social presence (H1), we compared one group where people were able to watch videos with DanMu enabled (DanMu-enabled video group) with the other group where people watched videos without DanMu (video without DanMu group). Traditionally, watching online videos is deemed a solitary activity, and the experience of watching online video is viewed as lacking human warmth and sociability. As such, it may be inappropriate and impossible to ask the participants in the control group (watching online videos without DanMu) to assess the sociability-related constructs such as perceived social benefits and group identification since the sociability is absent in this case. Moreover, although we could assess immersion and e-loyalty in both groups without referring to DanMu, having unequal sample sizes for different constructs in the structural model would later result in implementation and interpretation difficulties during structural equation modeling (SEM) analysis. Thus, we only used the survey data from the DanMu-enabled video group to test the construct relationships we proposed (H2–H6). Considering that the purpose of this article is to study the influencing mechanism of social presence elicited by the DanMu system on e-loyalty, we adopted an imbalance sample allocation method. In particular, each participant was identified by a random number generated in Excel with the random number (RAND) function. We arranged the random numbers. The smallest one-third of the random numbers were allocated to video without DanMu group, and the remaining participants were allocated to DanMu-enabled video group. By allocating more sample to the DanMu-enabled video group, we could maximize the efficiency (statistical power) to detect proposed construct relationships in the research model (H2–H6).

## **Procedures**

The experimental group and control group were tested in the different sessions. In the beginning of the experiment, participants in both groups were instructed to visit an online video site named AcFun ([www.acfun.tv](http://www.acfun.tv)) which is a large DanMu-enabled video website in China. The participants were then asked to choose and watch one to two of their favorite video clips on the homepage they had not viewed within 15 minutes. Before proceeding with the experiment, participants in the DanMu-enabled video group were encouraged by research assistants to read, refer, and post DanMu while watching videos whereas participants in the control group were asked to turn off the DanMu system before watching videos. Based on their initial understanding of the instructions, the participants were given several minutes to ask questions about the experiment. Then, they were asked to start watching videos. After watching videos, participants proceeded to complete an online questionnaire. The entire experimental survey was supervised and directed by two research assistants.

## **Participants**

We excluded 32 participants in the control group who reported inconsistent information while completing the questionnaire and did not comply with the instructions of turning off the DanMu system before watching videos. Twelve participants in the experimental group were also excluded based on the results of the manipulation checks. The final sample included 385 participants in the experimental group (video with DanMu-enabled) and 138 in the control condition (videos without DanMu). Of the 523 participants, 56.6 percent were men. Most of the participants (91.78 percent) were between 18 and 24 years old (average age was 21.65). In general, these participants rated themselves as Internet savvy (over 65 percent of the participants spent several hours online per day) and moderately familiar with the video sites visited and the DanMu system.

## **Measures**

An online structured questionnaire that contains only closed-ended questions was developed. The primary dependent variable was e-loyalty toward the online video site. Prior studies investigating website usage have conceptualized e-loyalty as repeat buying, repeat visit, recommendations, and positive WOM [13]. As such, our research adopted a two-dimensional conceptualization of e-loyalty, consisting of both WOM and revisit. Social presence and some control variables including gender, age, web experience, website familiarity, and perceived interestingness of videos were assessed by the participants in both groups. The principal constructs in our structural model (i.e., immersion, group



identification, perceived benefits, and e-loyalty) were assessed only by the participants in the experimental group. The control variable of DanMu familiarity was also measured only in the experimental group. All measurement items of the latent constructs in the questionnaire were chosen from established validated measurement instruments and measured on a 7-point Likert scale. The items were adapted to fit the context of this study. The measurement items are provided in online Appendix B.

In addition to these scales, two items were used to assess the extent of participants' familiarity with the website visited and DanMu system on a 7-point scale ranging from 1 (*not at all*) to 7 (*very much*). Another item was used to evaluate the perceived interestingness of the video. The amount of time participants reported spending on the Web was measured on a 4-point scale ranging from 1 (*a few times monthly or less*) to 4 (*several times each daily*), and was referred to as Web experience. Further, two manipulation check items (i.e., "Have you used the DanMu system during watching video clips?" "I have a clear idea of what the objectives of this survey are.") were included in the questionnaire.

The items were first translated from English to Chinese by a bilingual scholar who is proficient in both languages. A back-translation version (Chinese to English) was also created by another bilingual scholar to ensure that measurement items in the Chinese version are similar to those in the English version and can measure the same constructs accurately. We pretested the questionnaire with 20 undergraduate students at a large university, and three scholars from the e-commerce department confirmed the clarity of the questions and validity of the instrument. We made minor modifications to the wording of some questions before the questionnaire was finalized and distributed.

## Data Analysis and Results

### Measurement Model

We used the *matrixpls* [62], an open source R package for the partial least squares (PLS) path models, to evaluate the adequacy of the measurement model, including reliability, convergent validity, and discriminant validity. Reliability was examined using the Cronbach's  $\alpha$  and composite reliability (CR) values. As shown in Table 1, the Cronbach's  $\alpha$  and CR value of each construct ranged from 0.837 to 0.985, which were above the suggested threshold of 0.7 [24], indicating that the measures were reliable. Convergent validity was investigated by study of the average variance extracted (AVE) and factor loadings, and both should be greater than 0.5 [21]. As shown in Table 1, both criteria were met, suggesting convergent validity was assured.

Discriminant validity was assessed based on Fornell and Larker's [19] criteria, Gefen and Straub [21] criteria, and heterotrait-monotrait ratio of correlations (HTMT) [31]. As reported in Table 2, the square root of the average variance shared by the items within a construct was greater than the correlations between the construct and any other construct in the model, which



Table 1. Convergent Validity and Reliability Statistics.

Construct	PRE	IMM	UTI	HED	SOC	IDE	WOM	CON	t value	α	CR	AVE
PRE 1	<b>0.769</b>	0.452	0.524	0.535	0.372	0.477	0.491	0.465	23.504	0.923	0.942	0.766
PRE 2	<b>0.900</b>	0.529	0.604	0.654	0.457	0.564	0.541	0.519	40.471			
PRE 3	<b>0.906</b>	0.574	0.549	0.610	0.500	0.571	0.580	0.492	41.906			
PRE 4	<b>0.911</b>	0.577	0.583	0.622	0.518	0.557	0.587	0.447	43.297			
PRE 5	<b>0.882</b>	0.589	0.577	0.576	0.556	0.576	0.561	0.433	36.703			
IMM 1	0.650	<b>0.788</b>	0.573	0.574	0.574	0.638	0.540	0.449	24.796	0.879	0.911	0.673
IMM 2	0.479	<b>0.822</b>	0.451	0.480	0.530	0.541	0.365	0.311	28.182			
IMM 3	0.549	<b>0.863</b>	0.545	0.528	0.570	0.595	0.486	0.393	33.503			
IMM 4	0.399	<b>0.796</b>	0.369	0.395	0.573	0.510	0.344	0.225	25.893			
IMM 5	0.439	<b>0.831</b>	0.430	0.477	0.550	0.521	0.401	0.306	29.533			
UTI 1	0.587	0.516	<b>0.912</b>	0.661	0.461	0.556	0.572	0.517	43.406	0.921	0.944	0.808
UTI 2	0.547	0.488	<b>0.901</b>	0.657	0.390	0.494	0.560	0.466	40.602			
UTI 3	0.559	0.530	<b>0.904</b>	0.661	0.453	0.516	0.552	0.473	41.288			
UTI 4	0.630	0.566	<b>0.880</b>	0.772	0.525	0.622	0.645	0.561	36.288			
HED 1	0.614	0.560	0.723	<b>0.908</b>	0.514	0.616	0.598	0.538	42.513	0.929	0.950	0.825
HED 2	0.606	0.569	0.705	<b>0.917</b>	0.492	0.600	0.548	0.564	44.850			
HED 3	0.638	0.516	0.654	<b>0.908</b>	0.454	0.539	0.563	0.550	42.439			
HED 4	0.632	0.551	0.707	<b>0.899</b>	0.477	0.551	0.588	0.596	40.213			
SOC 1	0.556	0.615	0.520	0.575	<b>0.865</b>	0.656	0.544	0.385	33.686	0.928	0.946	0.778
SOC 2	0.498	0.582	0.462	0.485	<b>0.895</b>	0.616	0.521	0.357	39.176			
SOC 3	0.497	0.638	0.455	0.443	<b>0.892</b>	0.633	0.517	0.302	38.697			
SOC 4	0.440	0.567	0.409	0.429	<b>0.874</b>	0.629	0.483	0.267	35.175			
SOC 5	0.429	0.604	0.402	0.410	<b>0.884</b>	0.603	0.462	0.271	36.982			

(continues)

Table 1. Continued

Construct	PRE	IMM	UTI	HED	SOC	IDE	WOM	CON	t value	$\alpha$	CR	AVE
IDE 1	0.549	0.633	0.519	0.521	0.684	<b>0.855</b>	0.653	0.449	32.319	0.896	0.927	0.762
IDE 2	0.492	0.603	0.453	0.490	0.642	<b>0.863</b>	0.533	0.380	33.346			
IDE 3	0.585	0.621	0.602	0.621	0.603	<b>0.902</b>	0.657	0.564	40.947			
IDE 4	0.570	0.542	0.564	0.588	0.547	<b>0.870</b>	0.657	0.590	34.558			
WOM 1	0.561	0.491	0.568	0.528	0.542	0.655	<b>0.921</b>	0.482	46.417	0.837	0.925	0.860
WOM 2	0.609	0.490	0.636	0.641	0.524	0.673	<b>0.933</b>	0.559	50.692			
CON 1	0.537	0.410	0.569	0.614	0.353	0.565	0.565	<b>0.985</b>	112.494	0.969	0.985	0.969
CON 2	0.523	0.416	0.541	0.605	0.359	0.548	0.543	<b>0.984</b>	108.346			

Notes: PRE = social presence; IMM = immersion; UTI = utilitarian value; HED = hedonic value; SOC = social value; IDE = group identification; WOM = word-of-mouth; CON = continuance intentions;  $\alpha$  = Cronbach's  $\alpha$ ; t value = item loading's t value; CR = Composite reliability; AVE = the average variance extracted.

Boldface numbers represent factor loadings of items on their expected constructs.

**Table 2. Construct Correlations.**

	PRE	IMM	UTI	HED	SOC	IDE	WOM	CON
PRE	0.875							
IMM	0.623	0.822						
UTI	0.648	0.586	0.899					
HED	0.686	0.605	0.768	0.908				
SOC	0.551	0.682	0.512	0.534	0.882			
IDE	0.629	0.690	0.612	0.635	0.712	0.873		
WOM	0.632	0.529	0.650	0.633	0.575	0.716	0.927	
CON	0.538	0.419	0.564	0.619	0.361	0.565	0.563	0.984

Notes: Square root of AVE on diagonals. All correlation coefficients are significant at the level of 0.05. PRE = social presence; IMM = immersion; UTI = utilitarian value; HED = hedonic value; SOC = social value; IDE = group identification; WOM = word-of-mouth; CON = continuance intentions.

satisfies Fornell and Larker's [19] criteria for discriminant validity. Moreover, as indicated in Table 1, all items loaded highly on their expected constructs and none of the items loaded higher on other constructs than on its anticipated construct. Thus, Gefen and Straub's criterion [21] was also met for all constructs in our model. In addition, Table 3 shows that the maximum HTMT value (0.827) was below the cutoff value of 0.85. Collectively, adequate discriminant validity was present for the constructs in the proposed model [31].

To ensure common method variance (CMV) was not a serious threat in the survey dataset, we used the marker variable (MV) method proposed by Lindell and Whitney [47]. Because we did not define a marker variable a priori, this technique was employed in a post hoc manner by assuming the lowest correlation in the manifest variable correlation matrix (0.1078) to be the extent of CMV [47, 63]. We computed CMV-adjusted correlations using Equations (4) and (5) in Lindell and Whitney [47]. The results show that all previously significant correlations remained statistically significant even when CMV was controlled. We also used the second-smallest correlation (0.1443) as a more conservative estimate of CMV, and the result remained

**Table 3. Heterotrait-Monotrait Ratio of Correlations.**

	PRE	IMM	UTI	HED	SOC	IDE	WOM	CON
PRE	1.000							
IMM	0.680	1.000						
UTI	0.701	0.639	1.000					
HED	0.741	0.662	0.826	1.000				
SOC	0.591	0.753	0.547	0.571	1.000			
IDE	0.691	0.768	0.670	0.697	0.777	1.000		
WOM	0.718	0.607	0.736	0.714	0.650	0.827	1.000	
CON	0.570	0.444	0.593	0.652	0.378	0.610	0.623	1.000

Notes: PRE = social presence; IMM = immersion; UTI = utilitarian value; HED = hedonic value; SOC = social value; IDE = group identification; WOM = word-of-mouth; CON = continuance intentions.

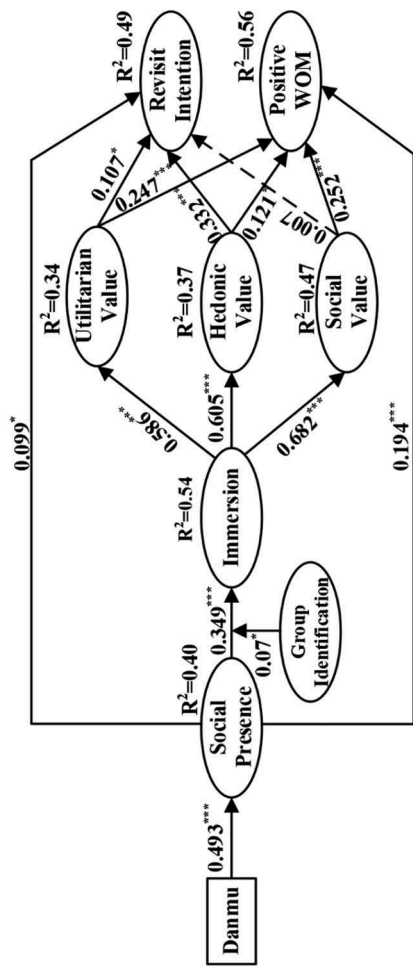
unchanged. The results suggest that CMV did not bias the results. In addition to the MV method, we also checked the construct correlation matrix. There were no high correlations (0.80 or above), which also confirms that CMV was not a problem in this study [12]. Thus, the data did not appear to suffer from a severe CMV threat, and we proceeded to test the structural model.

### **Structural Model**

We estimated the structural model using a two-step approach. Specifically, we first regressed the levels of social presence on dummy group variable while controlling for gender, age, Web experience, website familiarity, and perceived interestingness of video(s) to test H1. Then, the partial least squares path modeling (PLS-SEM) method was used to investigate the influences of social presence on loyalty (i.e., H2–H6) using the experimental group data. Figure 2 illustrates the results for the structural model.

As reported in Figure 2, a significant amount of variation in revisit intention (0.49) and positive WOM (0.56) is explained by the proposed model. Specifically, DanMu exerts a positive significant impact on social presence ( $\beta = 0.493$ ,  $p < 0.001$ , H1 supported) such that social presence improves in the presence of DanMu comments ( $M_{\text{DanMu-enabled video}} = 4.09$ ) compared with that in the absence of DanMu comments ( $M_{\text{DanMu-disabled video}} = 2.51$ ). As expected, social presence has a positive significant effect on immersion ( $\beta = 0.349$ ,  $p < 0.001$ ), revisit intention ( $\beta = 0.099$ ,  $p < 0.05$ ), and positive WOM ( $\beta = 0.194$ ,  $p < 0.001$ ), supporting H2 and H5. Immersion in turn has significantly positive effects on utilitarian value ( $\beta = 0.586$ ,  $p < 0.001$ ), hedonic value ( $\beta = 0.605$ ,  $p < 0.001$ ), and social value ( $\beta = 0.682$ ,  $p < 0.001$ ), supporting H3a, H3b, and H3c. The positive effects of utilitarian value on revisit intention ( $\beta = 0.107$ ,  $p < 0.05$ ) and positive WOM ( $\beta = 0.247$ ,  $p < 0.001$ ) are significant, supporting H4a. The impacts of hedonic value on revisit intention ( $\beta = 0.332$ ,  $p < 0.001$ ) and positive WOM ( $\beta = 0.121$ ,  $p < 0.05$ ) are also significant, and thus H4b is confirmed. As expected, social value is positively associated with WOM ( $\beta = 0.252$ ,  $p < 0.001$ ) loyalty are highly significant. However, the influence of social value on revisit intention is trivial and statistically nonsignificant ( $\beta = 0.007$ ,  $p = 0.44$ ). Hence, H4c is partially supported. Finally, identification with the DanMu-posting group significantly moderates the relationship between social presence and immersion ( $\beta = 0.07$ ,  $p = 0.03$ , H6 supported).

To test whether immersion and perceived benefits mediate the relationship between social presence and loyalty, we conducted the mediation tests. We computed confidence intervals for the indirect effects using the bootstrap method proposed by Preacher and Hayes [58]. Following the suggestions of these authors, we included all mediators in the same model and estimated the results simultaneously. The results reported in Table 4 confirm the significance of the mediation effects.



Notes: \*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$

The effect of control variables:

- (1) The influence of gender, age, and web experience on social presence is not significant; website familiarity ( $\beta = 0.13, p < 0.01$ ) and video interestingness ( $\beta = 0.29, p < 0.001$ ) significantly affect social presence;
- (2) The influence of the six control variables on immersion is not significant;
- (3) Website familiarity and video interestingness significantly affect revisit intention ( $\beta = 0.22, p < 0.001$ ;  $\beta = 0.09, p < 0.05$ ) and positive WOM ( $\beta = 0.11, p < 0.05$ ;  $\beta = 0.08, p < 0.05$ ); The influence of gender, age, DanMu familiarity, and web experience on revisit intention and positive WOM is not significant.

Figure 2. Main Structural Model

**Table 4. Mediation Analysis Results.**

Mediation path	Coefficient	Bootstrap SE	Mediation effect exists
Social presence → Immersion → Utilitarian value → Revisit intention	0.063	0.039	Yes
Social presence → Immersion → Hedonic value → Revisit intention	0.172	0.037	Yes
Social presence → Immersion → Social value → Revisit intention	0.006	0.025	No
Social presence → Immersion → Utilitarian value → WOM	0.133	0.036	Yes
Social presence → Immersion → Hedonic value → WOM	0.063	0.038	Yes
Social presence → Immersion → Social value → WOM	0.131	0.030	Yes
Total indirect effect	0.569	0.078	Yes

Notes: Standard errors are estimated with 500 bootstrap replications and percentile-based confidence intervals are provided. WOM = word-of-mouth.

## Discussion

As an emerging comment system and a powerful user engagement platform, the DanMu system has been gaining increased momentum in recent years, especially in online video-streaming sites. What differentiates DanMu-enabled videos from the others is their real-time comments on screen, which greatly increases the social presence. Though the extant research has enriched our knowledge about the positive influence of social interaction on e-loyalty, to our knowledge it has not been examined in the context of online video websites. The major thrust of our research lies in understanding how rather than whether the social presence affects e-loyalty (revisit intention and positive WOM). We emphasize the perception-experience-evaluation mediation process (social presence-immersion-perceived value) between DanMu comments and e-loyalty.

The results suggest that the DanMu system can significantly increase the perceived social presence. Social presence in turn not only directly influences loyalty, but also indirectly affects it via the two-stage serial mediation of immersion and perceived benefits. The indirect effect is much greater than the direct effect, suggesting that immersion and perceived benefits are important intervening variables in explaining the effect of social presence on loyalty. Moreover, this study reveals that the impact of social presence on immersion is contingent on the degree of identification with DanMu-posting peer group. Group identification strengthens the effect of social presence on immersion as group identification is conducive to the cultivation of feelings of attachment, belongingness, and commitment to the group, which increases the behavioral involvement and engagement.

The results also indicate that immersion mediates the relationship between social presence and the three types of perceived benefits or values (i.e., utilitarian value, hedonic value, and social value). The feeling of social presence helps video

viewers become immersed in the sharing watching environment, which serves as an important antecedent of perceived benefits. The influence of immersion on social benefits is greater than that on utilitarian and hedonic value, suggesting that an intense immersion experience greatly improves the viewers' value perception of building and extending social or parasocial relationships with peers.

Furthermore, three types of perceived benefits are found to be important in predicting e-loyalty. However, the results demonstrate that perceived benefits do not have an equally strong influence on the two facets of e-loyalty, revisit intention and positive WOM. Specifically, hedonic value is revealed as the key driver of revisit intention. On the other hand, utilitarian and social value are the key drivers of positive WOM. Contrary to our expectations, social value does not have a significant influence on revisit intention. A possible explanation is that the DanMu comment mainly satisfies the viewers' innate utilitarian and hedonic needs. Although the DanMu video website has stickier users than general video portals because of its embedded social component, compared to the DanMu system, some other social tools such as Tencent's WeChat Groups and QQ Groups provide more efficient and effective platforms in building an engaged community and engaging in social interactions and communications. As such, individuals are more likely to turn to these platforms to seek social support and maintain their social relations, and thus the social value of the DanMu system is not necessary to lead to viewers' revisit intention.

### ***Theoretical and Managerial Implications***

This study proposes a theoretical model exploring the mechanism of how the emerging DanMu system in online video websites influences viewers' e-loyalty, which is a practically pertinent, although scholarly rather understudied, phenomenon in the e-commerce domain. The study makes some unique and important contributions to the extant literature.

First, our study is among the first to provide theoretical insights into understanding how DanMu comments in the online video website affect users' e-loyalty. This study refines and extends research on the social presence-loyalty relationship in the online environment. Although previous research has asserted that social interaction has a positive effect on e-loyalty, these studies in general have focused on the direct effect between the variables. Compared to the existing research, this study provides a much more fine-grained analysis on how increased social presence influences e-loyalty. Specifically, we emphasize the perception-experience-evaluation mediation process (social presence-immersion-perceived value) between DanMu comments and e-loyalty. These constructs have been explored independently in separate studies; however, our research examines them together within an integrated framework to better understand how social presence influences e-loyalty.

Second, this research contributes to the extant social presence literature by revealing that immersion sense mediates the relationship between social presence and perceived benefits. This suggests a potential mechanism that

might explain the inconsistent findings on the relationship between social presence and perceived benefits in prior studies. Specifically, this study indicates that the effect of social presence on benefits could only exist under the condition that users obtain a compelling immersive experience. Social presence is not necessarily associated with the immersive experience because of the presence of moderators such as group identification investigated in this study. For instance, online video website users who do not identify with ACG cultures and want to concentrate on the video may regard DanMu comments as noises that distract their attention from the videos and may get annoyed by the bullet curtain. In this case (i.e., users fail to experience immersive feelings), enhanced social presence would not result in perceived benefits as reported in some prior studies.

Third, this research also enriches our knowledge about the contingent effect of social presence on immersion by including group identification as a moderator. A high level of group identification reinforces the influence of social presence on immersion experience. Examining the moderating effect of group identification not only enables us to appreciate what increases and sustains social presence effect on immersion, but also provides a sound theoretical base for future inquiries in this field.

Finally, with the exception of Charfi [7], few studies have examined the relationship between immersive experience and perceived benefits (utilitarian and hedonic value). This study extends this research stream by examining how immersive experience affects perceived utilitarian, hedonic, and social benefits, which in turn differentially influence the two facets that underpin e-loyalty, revisit intention, and positive WOM. Specifically, revisit intention is mainly driven by the perceived hedonic benefit while positive WOM likelihood is largely determined by the utilitarian and social benefits. The three perceived benefits comprehensively capture perceived value of visiting DanMu-enabled online video sites and help us to gain a complete understanding on perceived value of using a DanMu-enabled online service.

Altogether, considering that DanMu has been incredibly popular among young people and increasing online video websites are offering DanMu technologies in their platforms to meet the growing appeal of social interactions to users, our study provides a timely investigation to enable researchers and practitioners to understand how social presence triggered by DanMu comments inspires the desired loyalty responses. This study thus provides a stimulus and guidance for further deep inquiries into the role of DanMu comments.

From a practical point of view, this study provides important managerial insight. First, our study advises video site operators to leverage the DanMu system as an effective means to increase the feeling of social presence, which makes visitors willing to revisit the sites and spread positive WOM. Second, this research provides evidence that immersion and perceived benefits can substantially assist online video site operators in building and maintaining viewers' loyalty. As such, we advise the practitioners to allocate extensive thought and resources to carefully design an online environment that enables their visitors to engage in social interaction. It is imperative to turn visitors from passive viewers into active participants. Online and offline activities



could be organized by the practitioners to facilitate viewers' engagement and active participation with peers and to develop social bonding and parasocial relationships among the viewers, which boosts their perceived hedonic value, social value, and utilitarian value. Third, the study suggests that video site operators should make efforts to develop features that enhance visitors' group identity. Website operators can utilize some data mining techniques such as user profiling to segment visitors with similar needs and characteristics, and then perform peer recommendations. Online communities and incentive programs can also be employed to encourage the viewers to find out and connect with peers who share the same interests, concerns, problems, and opinions.

### ***Limitation and Further Research***

With complexity and cost considerations, we used a real-world DanMu video website in the study instead of creating a fictitious one. The results suggest that some participants in the control group (the DanMu system was turned off) were familiar with the website, potentially leading these participants to provide spurious high scores on the social presence scale (familiarity effect). As such, the path coefficient between DanMu and social presence tends to be biased toward zero (i.e., the correlation score between DanMu and social presence tends to underestimate). It can be expected that if all participants in the control group were not familiar with the website (e.g., researchers created a fictitious website for the study), the effect of DanMu on social presence would be even more salient than in this study. Using a fictitious website can avoid the familiarity effect, but the external validity of the results may be diminished to some degree.

Second, this is a cross-sectional study. Such a design is limited in directly assessing causality, restraining this study from claiming and examining exact causality among the constructs. Future studies are encouraged to use longitudinal approaches to investigate the causality of the relationships observed in this study. Third, this study used a convenience sample with college students aged 18 to 24 years, which may have reduced the external validity of the study. Although a survey report suggests that the individuals in this age group are the most active online video viewers [15], considering that online video viewing habits may vary across different age groups, future research is warranted to incorporate more heterogeneous samples to cross-validate this study's findings. Fourth, as an initial step in the exploration of the effect of DanMu comments on loyalty, the proposed model highlighted the positive effects of DanMu. The negative effects of DanMu, such as the interpretation of viewing the screen or low quality of comments by the viewers, may lead to different results of using DanMu. Further research can extend the results revealed in this study by investigating the dark side of the DanMu system (i.e., people may get annoyed by the DanMu comments and want to concentrate on the video).

## Acknowledgments

The authors would like to thank the editor and three anonymous reviewers for their helpful comments on this article. The work described in this article was partially supported by grants from the National Natural Science Foundation of China (No. 71571029, No. 71572028).

## Supplemental File

Supplemental data for this article can be accessed on the [publisher's website](#).

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