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The More Engaged, the More Generous: Examining the Influence of Viewers' Engagement on Their Gifting Behavior in Live Streaming Services

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ABSTRACT

Social Live Streaming Services (SLSSs) is an emerging form of social media that facilitates real-time interaction between streamers and their viewers through video streaming. With its growing prevalence worldwide, a wealth of literature has investigated its unique features of IT affordances and para-social interactions between streamers and their viewers, leaving viewers' inner development and adjustment of attitudes and actions during the watching remained largely unknown. This study empirically examined the effects of viewers' previous active engagement on their subsequent purchase behavior in SLSSs from the perspective of self-perception and perceived sunk costs. Results show that both free gifts and Danmaku (i.e., real-time comments) length significantly induce the purchase of charged gifts and that there are significant gender discrepancies underlying these mental attribution processes.

Keywords: Social live streaming services (slsss), self-perception theory, sunk cost, danmaku, virtual gifts

INTRODUCTION

"It's the time that you spent on your rose that makes your rose so important."

THE LITTLE PRINCE

Social Live Streaming Services (SLSSs), an increasingly prevalent means of social networking, enable users to share information through real-time video streaming. It is more than a combination of traditional social media and e-commerce because it possesses the prominent characteristics of those two platforms. First, it affords users two-way communications through its online environment, which is like the functions of traditional social media. Second, its unique gifting mechanism enables viewers to appreciate and support streamers' performance, which is similar to the service products provided in traditional e-commerce platforms. Gifting is a unique means of monetization on SLSSs first appeared in China. During a live streaming show, viewers could purchase virtual gifts through digital payments and send them to streamers. Last but not least, SLSSs facilitate a real-time interaction among all of these social and business activities, making the process of information sharing more instant and convenient. Figure 1 shows an example of SLSSs on the mobile end in China. On the top of the screen is the live video streaming with Danmaku (i.e., real-time comments) floating on it. In the lower comment area, viewers could observe others' real-time comments and virtual gifts.

China, as one of the leading counties in the field of SLSSs, has started tapping the market since 2005 with its initial goals of enhancing user stickiness to the websites. In 2020, users of SLSSs in China had reached 560 million, accounting for 62% of total internet users (Wei, 2020). in other countries, SLSSs has also attracted a huge number of users, such as Twitch, YouTube, and BIGO live. Among the five main sources of income (i.e., gifting, advertising, VIP membership fee, game promotion, and commission) in SLSSs, they are gifting accounts for 90% of the total revenue in the field of entertainment and online video games (Wei, 2020). Therefore, it is of great importance to explore factors impacting viewers' gifting behaviors in this unique cyber ecosystem.

Apart from the majority of existing literature on SLSSs that explore the roles of IT affordances in live streaming promotions, the rest focusing on the gifting behaviors have mostly interested in the relational benefit, and para-social interactions between streamers and viewers, resulting in viewers' inner development and adjustment of attitudes and actions during the watching remained largely unknown. More specifically, there is a lack of vertical investigation on the relationships between viewers' previous engagement and their subsequent behaviors (i.e., purchase virtual gifts) in SLSSs. Furthermore, empirical evidence on the influence of demographics on viewer behaviors is also sparse. Therefore, our research questions are raised accordingly to bridge these gaps.

Figure 1: An Example of SLSSs on the Mobile End in China

Does viewers' previous active engagement (i.e., sending free gifts and Danmaku) in SLSSs have an impact on their subsequent purchase of charged gifts? If yes, is there a demographic heterogeneity (i.e., gender) in these effects?

To deal with these questions, we first adopted the concept of cognitive consistency, the Self-Perception Theory, and the perspective of sunk costs to build up the framework for this study. Then, empirical analyses were conducted based on a real-world live streaming data set, and two robustness checks were exhibited to eliminate the endogeneity derived from reverse causality and omitted variables. Lastly, the theoretical and practical implications of the findings were demonstrated, together with the limitations of this study and further research directions.

THEORETICAL FOUNDATION

Self-Perception Theory

Self-perception theory, first proposed by Daryl Bem, refers to the practice that human inferences of their own perceptions could partly be influenced by their previous behavior and its potential causes (Bem, 1972). Originated from the literature of psychology, this theory provides a novel perspective for cognitive consistency, a phenomenon that individuals tend to keep their attitudes and opinions congruent in order to achieve inner harmony and balance.

A wealth of literature in social psychology has supported and developed this theory by addressing that human attitudes and emotions could be shaped by their own behaviors and actions, driven by the internal desire for cognitive consistency and congruency. For example, it is found that individuals regard themselves as more friendly to the environment if they have engaged in recycling-relevant behaviors (Chaiken & Baldwin, 1981). Likewise, it is observed that frequent volunteering work could lead individuals to become more considerate and kind-hearted with others (Brunelle, 2001). Woosnam *et al.* (2018) attributed such phenomenon to self-identifying stereotypes that could induce individuals to absorb and act correspondingly or oppositely.

Apart from the application in social psychology, the Self-perception theory has also been introduced to the field of Information Systems (IS) to explore how users' perceptions are shaped and adjusted by observing their own behaviors. For example, Xu *et al.* (2020) found that when facing events of infectious diseases in Social Networking Services (SNS), there are a series of reciprocal feedbacks in lieu of a one-way effect between users' attitudes toward risks and their sharing behavior at different stages. Comparable findings were revealed in research examining the impact of online reviews on customer loyalty, demonstrating that consumers with review behaviors contribute to a significantly larger volume of orders than those without (Lohse & Kemper, 2019). These findings attest notion that cognitions and perceptions follow actions and behaviors and are of great value for IS researchers to reinspect user behaviors from a dynamic and reciprocal perspective rather than a static and straightforward one.

Although the core idea of this theory seems akin to Embodied Cognition Theory, which proposes that human bodily states and behaviors could reversely affect their mental activities and subsequent actions, these two theories differ greatly in the underlying mechanisms, self-perception theory addresses the impacts of individuals' self-observation and self-reflection of their own behaviors on the subsequent perceptions, emphasizing the activeness and consciousness of introspection (Bem, 1972). In contrast, Embodied Cognition Theory posits that humans tend to reuse the neural resources derived from their previous sensory and bodily experience so that they unconsciously make similar perceptual and motoric reactions when facing the stimuli that are intrinsically related to the initial ones, which is more about a passive and unconscious reflex without awareness (Anderson, 2010; Barsalou, 2008; Krishna & Schwarz, 2014).

Social Live Streaming Services (SLSSs)
Social Live Streaming Services (SLSSs), an emerging form of social networking services, have attracted an increasing number of users and researchers these years due to its unique features in real-time interactions and monetization strategies in recent five years. Researchers pointed out that maximizing personal income and capabilities, as well as the sustainability of the environment, are fundamental objectives of SLSSs (Yang & Gao, 2017). Moreover, most of the SLSSs are designed to facilitate users' usage and promote users' engagement by means of various gamification strategies such as fan badges and virtual goods (Scheibe & Zimmer, 2019). With the popularity of SLSSs, the steadily growing literature on related topics has gradually formed three main streams of research.

The first stream of research focused on the content contribution and usage motivations of different social live-streaming platforms, namely, how could streamers produce more popular content and the motivations behind their using behaviors (Bründl & Hess, 2016; Bründl *et al*., 2017; Cai & Wohn, 2019; Zhao et al., 2018; Zimmer & Scheibe, 2019). The second stream of research focused on the monetization approaches in the mode of e-commerce promotions on social live steaming platforms, in other words, how could streamers and platforms make boost sales through effective advertising in live streaming shows (Chen *et al.*, 2019; Hou *et al.*, 2020; Li & Kang, 2020; Wongkitrungrueng & Assarut, 2020; Xu et al., 2019).

The third stream of research focused on another way of monetization, virtual gifts, or digital items purchases made by viewers while they are viewing the live streamings shows. Researchers have provided different theories and perspectives to understand the motivations of viewers' gifting behaviors. For example, from an identity investment perspective, viewers' consumption of charged gifts is significantly affected by their class identity, while their consumption of free gifts is motivated by their relational identity when there is a high social density in this live streaming room (Li et al., 2019). Another study shows that cognitive absorption and virtual crowd experience positively influence viewers' purchase intention for virtual gifts (Guan et al., 2019). Similarly, it is also found that both contextual factors (e.g., interactivity and social presence) and personal factors (e.g., trait curiosity and social media dependence) could influence viewers' consumption intention (Guo et al., 2019; Li et al., 2018).

Danmaku and Virtual Gifting in SLSSs
Danmaku, also known as "bullet curtain," is a Japanese term that refers to a type of real-time comments displayed on the screen of the video. Originated in Niconico, a video-sharing platform in Japan, Danmaku enables viewers to share comments synchronously as the video plays. More specifically, Danmaku appears in accordance with the time axis of the video, which differentiates it from traditional static comments posted below or beside the video.

In 2008, Danmaku was introduced to China as Danmu and rapidly gained popularity among young Chinese Internet users. Adopted by several major video-sharing platforms such as Bilibili, iQiyi, and Tencent Video, Danmaku has become the main source of attraction for video streaming services in China. In SLSSs, it is also a key function for viewers to interact with streamers and other viewers in real-time, largely enhancing users' sense of telepresence during the watching experience.
Virtual gifts in SLSSs are intangible products that could be bought and sent to streamers by viewers, serving as real-time performance feedback and streamer-viewer relationship enhancement. According to the pricing, virtual gifts are categorized into two types: free gifts and charged gifts. Free gifts are offered by platforms freely, while charged gifts can only be obtained through digital payment.

Although both free gifts and charged gifts are viewers' expressions of liking to streamers' performance, they take on different roles in the monetization process from the perspective of streamers and platforms. Charged gifts are the direct way for streamers and platforms to monetize their performance and services. In most cases, streamers and platforms share the earnings based on a certain ratio, so that streamers' income level largely depends on the amounts of charged gifts they receive. Although advertisements are also a way to earn money, these opportunities are scarce and mostly offered for top streamers.

Free gifts, unlike charged gifts, do not directly relate to streamers' income but are also indispensable in the monetization process for two reasons. First, they serve as a signal of the popularity of streamers as well as their performance. Since the number of free gifts is overwhelmingly beyond the charged ones, the animation and notification of sending free gifts help create an atmosphere in the virtual channel, leaving newcomers an impression that the streamer or her performance is attractive and interesting. As a result, there will be an increasing possibility for newcomers to stay longer in this channel. Second, free gifts could motivate viewers to purchase charged gifts through the shaping effect and the foot-in-the-door effect (Lammers, 1991). That is to say,

sending free gifts is a way that effectively approximates the real purchase of virtual gifts (i.e., the charged gifts) so that viewers are more likely to upgrade their consumption to charged gifts for a better experience.

HYPOTHESIS DEVELOPMENT

Free Gifts, Danmaku Length, and Charged gifts

According to the Self-perception theory, individuals have a tendency for introspection on their previous behaviors and make self-judgment for their attitudes accordingly (Bem, 1972). Apart from the influence mechanism of self-identifying and self-stereotyping proposed in the existing literature, the influence of suck cost remained unexamined. Rational individuals are inclined to weigh their costs and returns in order to avoid risks and losses, and thus they would only proceed with the work that is worthy and promising. However, when their inputs sometimes could not meet comparable rewarding, some individuals might be forced by the averseness and fear of losses to continue until achieving expected outcomes (Samuelson & Zeckhauser, 1988; Simon, 2013, pp. 72-73). More importantly, with the preference for maintaining an intrapersonal cognitive consistency, their perceptions towards the work would change correspondingly to justify their previous engagements, and the subsequent behaviors could be induced from these adjusted attitudes (Bhattacherjee, 2001).

In the context of SLSSs, free gifts and the Danmaku function offered by platforms create opportunities for viewers to input their efforts. First, both interactions induce viewers to devote mechanic costs during the watching. Sending free gifts requires viewers to click the mouse on the PC end or tap the screen on the mobile phone end multiple times, while sending Danmaku requires viewers to type through keyboards or screens. Hence, viewers are encouraged to be bodily active during the watching rather than merely looking at the video. Second, beyond the mechanic cost, sending Danmaku calls for two additional costs: cognition cost and emotion cost. Organizing and structuring a sentence to express opinions and affections involves the collaborations and elaborations of certain brain regions and multiple hormones (Planton et al., 2017; Van Wingen et al., 2011). Hence, when viewers observe and reflect on these efforts they made in a channel, they are inclined to infer themselves as interested and appreciated with the performance, and thus would be more willing to pay for shows. Therefore, it is reasonable to hypothesize that sending more free gifts and longer Danmaku could induce an increase in the amount of charged gifts.

H1: There is a positive correlation between the number of free gifts and the amount of charged gifts.

H2: There is a positive correlation between the length of Danmaku and the amount of charged gifts.

Moderating Role of Viewer Gender

Gender differences are ubiquitous across disciplines. In the field of consumer behavior, evidence shows that females and males differ a lot in buying motivations and shopping preferences (Ulbrich et al., 2011). For example, females' online consumptions are more emotional-and social-oriented while males' are more pragmatic- and functional-oriented in buying (Dittmar et al., 2004). Apart from the gender discrepancies in consumer behavior, females and males also behave dissimilarly in terms of sunk costs. Johnson and Whisman (2013) found that females are more inclined to reflect and anxious about their past decisions, actions, and experiences than males. Moreover, such a tendency of rumination and self-reflection results in the continuance of investment in previous unsuccessful events (Bruine de Bruin et al., 2014). The comparable finding reveals that compared to males, females suffer from significantly higher switching costs during the migration from the present management system to another one (Dang et al., 2015).

However, an overlooked point in this literature is that the sunk cost could be impacted by the individual's subjective sensation of the cost. More specifically, individuals might perceive the different extents of sunk cost hinging on their motivations, preferences, capabilities, and even habits. For example, individuals talented in sports would perceive finishing a marathon as less costly than those without the talent. Hence, in the context of SLSSs, viewers' perceived sunk costs of sending free gifts and Danmaku should be not only determined by their inherent sensibility and tolerance to the sunk cost but also by their inner attitudes and feelings on these actions. For example, males will perceive the less sunk cost of sending free gifts than females because they inherently prefer free gifts to charged ones in light of their functional-orientated consumption perceptions. Given that males are less sensitive to the sunk cost, it is reasonable to expect that they negatively moderate the effects of sending free gifts on the amount of charged gifts.

H3: Compared to female viewers, the impact of the number of free gifts on the amount of charged gifts will be smaller for male viewers.

Nonetheless, the situation becomes complicated for the Danmaku sending. On the one hand, males are less sensitive to the sunk cost than females, indicating that the main effect will be smaller for them. On the other hand, males tend to perceive more sunk costs of cognition and emotion for sending Danmaku because they are less emotionally expressive than females (Kring & Gordon, 1998). Therefore, two contradicted hypotheses are proposed.

H4a: Compared to female viewers, the impact of the Danmaku Length on the amount of charged gifts will be smaller for male viewers.

H4b: Compared to female viewers, the impact of the Danmaku Length on the amount of charged gifts will be greater for male viewers.

METHODOLOGY

To test the hypotheses, a real-world dataset was crawled from a top E-sports streamer's channel on a leading live streaming platform in China. The data collection started on April 3, 2021, and ended on April 30, 2021, with a duration of 4 weeks. During this period, viewers (N = 121,544) that have sent at least one Danmaku in the first week were selected for the subsequent observation. That is to say. This dataset could be regarded as week-level panel data with a time length of 4. Therefore, the data size is 486,176 (121,544 * 4).

The variables comprise three segments: viewers' demographic information, viewers' gift-sending, and Damaku-sending behaviors, and the shows' performance information. The first segment includes a viewer's gender, fan level, and noble level. Fan level is calculated by the platform in accordance with the number and monetary value of gifts a viewer sent to a streamer, reflecting the viewer's attitude and loyalty to a specific streamer. The noble level is a VIP membership providing a combo of identity-prominent services, indicating a viewer's concern on the virtual identity on the platform. Fan level and noble level were considered as control variables because fan identity and noble identity might both contribute to the charged-gifts sending behavior (Li *et al*., 2019). The second segment reflects a viewer's activities information in a channel, including the number of free gifts, the amount of charged gifts, and the average length of Danmakus that have been sent out. The last segment consists of three different sentimental expressions in the Danmaku, indicating viewers' general impression and attitude toward the shows they watch. These three were also considered as control variables because the quality of performance could directly influence viewers' willingness to purchase the charged gifts.

Table 1: Variable Description

	Variable	Alias in Model	Description
DV	Amount	*lnamt*	The total amount of charged gifts a viewer purchased and sent during a certain period
IV	Free Count	*lnfreecnt*	The total number of free gifts a viewer sent during a certain period
	Danmaku Length	*lndmlen*	The average length of Damaku (aka Danmu) a viewer sent during a certain period
	Gender/Male	*gender*	Set to one when the viewer is male
Controls	Fan Level	*lnfan*	A fan membership is determined by the number and the amount of gifts a viewer sent to a specific streamer, set to zero if the viewer did not send any gifts
	Noble Level	*lnnoble*	A VIP membership purchased by a viewer on a specific platform, set to zero if the viewer did not make the purchase
	Awesome Performance	*lnawesome*	The average frequency of Danmaku with the positive word in the live shows during a certain period
	Confusing Performance	*lnconfuse*	The average frequency of Danmaku with the confusing word in the live shows during a certain period
	Negative Performance	*lnnegative*	The average frequency of Danmaku with the negative word in the live shows during a certain period

To eliminate the skewness and large differences in variable scales, we log-transformed all the continuous variables to ln(x + 1). A two-way fixed-effects Model was adopted, and the model specification shows as follows:

$$lnamt_{it} = \beta_0 + \beta_1 lnfreecnt_{it} + \beta_2 lndmlen_{it} + \beta_3 lnfreecnt_{it} * gender_i + \beta_4 lndmlen_{it} * gender_i \\ + \gamma individual_i + \theta week_t + \delta controls_{it} + \varepsilon_{it}$$

(1)

ANALYTICAL RESULTS

Table 2 presents the descriptive statistics of variables grouped by gender. The ratio between female (gender = 0) and male (gender = 1) viewers approximate 1:2 (N = 45,186 vs. N = 76,358) because the channel we observed focus on E-sports performance and female fans are generally fewer than male fans. It could also be found that the mean length of Danmaku sent by females is higher than those of males, with 1.496 vs. 1.132 and 3.300 vs. 3.130, respectively. In contrast, the count of free gifts sent by females is lower than that of males (31.96 vs. 47.71) while the amount of charged gifts sent by females are higher than that of males (10.54 vs. 9.611), indicating that females are more willing to spent money to express their appreciations while males are more inclined to show their support through costless means. This discrepancy is aligned with the findings that testosterone induces less generosity and more selfish decision makings especially for distant others (Ou *et al.*, 2021).

Table 2: Descriptive Statistics by Gender

VARIABLES	(1) gender 0 N	(2) mean	(4) min	(5) max	(6) gender 1 N	(7) mean	(9) min	(10) max
code	180,744	62,891	4	125,262	305,432	62,496	1	125,261
week	180,744	2.500	1	4	305,432	2.500	1	4
danmu_count	180,744	1.496	0	470.9	305,432	1.132	0	389.3
danmu_length	180,744	3.300	0	97.10	305,432	3.130	0	154.4
free_count	180,744	31.96	0	2,261	305,432	47.71	0	3,303
total_amount	180,744	10.54	0	95,132	305,432	9.611	0	51,510
awesome	180,744	12,165	0	51,605	305,432	12,896	0	51,605
confusing	180,744	2,676	0	7,182	305,432	2,847	0	7,182
negative	180,744	391.8	0	1,236	305,432	431.4	0	1,236
fanslevel	180,744	2.929	0	32	305,432	4.745	0	30
noblelevel	180,744	0.0331	0	6	305,432	0.0749	0	5

Table 3 summarizes variables through the lens of time. It shows that viewers' activeness in Danmaku sending and gift sending flopped sharply in the second week and then slightly fluctuated in the following three weeks. Since the observation is concentrated on the same group of people throughout the data collection window, it could be inferred that viewers' enthusiasm on the live streaming shows did not follow a steadily increasing pattern but an unstable variating pattern.

Table 3: Descriptive Statistics by Week

VARIABLES	(1) week 1 N	(2) mean	(3) week 2 N	(4) mean	(5) week 3 N	(6) mean	(7) week 4 N	(8) mean
code	121,544	62,643	121,544	62,643	121,544	62,643	121,544	62,643
danmu_count	121,544	2.584	121,544	0.727	121,544	0.921	121,544	0.837
danmu_length	121,544	6.717	121,544	1.894	121,544	2.128	121,544	2.034
gender	121,544	0.628	121,544	0.628	121,544	0.628	121,544	0.628
free_count	121,544	46.97	121,544	41.05	121,544	42.31	121,544	37.07
total_amount	121,544	14.39	121,544	4.105	121,544	12.32	121,544	9.013
awesome	121,544	25,058	121,544	8,278	121,544	10,685	121,544	6,476
confusing	121,544	5,019	121,544	1,741	121,544	2,201	121,544	2,172
negative	121,544	735.0	121,544	388.5	121,544	288.8	121,544	254.5
fanslevel	121,544	4.005	121,544	4.048	121,544	4.086	121,544	4.142
noblelevel	121,544	0.0589	121,544	0.0592	121,544	0.0595	121,544	0.0599

Although Table 4 shows a relatively high correlation between two key independent variables (i.e., *lnfreecnt* and *lndmlen*) and three show performance indicators (i.e., *lnawesome, lnconfuse,* and *lnnegative*), the Variance Inflation Factors (VIF) of *lnfreecnt* and *lndmlen* are 4.70 and 4.21 respectively, which are less than the threshold of 5 and could be tolerated. Moreover, in the following analysis, Coarsened Exact Matching (CEM) and Instrumental Variables will be adopted to separate the influence of control variables on independent variables.

Table 4: Correlation Matrix

	lnamt	lndmlen	gender	lnfan	lnnoble	lnfreecnt	lnawesome	lnconfuse	lnnegative
lnamt	1								
lndmlen	0.194***	1							
gender	0.022***	-0.015***	1						
lnfan	0.236***	0.151***	0.169***	1					
lnnoble	0.138***	0.018***	0.074***	0.176***	1				
lnfreecnt	0.274***	0.294***	0.098***	0.635***	0.039***	1			
lnawesome	0.252***	0.717***	0.047***	0.364***	0.042***	0.574***	1		
lnconfuse	0.250***	0.718***	0.047***	0.363***	0.042***	0.573***	0.998***	1	
lnnegative	0.244***	0.711***	0.049***	0.365***	0.043***	0.574***	0.987***	0.991***	1

Note: *** p<0.01, ** p<0.05, * p<0.1

Table 5 presents the preliminary results of OLS regressions. In Model 1, only control variables were taken into consideration, and the results reveal that noble level and awesome performance are positively related to charged gifting while negative performance is negatively related to the charged gifting. In Model 2, *lnfreecnt* ($\beta_1 = 0.117, p < 0.01$) and *lndmlen* ($\beta_2 = 0.072, p < 0.01$) came in, and both of them show significant positive correlations with *lnamt*, supporting Hypothesis 1 and Hypothesis 2. *gender* was omitted in these models because of its fixed effects. Model 3 added in the interaction term of *lnfreecnt* and *gender*, revealing that compared to females, males significantly weakened the positive effect of free gifting on charged gifting ($\beta_3 = -0.033, p < 0.01$). Hence, Hypothesis 3 was supported. Model 4 added in the interaction term of *lndmlen* and *gender*, showing that compared to females, males significantly strengthen the positive effect of Danmaku Length on charged gifting ($\beta_4 = 0.011, p < 0.01$). Therefore, H4b was supported. Model 5 integrated all the variables, and all the effects hold still.

Table 5: Results of OLS Regressions

MODEL	(1)	(2)	(3)	(4)	(5)
VARIABLES	lnamt	lnamt	lnamt	lnamt	lnamt
lnfreecnt		0.117***	0.139***	0.117***	0.142***
		(0.002)	(0.004)	(0.002)	(0.004)
lndmlen		0.072***	0.071***	0.065***	0.059***
		(0.003)	(0.003)	(0.003)	(0.003)
freecnt_gen			-0.033***		-0.037***
			(0.005)		(0.005)
dmlen_gen				0.011***	0.018***
				(0.003)	(0.003)
lnfan	-0.075***	-0.080***	-0.080***	-0.080***	-0.080***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
lnnoble	0.540***	0.557***	0.557***	0.556***	0.555***
	(0.200)	(0.196)	(0.196)	(0.196)	(0.196)
lnawesome	0.068***	0.052***	0.052***	0.052***	0.052***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
lnconfuse	-0.005	-0.006	-0.006	-0.006	-0.006
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
lnnegative	-0.067***	-0.071***	-0.071***	-0.071***	-0.071***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
2.week	-0.094***	-0.071***	-0.072***	-0.071***	-0.071***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
3.week	-0.012***	0.007	0.006	0.007	0.007
	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
4.week	-0.054***	-0.030***	-0.030***	-0.030***	-0.030***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Constant	0.271***	0.142***	0.144***	0.141***	0.143***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Observations	486,176	486,176	486,176	486,176	486,176
R-squared	0.029	0.050	0.051	0.050	0.051
Number of codes	121,544	121,544	121,544	121,544	121,544
Code FE	YES	YES	YES	YES	YES
Week FE	YES	YES	YES	YES	YES
F test	0	0	0	0	0
r2_a	0.0286	0.0504	0.0508	0.0504	0.0509

Note: Robust standard errors in parentheses,*** p<0.01, ** p<0.05, * p<0.1

ROBUSTNESS CHECK

Considering some covariates that might in the meantime contribute to the independent variables and the dependent variable and contaminate the causal inferences, Coarsened Exact Matching (CEM) was adopted to approximate the premises of the control experiment, in other words, the randomization. CEM as an emerging matching technique has been widely applied across disciplines in the recent decade and is regarded as more effective and efficient in imbalance reducing and model dependence than commonly used traditional matching methods (e.g., Propensity Score Matching (PSM)) (Matthew Blackwell, 2009). Different from PSM that matches pairs with close total propensity scores, CEM stretches the matching rules according to authors' ideas by coarsening the exact matching of variables to predefined groups (e.g., match pairs in the same age group in lieu of exact birthdays) (Stefano M. Iacus *et al*., 2012).

Table 6 presents the Multivariate L1 distance of two key independents (i.e., *lnfreecnt* and *lndmlen*) before and after the matching. Multivariate L1 distance refers to the overall imbalance of variables between a certain treatment group and its control group. It could be found that the imbalance drops from .8026684 to .65123378 for *lnfreecnt* and drops from .61980766 to .43094981 for *lndmlen,* indicating that the matching is well conducted. Table 7 displays the regression results before and after the matching for two key independent variables, respectively. It shows that the influence of free gifting ($\beta = 0.038, p < 0.01$) and Damaku length ($\beta = 0.185, p < 0.01$) on charged gifting both remain significant after the matching, ruling out the possibilities to a great extent that some common factors (e.g., the fan loyalty to streamers) lead to both independent and dependent variables.

Table 6: CEM Results for Two Treatments

Treatment Dummy Variable	Multivariate L1 distance		Matching Summary	
	Before Matching	After Matching	Number of strata	Number of matched strata
lnfreecnt	0.8026684	0.65123378	14397	3615
lndmlen	0.61980766	0.43094981	14397	3183

Table 7: OLS Regressions after CEM

Treatment	lnfreecnt		lndmlen	
	Before Matching	After Matching		Before Matching	After Matching
VARIABLES	**lnamt**	**lnamt**	**VARIABLES**	**lnamt**	**lnamt**
lnfreecnt	0.131***	0.038***	lndmlen	0.286***	0.185***
	-56.7	-10.66		-33.32	-20.37
freecnt_gen	-0.030***	-0.030***	dmlen_gen	-0.007	0.019*
	(-12.32)	(-7.49)		(-0.61)	-1.72
gender	-0.002	-0.005	gender	-0.039***	-0.027*
	(-0.24)	(-0.46)		(-2.63)	(-1.89)
lnfan	0.098***	0.311***	lnfan	0.253***	0.264***
	-25.4	-82.85		-89.06	-95.72
lnnoble	1.058***	1.022***	lnnoble	0.934***	0.317***
	-59.62	-22.5		-52.5	-9.93
lnawesome	0.082***	0.109***	lnawesome	0.107***	0.059***
	-7.85	-5.34		-10.18	-5.8
lnconfuse	0.098***	0.182***	lnconfuse	0.053**	0.055**
	-3.93	-4.54		-2.08	-2.16
lnnegative	0.078***	0.173***	lnnegative	0.080***	0.054***
	-4.77	-6.42		-4.84	-3.24
Constant	-2.085***	-3.582***	Constant	-2.176***	-1.503***
	(-6.59)	(-7.19)		(-6.82)	(-4.62)
Observations	121,544	94,424	Observations	121,544	94,224
R-squared	0.15	0.087	R-squared	0.136	0.126
F test	0	0	F test	0	0
r2_a	0.15	0.0868	r2_a	0.136	0.126
F	2690	1123	F	2395	1694

Note: t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Since a viewer's free gifting, Danmaku sending and charged gifting behaviors might happen at the same time or even reversely, to eliminate the endogeneity caused by reverse causality and other omitted variables, we utilized lagged independent variables as Instrumental Variables (IV) with Two-Stage Least Square (2SLS) method in lieu of the originated ones. Lagged free gifting

and Damaku sending were highly correlated to independent variables in the current phase because people tend to behave consistently to avoid cognitive dissonance (Festinger, 1957; Harmon-Jones & Mills, 2019), and meanwhile,, were unrelated to error terms because they were not in the same window. Moreover, since the lagged behaviors occurred one week before other variables, the reverse causality was also excluded. Table 9 displays the 2SLS regression results of *lnfreecnt* and *lndmlen*. It could be found that in the second stage of regression, the impacts of *lnfreecnt* ($\beta = 0.055, p < 0.01$) and *lndmlen* ($\beta = 0.286, p < 0.01$) remained significant, indicating that the main effects still hold with instrumental variables adjusting the original independent variables.

Table 8: Summary Results for First-stage Regressions

| Variable | F(4,364620) | P-value | Under-identification test | | Weak identification test |
			SW Chi-sq(1)	P-value	SW F(1,364620)
lnfreecnt	25131.21	0.0000	45833.91	0.0000	45832.40
lndmlen	4598.24	0.0000	13915.20	0.0000	13914.74
freecnt	1.7e+05	0.0000	40145.16	0.0000	40143.84
dmlen_gen	24381.53	0.0000	33348.00	0.0000	33346.91

Table 9: 2SLS Regression for Two Independent Variables

MODEL VARIABLES	(1) lnamt
lnfreecnt	0.055***
	(0.004)
lndmlen	0.286***
	(0.012)
freecnt_gen	-0.018***
	(0.003)
dmlen_gen	0.017*
	(0.010)
lnfan	0.076***
	(0.002)
lnnoble	0.584***
	(0.018)
lnawesome	0.138***
	(0.008)
lnconfuse	-0.082***
	(0.010)
lnnegative	-0.107***
	(0.006)
2.week	-0.038***
	(0.003)
3.week	0.021***
	(0.003)
Constant	-0.048***
	(0.002)
Observations	364,632
r2_a	0.103

Note: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

DISCUSSION

This study aims to investigate whether viewers' active involvement during watching live streaming could induce their pay for the services. Free gifts and Danmaku sending as two typical types of active behaviors were examined under the framework of the Self-perception theory. Although these two behaviors seem zero-cost to most viewers and streamers, they are, to some extent, not costless at all. While viewers tend to merely be concerned about the sunk cost of money during their participation in live streaming shows, they also unconsciously weigh the sunk cost of mechanics, cognition, and emotion against their engagement. These time-consuming efforts could exert a subtle influence on their attitudes toward the shows and thus could eventually shape their perceptions of loyalty to the streamer/channel. More specifically, the more efforts they made in a channel, the more probabilities that they perceive themselves as enjoyed because rational people would generally take efforts in attractive things. Consequently, these active viewers are more inclined to pay for the performance because they regard it as worthwhile.

Furthermore, considering the diversity of viewers' profiles and structures, it is of great value to explore the heterogeneity of main effects under different viewer demographics (e.g., gender).

The results of empirical analysis attested to our hypotheses that both free gifts and Danmaku length could contribute to charged-gift sending. These findings become more convincing after the following two robustness checks (i.e., CEM and Instrumental Variables) by reducing the endogeneity caused by unbalanced samples and reverse causality. The regression results also exhibited that gender moderates these two main effects in different ways. Compared to females, males impaired the positive effect of free gifts on charged gifts but underpinned the positive effect of Danmaku length. The inconsistency between these two moderating effects attests to the previous argument that individuals' self-perception process is not only affected by their inner sensitivity to sunk costs, in other words, the extent of loss aversion, but also influenced by their subjective sensation to different types of sunk costs, namely, the perceived sunk cost. Sending free gifts merely involves the cost of mechanic work (i.e., clicking the mouse or tapping the screen), and to the best of our knowledge, there is no evidence showing gender differences in it. In this case, the perceived sunk cost for females is indifferent to that of males. Therefore, due to the fact that females are more intolerant of loss, it is reasonable that they purchase more charged gifts than males do after sending free gifts. In contrast, sending longer Danmaku calls for more elaboration in organizing sentences, involving not only the cost of mechanic work (i.e., typing with the keyboard or the touch screen) but also the cognitive and emotional attribution. Since males have been proved to be less emotionally expressive than females, it could be inferred that they generally perceive a higher sunk cost in sending Danmaku (Kring & Gordon, 1998). Therefore, males are more inclined to regard themselves as devoted to a channel after conducting such expression-relevant work and thus are more willing to make the real purchase subsequently.

CONTRIBUTION AND LIMITATION

This research contributes to the literature on SLSSs and Self-perception theory in a meaningful way. First, while the majority of research on SLSSs gives attention to the IT affordances for advertisements and promotion activities, this research concentrated on gift sending, another crucial means of monetization, enriching the diversity of perspectives on related pieces of literature. Second, to the best of our knowledge, this is the first empirical study based on the real-world data giving insights into viewers' self-development and self-adjustment of attitudes and behaviors in SLSSs during a continuous observational window. Through examining the effects of previous engagement (i.e., sending Danmaku and free gifts) on the subsequent purchase behavior (i.e., sending charged gifts), this individual-level vertical study addresses the interactions among viewers own behaviors, following inspiring researches that these activities are not independent but have subtly correlated with each other. Last but not least, this study not only empirically supports the Self-perception theory but also theoretically enriches it by introducing the idea of perceived sunk costs and demonstrating the gender heterogeneity in the self-perception process, offering the Self-Perception Theory a novel lens for the underlying mechanism.

Apart from the theoretical contributions, the study also generates practical implications for platforms and streamers in the industry of SLSSs. First, it is of great importance to design various activities for viewers to get involved in a channel, imperceptibly increasing their sunk costs of time and effort. For example, to increase their sunk cost of mechanical effort, platforms could adopt gamification strategies to encourage users' bodily movements and gestures such as hard press, swipe, and even shake the touch screens. To increase the cognitive cost, streamers could offer simple quizzes about the show content with prizes during the live streaming to attract viewers' attention and inspire their thinking. To increase the sunk cost of emotions, except for the lottery draw from Danmaku senders, platforms/streamers could also present mini questionnaires (e.g., pop up on the side of the screen) and memes/emojis for selection during the live streaming to foster viewers to express their attitudes and feelings. Second, platforms and streamers could utilize the gender differences in certain types of activities to optimize the fan economy. More specifically, as males are less willing to pay for the shows but are more sensitive to their cognition and emotional cost, they could be intentionally guided to more expression-relevant activities. Females could be offered more free gifts to increase their activeness as well as enhance user stickiness and loyalty. Last but not least, the ideas above could be generalized and promoted to any platforms that facilitate the functions of social networking, including e-commerce services, online games, and possibly Virtual Reality (VR) as well as Augmented Reality (AR) communities in the future.

This study also has several limitations. First, due to the storage and processing limitation of the real-time live streaming data, only 4-weeks of observational data were analyzed, resulting in an uncertainty of the generalization of main effects to a larger time window (e.g., 3/6/12 months). Second, since we only collected the data in one male streamer's channel, it remains unknown that whether the viewer behaviors are homogeneous in a female streamer's channel because it has been argued that viewers tend to pay more for streamers of the opposite gender (Cho *et al.*, 2019). Third, this study overlooks the social influence from peers' active participation. More specifically, viewers are exposed to others' behaviors during the live streaming and could be stimulated to reinforce some actions (e.g., impulsive buying of charged gifts) due to the social comparison and herding effects. Therefore, future research could append these crowd-related factors to the existing model.

CONCLUSION

This study examined the effects of viewers' previous active engagement on their subsequent purchase behavior in SLSSs from the perspective of self-perception and perceived sunk costs. Results show that both free gifts and Danmaku length significantly induce the purchase of charged gifts and that there are gender discrepancies underlying this mental attribution process. Compared to female viewers, male viewers experience a weaker effect of free gifts on charged gifts and a stronger effect of Danmaku length

on charged gifts. We propose that the self-perception process is affected by both the sensitivity to sunk costs (i.e., the extent of loss aversion) and the subjective sensation to different types of sunk costs (i.e., perceived sunk costs). Males are predicted to perceive more sunk costs in sending Danmaku because of their inner less willingness for emotional expression compared to females. This study not only enriches the literature of SLSSs but also supplements the Self-Perception Theory with a novel lens of sunk costs. It also provides platforms with applicable suggestions to increase the viewer activeness, stickiness, and, most importantly, the sales of charged gifts.

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