"I Can't Even Recall What I Bought": How Design Influences Impulsive Buying in Douyin Live Sales

ZHENG WEI, The Hong Kong University of Science and Technology, China
LIK-HANG LEE, The Hong Kong Polytechnic University, China
WAI TONG, Texas A&M University, College Station, United States of America
XIAN XU*, The Hong Kong University of Science and Technology, China
CHAOZHE ZHANG, The Hong Kong University of Science and Technology (Guangzhou), China
HUAMIN QU, The Hong Kong University of Science and Technology, China
PAN HUI*, The Hong Kong University of Science and Technology (Guangzhou), China

Impulsive buying tendencies exist on Douyin, the most popular Chinese social media platform, primarily due to the users' exposure to live sales events. This study delved into examining impulsive buying behaviour, specifically triggered by external stimuli, through the lens of the Stimulus-Organism-Response framework model. Thus, our study implemented a tailored Douyin client, namely Douyin X, that contains four interventions: Visualizing the wallet's balances, enhancing payment friction, Prolonging the duration of purchase decision-making, and imposing browsing time limits and usage statistics. Our user study with 20 participants implies individuals' impulsive buying due to external stimuli, combined with the proliferation of impulsive buying-promoting designs, which has led to the excessive prevalence of impulsive buying in live e-commerce. Our research offers a comprehensive framework that can effectively mitigate the likelihood of impulsive buying behaviours, specifically from a design-oriented standpoint.

Additional Key Words and Phrases: Social Media, Douyin, Live Sales, Impulsive Buying, S-O-R model

1 INTRODUCTION

Impulsive buying has emerged as a prevalent consumer behavior in the context of live e-commerce platforms, particularly on social media applications like *Douyin* (the Chinese version of *TikTok*). This phenomenon encompasses a range of stimuli—including unexpected demand, visual cues, promotional activities, and personal emotions—that trigger spontaneous purchasing decisions [6, 44, 60, Dhebar et al.]. These stimuli collectively induce emotional responses that lead to impulsive buying behaviors, which can be effectively examined using the Stimulus-Organism-Response (S-O-R) framework [34].

The S-O-R framework serves as a foundational model for understanding how external stimuli affect internal states (organism) and subsequently influence behavioral responses. In the context of online shopping, stimuli such as interactive features, real-time engagement, and persuasive design elements can significantly impact consumers' emotional and cognitive states, leading to impulsive buying [2, 41, 55]. While previous research has extensively explored the factors contributing to impulsive consumption using the S-O-R framework, there remains a critical gap in understanding how specific design interventions can mitigate such behaviors on live e-commerce platforms.

Studies by Lee and Huo [22, 30] highlight that impulsive buying is often considered unfavorable, with a substantial proportion of individuals consciously avoiding such behavior during experimental settings [45].

*Corresponding authors

Authors' addresses: Zheng Wei, The Hong Kong University of Science and Technology, Hong Kong, China, zwei302@connect.ust.hk; Lik-Hang Lee, The Hong Kong Polytechnic University, China, lik-hang.lee@polyu.edu.hk; Wai Tong, Texas A&M University, College Station, United States of America, wtong@tamu.edu; Xian Xu, The Hong Kong University of Science and Technology, China, xianxu@ust.hk; Chaozhe Zhang, The Hong Kong University of Science and Technology (Guangzhou), Guangzhou, China, czhang382@connect.hkust-gz.edu.cn; Huamin Qu, The Hong Kong University of Science and Technology, China, huamin@ces.ust.hk; Pan Hui, The Hong Kong University of Science and Technology (Guangzhou), Guangzhou, China, panhui@hkust-gz.edu.cn.

Social expectation bias plays a significant role in this context, influencing individuals to underreport or suppress impulsive purchasing tendencies. Consequently, researchers commonly employ the construct of "impulse to buy" as a more accurate metric in impulsive buying studies, focusing on the psychological state of desire rather than the actual purchasing act [6].

Despite recognizing the negative implications of impulsive buying, there is a paucity of research on how design elements can be strategically employed to reduce such behaviors. The majority of existing studies emphasize enhancing user engagement and increasing transaction metrics by encouraging impulsive purchases [1, 49]. Designers often aim to maximize users' time on the platform, click frequency, and spending amounts, cultivating habitual use of live e-commerce for shopping [48]. This approach has contributed to perceptions of live shopping as having an addictive nature [11], raising concerns about consumer well-being. Given this backdrop, our study addresses the critical need to explore how design interventions can influence impulsive buying behaviors on live e-commerce platforms. Specifically, we aim to fill the research gap by investigating:

- Consumers' experiences of viewing *Douyin* live e-commerce through the lens of impulsive shopping induced by stimuli.
- The impact of design elements on impulsive consumption within *Douyin*'s social media environment.

To achieve these objectives, we developed a modified version of the *Douyin* app, termed *Douyin X*, incorporating four distinct design interventions: visualizing the user's wallet balances, enhancing payment friction, prolonging the duration of purchase decision-making, and imposing browsing time limits with usage statistics (see Figure 3). We conducted an experiment involving twenty participants who used each version of *Douyin X* for 30 minutes. Through in-app experience sampling [10], we measured their levels of impulse when exposed to live e-commerce stimuli, comparing scenarios with and without the impulse-triggering features. Additionally, we conducted semi-structured interviews with twelve participants to gain deeper insights into their experiences and the factors influencing their impulsive buying behaviors. Our study contributes to the existing body of knowledge in several ways:

- **Empirical Analysis of Design Interventions:** We provide empirical evidence on how specific design interventions can mitigate impulsive buying behaviors on live e-commerce platforms like *Douyin*. By implementing features such as visualizing wallet balances, enhancing payment friction, prolonging decision-making time, and imposing browsing limits, we demonstrate the effectiveness of design elements in reducing consumers' impulse to buy.
- **Extension of the S-O-R Framework:** We extend the Stimulus-Organism-Response (S-O-R) framework by integrating inhibitory design elements as critical stimuli that influence consumers' internal states. Our study highlights how these design interventions can alter the emotional and cognitive processes that lead to impulsive buying, thus enriching the theoretical understanding of consumer behavior in digital environments.
- **Practical Guidelines for Ethical Design:** We offer actionable insights and design guidelines for practitioners aiming to promote consumer well-being. By showcasing how interface designs can be strategically employed to reduce impulsive purchasing tendencies, our findings contribute to the development of more ethical and user-centric live e-commerce platforms.

This paper primarily contributes to the examination of impulsive buying in *Douyin* and, accordingly, to design tactics for alleviating impulsive buying through interface designs. Our experiment results showcase that designers can reduce the user's impulse to buy by designing inhibitors to impulsive buying, as well as the ability to enhance it. While *Douyin* incentivizes designers to promote impulsive buying as much as possible [1, 49], this has led to a view of the 'has contributed to the perception that live shopping has an addictive nature' [11]. We found that people's habitual use of impulse spending due to external stimuli, coupled with various designs to enhance impulse spending impulses, has led to the overuse of impulse shopping in live e-commerce.

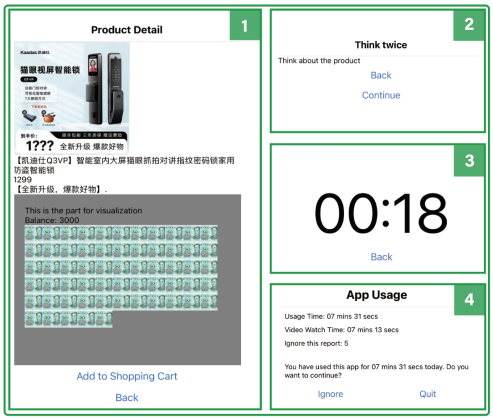

Fig. 1. *Douyin X* interface: (1) Visualizing the wallet’s balances. (2) Enhancing payment friction. (3) Prolonging the duration of purchase decision-making. (4) Imposing browsing time limits and usage statistics.

2 RELATED WORK

Impulsive buying behavior has garnered significant attention in consumer research, particularly with the rise of online and mobile shopping platforms. Despite extensive studies on factors that encourage impulsive purchases, there is a notable gap in the literature concerning how design interventions can mitigate such behavior, especially in live-stream shopping environments like *Douyin*. This section critically examines existing studies to highlight this gap and establish the necessity of our research.

2.1 Douyin and Live E-commerce

Douyin (internationally known as *TikTok*) directly integrates live-streaming functions into its social media ecosystem, enabling creators and brands to host live events and showcase products in real time [35, 52, 59]. During live streams, hosts interact with viewers through comments and reactions, providing instant feedback and fostering a sense of community [52, 62]. Viewers can explore product details, ask questions, and seamlessly complete purchases within the same interface, often enjoying exclusive live-only promotions such as flash sales and limited-time discounts. The platform’s streamlined payment system eliminates the need for password entry and does not require saving delivery information, allowing transactions to be completed quickly and effortlessly, thereby encouraging impulsive buying behavior [17, 26, 39].

In the broader e-commerce ecosystem, *Douyin*’s live e-commerce model stands out compared to other global platforms such as Amazon Live and Facebook Marketplace. Amazon Live primarily leverages influencers and brand ambassadors to showcase products, with a structure closely aligned with traditional e-commerce practices. Although it incorporates live-streaming elements, the transactional process remains similar to Amazon’s standard shopping experience, with lower levels of interactive engagement during live sessions [23, 56]. On the other hand, Facebook Marketplace primarily functions as a peer-to-peer marketplace with limited integration of live-streaming for direct sales, focusing more on facilitating connections between individual buyers and sellers rather than creating a centralized shopping experience.

However, Douyin fundamentally transforms live e-commerce by making live-streaming the core mechanism for shopping [13]. Its advanced design elements, such as real-time interaction tools, integrated shopping carts, and personalized content recommendations, create an immersive and engaging environment that significantly

enhances the user experience [28, 51]. This model not only increases participation rates but also stimulates spontaneous purchasing decisions through psychological triggers like urgency and exclusivity.

Douyin's influence has extended beyond China, with the recent launch of *Douyin* Shop in multiple international markets indicating its move towards globalization. As live e-commerce continues to gain momentum worldwide, *Douyin*'s innovative approach provides a valuable blueprint for other platforms aiming to adopt similar models. Understanding the unique design dynamics and consumer engagement strategies that underpin *Douyin*'s success offers critical insights for enhancing global e-commerce practices and expanding the reach of live-commerce initiatives across diverse markets [58].

2.2 Theoretical Framework: Impulsive Buying and the Stimulus-Organism-Response (S-O-R) Model

Impulsive buying is a complex phenomenon characterized by spontaneous, unplanned purchases prompted by external stimuli [4]. Unlike compulsive buying, which is linked to psychological disorders and involves chronic, repetitive purchasing with little interest in product usage [38], impulsive buying is typically situational and influenced by immediate environmental factors. The Stimulus-Organism-Response (S-O-R) model, proposed by Mehrabian and Russell [34], serves as a grand theory underpinning our research. It posits that environmental stimuli (S) affect an individual's internal state (O), which in turn leads to a behavioral response (R). In consumer behavior, this model explains how external factors such as marketing cues and environmental design can evoke emotional responses that lead to impulsive purchases [8, 9]. Eroglu et al.[14] were among the first to apply the S-O-R model to online consumer behavior, demonstrating that website atmospherics significantly impact consumers' emotional states and purchasing decisions. Chan et al.[7] further highlighted that the S-O-R model is prevalent in studying online impulsive buying, emphasizing its relevance in digital contexts.

However, while the S-O-R model provides a robust framework for understanding impulsive buying, it does not fully account for the underlying psychological motivations driving consumers to respond to stimuli. The Theory of Planned Behavior (TPB) [3] offers additional insights by incorporating attitudes, subjective norms, and perceived behavioral control as predictors of behavioral intentions. Integrating TPB with the S-O-R model could offer a more comprehensive understanding of impulsive buying, but this integration has been underexplored in the existing literature. Moreover, previous studies often focus on affective responses without considering cognitive processes such as self-regulation and decision-making biases. The Dual-Process Theory [15] distinguishes between intuitive (System 1) and analytical (System 2) thinking, which could explain why consumers sometimes make impulsive decisions without deliberate thought. This suggests a potential gap in current research, which our study aims to address by incorporating these cognitive aspects into the analysis of impulsive buying behavior on Douyin.

2.3 Design Influences on Impulsive Buying in Douyin

Douyin, China's largest social media live e-commerce platform, has become a fertile ground for studying the impact of design on impulsive buying [50]. Several studies have explored how specific design elements enhance impulsive purchasing behavior. For example, Hewei et al. [21] investigated the impact of the 'checkout button' design on impulsive buying of clothing items, finding that certain design features can facilitate quicker purchasing decisions. Similarly, Han et al.[20] corroborated these findings, emphasizing the role of interface design in influencing consumer behavior during live streams. Yang et al.[58] added to this by demonstrating that personalized product recommendations based on users' search behavior can increase impulsive buying tendencies. While these studies provide valuable insights, they tend to be descriptive and focus primarily on positive design influences that encourage impulsive buying.

There is a lack of critical analysis regarding the limitations and potential negative consequences, such as technology addiction and consumer regret. Macit [32] warns that overuse of technology can lead to addictive

behaviors, which is supported by De Santana and De Almeida [11], who discuss the transfer of addiction to live shopping platforms.

Furthermore, existing literature often overlooks the ethical considerations of designing interfaces that intentionally encourage impulsive buying. The long history of using technology to capture and retain users' attention [16, 18, 27, 40] raises questions about the responsibility of designers and platforms. Some studies suggest the need for designs that promote rational use and help users avoid falling into impulsive buying traps [29].

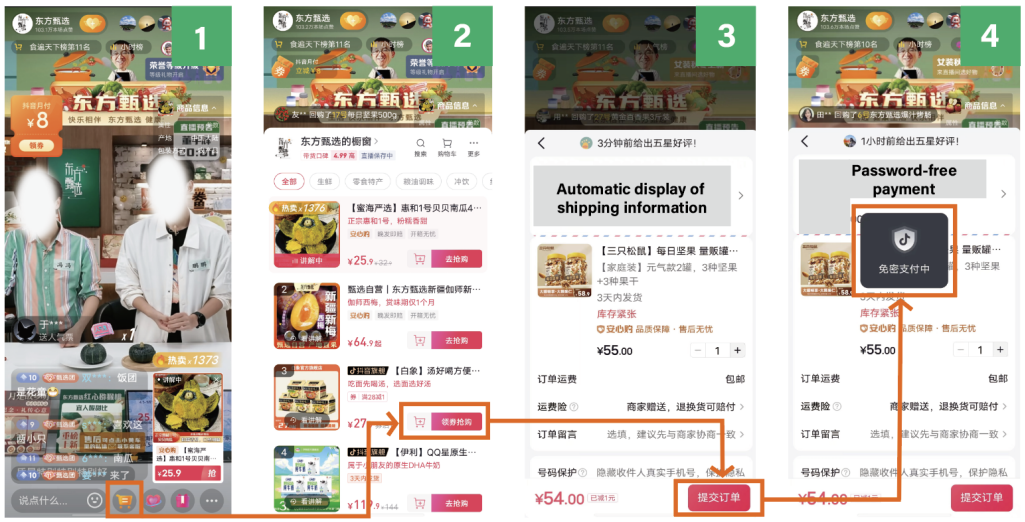

Fig. 2. *Douyin* buying process interface: (1) Live Sales Interface. (2) Product Introduction & Display Interface. (3) Purchase Interface. (4) Password-free payment (no need to enter shipping information, or payment information).

Figure 2 illustrates*Douyin*'s buying process interface, which provides a seamless purchasing experience that minimizes the time consumers have to reconsider their decisions. This design can enhance impulsive buying behavior, but it also raises concerns about encouraging overconsumption and potential addiction.

In summary, while prior research has explored various design elements that influence impulsive buying on *Douyin*, there is a notable gap in addressing the limitations and potential negative impacts of these designs. Our study aims to fill this gap by not only identifying how design influences impulsive buying but also proposing design interventions that can help mitigate negative outcomes such as addiction and buyer's remorse. By integrating the S-O-R model with theories like TPB and Dual-Process Theory, we seek to provide a more comprehensive understanding of impulsive buying behavior and offer practical solutions for promoting responsible consumer practices.

3 METHODS

This study aims to investigate the impact of specific design interventions on impulsive buying behavior among *Douyin* users. To achieve this, we employed a mixed-methods approach that combines quantitative experiments with qualitative semi-structured interviews. This section provides a detailed account of the methodology, including the development of the *Douyin X* client, participant recruitment, experimental procedures, data collection methods, and data analysis techniques.

3.1 Development of Douyin X Client

To systematically evaluate the effects of design interventions, we developed a customized version of the *Douyin* application, referred to as **Douyin X**. This client was designed to replicate the authentic *Douyin* platform while allowing for the implementation of specific design modifications.

3.1.1 Douyin X Client Description. We created *Douyin X* using the open-source project *tiktok-clone deep customization*[1], allowing us to replicate the operational characteristics of the authentic Douyin platform and implement specific design interventions.

3.1.2 Design Interventions. The research methodology included conducting interviews and engaging in drawing activities with a team of three seasoned designers. Additionally, reference studies were made on authentic e-commerce designs from various social media platforms. Our design also draws upon the 'friction' technology design guidelines proposed by Moser et al., which aim to assist users in making more thoughtful consumption decisions [36]. Based on the aforementioned procedure, a collection of design interventions was produced, including three internal and one external intervention factors, with the aim of augmenting users' perception of agency. Given that impulsive buying is the spontaneous act of purchasing in response to an external stimulus, it is appropriate to leverage these designs to evaluate how design impacts impulsive buying on social media platforms.

The three internal intervention and one external intervention designs can be deployed individually in *Douyin X*. Four different combinations of designs have emerged from this: (1) a version where only the 'external intervention' design intervention is deployed, (2) a version where only the 'internal intervention' design intervention is deployed, (3) a version where both the 'external intervention' and the 'internal intervention' design interventions are fully deployed, and (4) an original version without all four design interventions. Next, we describe these four design interventions in detail.

The 'Internal interventions' can be supported by the first approach, namely (a) Visualizing the wallet's balances (a1) users can get the available amounts in the budget, (a2) a graphical display appears to display the amount in the UI, (a3) when the user chooses an item in the shopping cart, the available money in the wallet will change accordingly, (a4) when an item is removed from the shopping cart, the displayed amount from the wallet will be resumed (increased).

The second approach is to (b) enhancing payment friction of the purchase journey. As such, the users have to do the following: (b1) Browse the product categories and information. (b2) Select the product to navigate to the page containing the product description. (b3) Click on the 'Add Item to Shopping Cart' option in order to navigate to reconfirm the needs. (b4) Press 'Continue' button to add the item to the shopping cart. (b5) Tap on the 'Shopping Cart' to get the chosen item information. (b6) Click 'Check out' to complete the payment.

The third method prolonging the duration of purchase decision-making. (c1) Initially, the user cannot directly purchase the product, which refers to a short-cut method of directly purchasing an item, as the related button is removed from the interface. In comparison, the official app allows users to buy the item directly with just one click on the 'direct purchase' button. Instead, it is necessary to add the product to the shopping cart before proceeding with the purchase. (c2) The user has the option to postpone the delivery time within a range of 0 to 48 hours. (c3) The postponed period of good delivery allows users to cancel the order. In other words, once the postponed period has elapsed, the shipment of the goods and the subsequent payment will be initiated.

'External Intervention' design measures: Display the feature that imposes browsing time limits and shows usage statistics. in one interface. Users can view the time spent using the app, the time spent browsing videos, and the number of times they choose to ignore this interface. The system can initially set its own intervention

[1]https://github.com/matheuscastroweb/tiktok-clone

time to 1 minute. Every single minute, a pop-up window appears. Users can choose to click to exit the system or choose to click to continue browsing.

3.1.3 Versions of Douyin X. Figure 3 illustrates the interfaces of *Douyin X*. It was built by a simulator based on the authentic Jitterbug platform. We created four versions of *Douyin X* by varying the combination of design interventions:

Version 1: Only the external intervention is implemented.
Version 2: Only the internal interventions are implemented.
Version 3: Both external and internal interventions are fully implemented.
Version 4: Original version without any interventions (control condition).

Its interface has been meticulously crafted to replicate the operational characteristics of *Douyin*. Four iterations of *Douyin X* were developed using a user-centered design approach, with the primary objective of enhancing the user's feeling of agency throughout its use. A user study with *Douyin X* was conducted, consisting of user interviews with 20 individuals from mainland China who use *Douyin* for everyday purchasing purposes, with a minimum frequency of once a week.

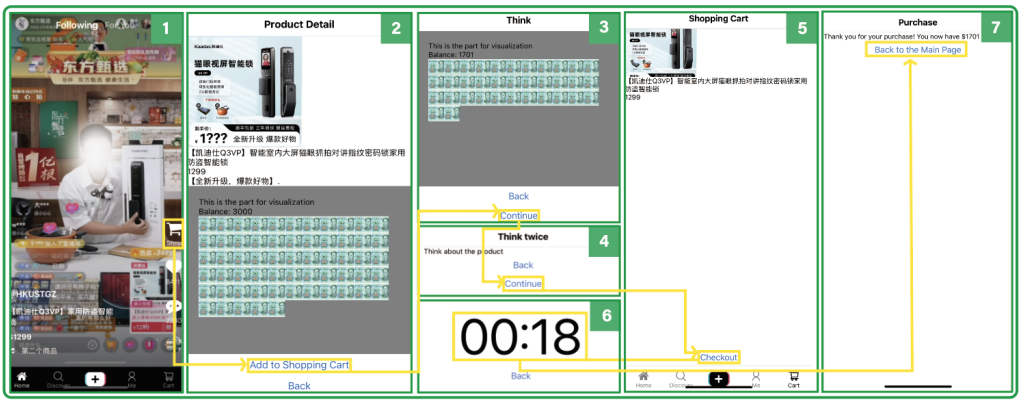

Fig. 3. *Douyin X* buying process interface: (1) Live Sales Interface. (2) Product Introduction & Visualizing the wallet's balances Interface. (3) Visualizing the wallet's balances. (4) Second Confirmation of Purchase. (5) Cart Page. (6) Customise Shopping Cooling-off Period. (7) Account Balance Display.

3.2 Participants

We recruited 20 participants, all of whom were settled in mainland China, used *Douyin* to shop at least once a week, and spent at least 10% of their daily browsing time on the *Douyin*app. We assisted the participants in installing *Douyin X* on their own mobile phones. The age range of the 20 participants was 21-40 years old, with 11 males and 9 females ($\bar{M}$ = 25.75, SD = 1.58). In addition, all participants had good or corrected vision. We interviewed participants P1, P3, P4, P7, P9, P10, P13, P15, P16, P18, P19, P20. After concluding the experiment, we issued each participant a token of 30 RMB.

3.3 Experimental Procedures

3.3.1 Study Design. We employed a within-subjects design where each participant interacted with all four *Douyin X* versions. To control for order and learning effects, we used a Latin square design to balance the sequence of version exposure among participants [25].

Latin Square Design Rationale. The Latin square design is effective for controlling sequence effects in experiments where subjects are exposed to multiple conditions [25]. By ensuring that each version appears equally in each ordinal position and follows every other version equally often, we minimized potential biases due to learning or fatigue.

Implementation. Participants were randomly assigned to one of four groups, each following a different version sequence as depicted in Figure 4. Each participant used each *Douyin X* version for a maximum of 30 minutes. Participants provided informed consent and were assured of confidentiality and anonymity. The study was conducted in accordance with ethical guidelines and approved by the university's institutional review board. Participants were informed of their right to withdraw at any time without penalty.

Participant	1st	2nd	3rd	4th
Group1	Version(1)	Version(2)	Version(4)	Version(3)
Group2	Version(2)	Version(3)	Version(1)	Version(4)
Group3	Version(3)	Version(4)	Version(2)	Version(1)
Group4	Version(4)	Version(1)	Version(3)	Version(2)

Fig. 4. Balance the order of versions participating in using *Douyin X* according to the design of the Latin square.

3.3.2 Data Collection. Data was collected through three primary methods.

User Behavior Logging involved capturing user activity data during interactions with each *Douyin X* version. The metrics included browsing duration, the number and value of purchases made, and the frequency of dismissing the time limit prompts.

Post-Task Questionnaires were administered after participants used all versions, comprising demographic questions and measures adapted from Lee et al.'s impulse buying questionnaire [30]. These questionnaires assessed five dimensions: Attractiveness, Product Usefulness, Perceived Usefulness, Urge to Buy Impulsively, and Design Influence on Impulsive Buying, utilizing a 7-point Likert scale (1: Strongly Disagree to 7: Strongly Agree). Additional questions evaluated participants' feedback on the specific design interventions.

Lastly, **Semi-Structured Interviews** were conducted with 12 participants (P1, P3, P4, P7, P9, P10, P13, P15, P16, P18, P19, P20) selected based on availability and willingness to provide in-depth feedback. Each interview lasted approximately 30 minutes and explored participants' experiences with impulsive buying, perceptions of the design interventions, and suggestions for improvement.

3.3.3 Metrics. User behaviour was captured at two distinct levels. The data shown in Figure1-(4) illustrates the use statistics of *Douyin X*, including the duration of time users spent browsing items, the total expenditure on purchased products, and the frequency of instances when users disregarded the time restriction dialogue box. A total of 80 user logs were recorded.

We also administered a questionnaire to all participants to collect user feedback on the participants' impulse to buy while watching live e-commerce on social media, and the payment design to intervene in the urge to buy on impulse. Our questionnaire questions were referenced from Lee et al.'s questionnaire on the impulse to buy [30]. The questionnaire has a total of 13 questions. Questions 1–3 are personal information questions

including age, gender, and frequency of shopping with Douyin; Questions 4-13 reflect on Attractive, Product Usefulness, Perceived Usefulness, Urge to Buy Impulsively, Design Influences impulsive buying, which refer to five dimensions and each dimension has two questions. Note that the questionnaire is based on a 7-point Likert scale (1: Strongly Disagree, and 7: Strongly Agree). Furthermore, considering the different version systems, we constructed additional queries to evaluate participants' feedback on the four designs influencing impulsive buying behaviour.

3.4 Analysis

3.4.1 Impulsive buying Dataset. The data was analysed in relation to inquiries on the inclination to make purchases, with a rating scale ranging from 1 (Strongly Disagree) to 7 (Strongly Agree). Participants reported experiencing many spontaneous desires to make purchases when engaging in online shopping activities. The quantitative findings pertaining to the 'impulse to purchase' as elaborated upon afterwards, pertain to the replies of participants upon finishing the *Douyin X* platform, as documented in the questionnaire. The quantitative results of the 'impulse to make impulsive buying' discussed in the text refer to the participants' responses to the questionnaire after using *Douyin X*.

3.4.2 Metric Selection and Relevance. To examine the relationship between user behavior during live e-commerce sessions on social media and impulsive buying, we collected 1,780 instances of user activity records on the *Douyin X* platform, encompassing 80 comprehensive browsing behavior records. This dataset includes various metrics such as the duration of user engagement with the application, the number of completed purchases, and a time-sensitive dialogue interface for user interactions (e.g., clicks). To better understand the impact of design interventions on impulsive buying, we selected specific metrics directly related to user behavior within the app: browsing duration, purchasing frequency, the number of clicks on certain buttons (e.g., 'continue', 'ignore'), and the ratio of non-video viewing time to total system usage time. Browsing duration is critical as it reflects the time users spend engaging with content that could lead to impulsive purchases, with longer durations potentially increasing exposure to tempting products. Purchasing frequency measures how often users make purchases, serving as a direct indicator of impulsive buying tendencies. The number of clicks on specific buttons, such as the 'continue' button during the payment process, provides insight into the user's decision-making process, where multiple clicks may indicate hesitation or reconsideration—factors important in impulsive buying behavior. Additionally, the ratio of non-video viewing time to total system usage time helps us understand how users allocate their attention between browsing products and consuming other content, influencing impulsive purchasing. These metrics were chosen for their ability to provide quantifiable and observable data closely tied to the mechanisms of impulsive buying within the context of social media live sales platforms like *Douyin X*.

3.4.3 Statistical Model Selection. To evaluate the impact of our interventions on impulsive buying behavior, we employed an inverse Gaussian mixed-effects model, which is well-suited for the positively skewed and overdispersed time-to-event and count data typical in user interactions, such as click intervals and action durations. By incorporating participant ID as a random effect, we accounted for individual variability. We benchmarked the fitting precision of both Gaussian (linear) and inverse Gaussian models using the CurFi tool [46] and consistently found that the inverse Gaussian mixture model outperformed the Gaussian model based on residual analysis. Unlike the Gaussian model, the inverse Gaussian model more accurately represents our data distribution, and unlike the Poisson model, it accommodates unequal means and variances, making it a superior choice for our study. This methodological approach ensures that our statistical analysis reliably captures data patterns, leading to robust conclusions about the effectiveness of our design interventions on impulsive buying behavior. The datasets and R analysis code are available on GitHub: https://anonymous.4open.science/r/tiktokchina-7B18/README.md.

3.4.4 Interview Data. During the interviews, participants were queried on their encounters with impulsive buying, specifically concerning impulsive buying made on *Douyin* and other social media platforms subsequent to engaging with live e-commerce content. The participants were requested to describe their experiences. Additionally, we investigated the effects of these experiences on the participants and compared the impacts of impulse purchasing on them. This comparison was facilitated by implementing design interventions specifically designed for impulsive buying. The interview questions are accessible on the GitHub platform.

The content of the semi-structured interviews was subjected to analysis using open coding. During this process, elements in the questions pertaining to impulsive buying in live social media e-commerce were coded and tagged. Subsequently, the coding was modified via collaborative meetings, discussions, and question revisions. A closed coding scheme was used to recode the same interview data set. The present study has successfully identified a specific category of impulsive thoughts, namely those associated with making one or more impulsive buys while watching a live stream. The impulsive buying, occurring within the context of live e-commerce facilitated by social media platforms, is characterised by the desire or thought of purchasing an item unrelated to the initial purchase goal. The following discussion employs the concept of 'impulsive buying' as the framework for implementing the qualitative findings. The provided quotations have been appropriately revised to eliminate unnecessary words, rectify grammatical errors, and remove self-corrections to enhance the clarity and comprehension of the statements.

4 RESULTS

This section presents a comprehensive analysis of the outcomes derived from a mixed-methods survey conducted to investigate individuals' experiences with impulse purchasing while seeing live e-commerce on social media platforms. Additionally, the study explores the development of treatments to address impulse-buying tendencies.

4.1 Experiencing Impulsive Buying while Using Social Media Type Live Sales

The findings indicate that most respondents, namely 11 out of 12, described impulsive buying behaviour stimulated by the thrill of getting a live video while engaging with the *Douyin* platform. Out of the total sample size of 20 participants, 19 individuals agreed, either in the form of *'somewhat agree,' 'agree,'* or *'strongly agree,'* at least once in response to the following query: *'I have experienced occasional impulsive desires to make purchases while engaging in live e-commerce activities on social media.'* According to the participants, they frequently experienced a strong inclination to make a purchase upon encountering a friendly anchor and an appealing introduction (P1). P1 further mentioned, *'the product's low price made it difficult for them to resist an impulsive buying.'* Another participant expressed that the enticing introduction delivered by the anchor compelled them to desire an immediate purchase (P10). Similarly, another participant stated that the anchor's captivating introduction prompted an immediate desire to purchase (P16). The desire for quick purchase is triggered by several factors, including the presence of a sales anchor, the luxurious design of the living room, and the appealing qualities of the product (P3, P4, P7, P9, P13, P15, P18, P19, P20).

4.1.1 impulsive buying from the Stimulus-Organism-Response Perspective. During the interviews, a majority of the participants indicated experiencing a strong inclination towards impulsive buying behaviour, which was attributed to the persuasive sales discourse delivered by the anchor. This discourse effectively captured their attention and increased their desire to make unplanned purchases. According to P1, there is a tendency to be drawn towards some persuasive techniques, such as the assertion of a favourable bargain, despite the absence of any concrete price comparisons or exclusive discounts. P1 states, 'However, I do not thoroughly examine it in detail; instead, I prioritise the perceived affordability as an indicator of superior value, influencing my decision to purchase the product.'

Certain participants expressed more significant concern over the professional competency of the anchors. Participant P10 articulated this sentiment, stating, *'While the anchors' likability does influence me, I am not particularly drawn to overly emotional sales pitches that employ phrases such as 'I think you need this'.'* Conversely, if the presenter can provide a comprehensive explanation of the target audience for the product based on the diverse requirements of many users, I would choose to purchase this kind of sales presentation.

A significant number of participants said that they were motivated to engage in impulsive buying behaviour due to the pricing of a particular item. Participants said they saw the standard and actual prices in the anchor's bottom right corner. According to the statement provided, P19 expresses: *'I am willing to make an urgent purchase when there is a significant difference between the two prices, even though the item is unnecessary to the participant.'* P20 had a similar perspective: *'I would be inclined to purchase an item if its price significantly deviated from their usual notion of everyday prices.'*

The reasons participants were stimulated by the live programme, which evoked their attention and, thus, impulsive buying, were varied. P3 reported his experience of being stimulated by the luxurious décor of the live room and choosing to make an impulsive buying: 'Once I found out that the same brand's goods would be sold in a number of live rooms, and when I browsed through to the brand's official live room. When I browsed the brand's official live room, the luxurious and grand style of the décor made me quickly purchase.' P4 reported on his impulsive buying experience stimulated by product design and functionality: *'I made an impulsive buying once because I found that the product for sale itself was novel, very well-designed, and had novel functionality'.*

P9 reported his impulsive buying experience stimulated by the anchor's live charity sales:

> *'In one case, I was not attracted by the product, but by the anchor's charity activities. The anchor went to the countryside to promote local farmers' fruits, saying they earn a living in the context of the farmers' hardship. When I saw that they were leveraging their followers for well-being purposes, I immediately purchased a lot of them, so many that I couldn't finish them all by myself.'*

Certain participants expressed the significance of investigating the phenomenon of impulsive buying within the context of live e-commerce on social media. P1 articulated their personal inclination towards perusing *Douyin*, a popular social media platform, and frequently engaging with prominent live streams. They acknowledged occasionally making impulsive buying without a discernible motive, which often brings them amusement. However, they also acknowledged that this behaviour could occasionally provoke introspection and contemplation. As P1 mentioned:

> *'I recollect an instance whereby I engaged in impetuous behaviour by acquiring a substantial quantity of contact lenses, only to recognise the excessiveness of my purchase upon their receipt. Nevertheless, I encountered significant inconvenience in returning the purchased items, evoking a profound sensation of remorse akin to the acquisition of illicit goods. This predicament prompted me to question the rationale behind my excessive procurement of several contact lenses during that particular period.'*

4.1.2 The relationship between impulsive buying and technology use. P18 discusses the influence of technology on impulsive buying behaviour, exemplifying a scenario where exposure to a shampoo endorsement by an online program anchor prompted him to click on the product description instinctively. Upon doing a brief checking, P18 found the product to be satisfactory and afterwards expressed interest in exploring the reduced pricing. However, while selecting the 'Buy Now' option, P18 inadvertently proceeded to click on 'Submit Order' without sufficient time for contemplation, resulting in the completion of the payment process. The most visually appealing elements on the webpage were the 'Buy Now' and 'Submit Order' buttons. Additionally, due to my previous purchases from Shakeology, P18 had already activated the option for a modest monthly payment, which eliminated the need for me to input my password in order to finalise the purchase. Such a design is unappealing.

The participant further expressed his perspective by stating, *'These technologies appear to prioritise user-friendliness, yet in practise, I find myself constantly grappling with the technology, consistently striving to resist its persuasive attempts to encourage purchasing behaviour.'* P16 concurred with this attitude, expressing how the payment structure and the personalised delivery of material had resulted in a perpetual state of surfing and a desire to make impulsive buying on several occasions. P20 conveyed a similar viewpoint, stating that they often allocate significant effort to perusing live bargains on *Douyin*.

> *'On several occasions, I have been motivated by the cost and the psychological influence to engage in spontaneous purchasing behaviour, and the convenience of the transaction surpasses my highest expectations – the procedure is executed effortlessly and without conscious deliberation. I may not have a genuine need for the item in question. Furthermore, upon its receipt, I refrain from returning it due to the inconvenience associated with the process. Consequently, the item remains unused, representing a squandered resource that elicits feelings of remorse; I will never buy any products from this brand again.'*

This observation implies that the excessive utilisation of technology in live e-commerce facilitates users' propensity for impulsive buying behaviour. Additionally, it highlights the inherent power imbalance between users and technology, whereby users often find themselves disadvantaged. Furthermore, it underscores users' challenges in normatively disengaging from watching videos of live purchasing [5].

4.1.3 Attitudes towards impulsive buying: a spontaneous will? Or is it an inescapable addiction? We are interested in understanding the user attitudes towards impulse shopping: Is it a spontaneous will? Or is it an inescapable addiction?

The findings from our interviews indicate that respondents exhibited a range of attitudes towards impulsive buying. One participant expressed satisfaction in utilising *Douyin* for live shopping and did not perceive it as leading to impulsive buying. Other respondents displayed ambivalent feelings towards impulsive buying, acknowledging that the *Douyin* platform offers a wide selection of high-quality and affordable products. However, they also acknowledged that while browsing and shopping, they would become engrossed in the technological influences and other factors that impact rational consumption. Consequently, they would find themselves caught up in the experience of endless browsing and waiting. Additionally, some respondents expressed feelings of guilt and disgust upon realising their impulsive buying behaviours.

Certain participants may refer to the compulsion for impulsive buying on Douyin as an 'addiction.' P7 posits that the utilisation of technology engenders a particular condition of addiction. P7 states:

> *'Observing Douyn's shopping activities induces a state of addiction within me. While I engage in live streaming, I feel compelled to heed the Network anchor narrative that describes various commodities, presents gift options, and highlights special prices. This convenient design enables me to swiftly acquire desired items at the lowest possible cost, thereby ensnaring me in an unending cycle. Consequently, I become deeply fixated on these presentations of commodities, ultimately losing track of time.'*

P13 argues that the need to make purchases when presented with a reliable host is akin to addiction, stating, *'In the presence of a trusted anchor, I am inclined to readily acquire the products they endorse without hesitation.'* The subjective evaluation of the commodity's quality is of little significance to the participants since their unwavering confidence in the host takes precedence over all other considerations. P13 prefers the impulsive buying experience facilitated by *Douyin* over the return experience. P13 acknowledges possessing numerous unused items at home and attributes this accumulation to the purchase designs employed by *Douyin*, which prompt hasty decision-making and result in the acquisition of numerous goods without much contemplation. However, P13 finds the return process considerably intricate when returning unwanted items. P7 shares a similar

perspective, stating that they may choose not to revisit a store for some inexpensive items due to the perceived challenges associated with the return procedure.

A heightened level of aversion was reported among participants upon realising that their impulsive buying actions exhibited addictive characteristics. P20 contends that *'inducing individuals into compulsive spending constitutes a form of psychological control that can be regarded as unethical behaviours.'*

Several participants shared their personal encounters with live e-commerce platforms, highlighting their experiences. As mentioned by P19:

> *'I once had a habit of making impulsive buying, but now I'm making concerted efforts to avoid it. Before making a buying decision, I allocate a substantial amount of time to the process of careful consideration and extensive investigation of buying items, fully cognizant of the fact that my financial resources will rapidly diminish upon completion of the payment.'*
>
> *'I invested even more time reviewing user feedback and detailed information to ensure that a product is truly worth it. Sometimes, this process stretches beyond an hour for just one item. Despite all this, I still find myself dissatisfied or regretful after the purchase. It feels like I am constantly battling against the shopping platform.'*

Certain participants believed impulsive buying is inevitable on live sales platforms. Notably, platforms such as Pinduoduo, Taobao, JDcom, Little Red Book, and various social media platforms in mainland China have embraced live e-commerce. Consequently, individuals have become accustomed to this phenomenon. As P3 stated: *'impulsive buying are prevalent across all platforms, and the affordability of goods on live platforms often compels individuals to make impulsive buying if they are inclined to do so.'*

4.2 Design Influences Impulsive Buying on Social Media Type Live Sales

Based on our analysis of qualitative and quantitative data, it can be inferred that the four designs we examined exhibit efficacy in mitigating impulsive buying. These designs include enhancing payment friction, prolonged purchase decision time, the implementation of a visual wallet for savings accounts, and the imposition of browsing time limitations accompanied by usage statistics.

4.2.1 Internal intervention: Visualizing the wallet's balance. According to several users, visualizing the wallet's balances has the potential to mitigate impulsive buying tendencies that arise while browsing activities on *Douyin X*. P04 expresses:

> *'The feature enables me to quickly ascertain the whole amount of money I have spent as well as the remaining balance. The ability to easily comprehend the cost of each spend is beneficial to me. Occasionally, individuals may experience a sense of astonishment upon acquiring an item and afterwards realising its exorbitant cost. However, by visualizing the wallet's balances, individuals may get a more intuitive and precise representation of their expenditure patterns.'*
>
> *'Visual representations effectively convey the magnitude of monetary reductions, enabling a visible impact on one's budget or savings. Upon seeing a noticeable decrease in my savings due to my expenditures, I realised that adopting a more economical approach is imperative.'* said P9.

We collected 40 responses from the participants regarding the payment flow by visualizing the wallet's balances ($\bar{M}$ =5.65, SD =1.33), and 997 batches of data logs regarding the participant activities with *Douyin X*. The inverse Gaussian model was applied to a data set comprising 1,780 user activity logs to evaluate the influence of visualizing wallet balances on impulsive buying. impulsive buying were operationalized as users' responses to questionnaire items categorised as *'Somewhat Agree'*, *'Agree'*, and *'Strongly Agree'*. The study included the following independent variables:(1) a categorical variable that indicates whether users prefer to toggle the visibility of their savings account wallet on or off, reflecting their preference for visualizing the wallet's balances, (2) a categorical variable

of the percentage of non-video viewing time in the total system usage time. Participant ID was added as a random effect.

Table 1. **An inverse Gaussian mixed model demonstrated a negative correlation between the visualizing wallet balances and impulsive buying on the *Douyin X* platform. The wallet switch factor significantly influenced impulsive buying behaviour.**

	β	se	z	p
(Intercept)	-1.316	0.594	-2.215	0.027
Wallet Switch	9.287	2.451	3.789	0.000
Percentage of Non-video Views	-0.668	1.249	-0.535	0.593

Table 1 illustrates the benefits of visualizing a wallet's balance to prevent impulsive buying with *Douyin X* (β = -1.316, t = -2.215, p <0.05).

P18 hopes that the function can be implemented in many real-life platforms, showing the willingness to use the new tools for future e-commerce. P18 further expressed:

> *'Upon engaging in routine purchasing activities and proceeding with a transaction, I do not promptly verify the remaining funds inside my wallet. Upon further examination of my card balance, I am aware of the few funds available, resulting in a little sense of melancholy. This functionality enables me to see the real-time fluctuations of my account balance.'*

4.2.2 Internal intervention: Enhancing payment friction. When queried about the potential impact of design elements in *Douyin X* on impulsive buying, several participants expressed the view that design aspects that enhance payment friction impeded their ability to make impulsive buying on *Douyin X*. The design of *Douyin X* exhibited a commendable instance of a design attribute capable of exerting impact on impulsive buying behaviour. P1 stated:

> *'The design of 'Think Twice' is very appealing since it prompts individuals to reconsider their need for a certain item. This feature can significantly impact purchasing decisions, as it encourages individuals to evaluate the need of the item in question critically.'*

P20 had a similar viewpoint, stating that the 'Think Twice' design facilitated their ability to disengage from the captivating nature of impulsive buying and encouraged a more contemplative approach. However, it should be noted that, ultimately, they refrained from making the purchase. P19 said: *'the system's architecture gives me enough opportunity to deliberate on their purchase choice, giving me an additional chance to choose whether or not to proceed with the transaction.'* As such, this feature is seen as beneficial by the participant.

Regarding the technique of increasing the payment fiction, we collected 40 responses from the participants ($\bar{M}$ =5.85, SD =1.21) and 997 batches of data logs.

We ran an Inverse Gaussian model to analyze the 1,780 data logs to assess the influence of enhancing payment friction on impulsive buying. The questionnaire asks for their agreement on the effectiveness of such a feature, with three options: *'Somewhat Agree'*, *'Agree'*, and *'Strongly Agree'*. We employed two independent variables (1) The first variable is a categorical variable, reflecting the number of users who clicked on the 'continue' button on the first purchase confirmation page; (2) a categorical variable of the number of times users clicked the 'continue' button on the second purchase confirmation page. Participant ID was added as a random effect.

Table 2 shows the effectiveness of exerting increased fiction to alleviate impulsive buying (β = -13.825, z = -2.143, p <0.05).

4.2.3 Internal intervention: Prolonging the duration of purchase decision-making. Several participants said that using a design feature that prolongs the duration of the purchase choice process proved to be effective in

Table 2. **An inverse Gaussian mixed model demonstrating the relationships between users clicking the 'continue' button on the first and second purchase confirmation pages, and impulsive buying. There was a negative correlation between impulsive buying and the intercept, indicating that increased friction alleviates impulsive buying**

	β	se	z	p
(Intercept)	-13.825	6.452	-2.143	0.0321
First Purchase Confirmation Clicks	0.554	1.356	0.409	0.683
Second Purchase Confirmation Clicks	13.569	6.846	1.982	0.047
First Vs. Second	-1.650	1.093	-1.510	0.131

mitigating impulsive buying behaviour when utilising *Douyin X*. P16 claims: *'the inclusion of a countdown timer proves to be quite advantageous, since it affords me enough duration of tranquility for contemplation.'* P9 and P15 shared a similar perspective regarding their ability to determine the timing of their purchase decisions. P9 stated, *'I have the authority to set the purchase decision time according to my preferences; I possess control over this aspect.'* Similarly, P15 expressed, *'Observing the countdown prompts me to contemplate my purchase motivation earnestly; the countdown creates a sense of formality that necessitates serious consideration.'*

Regarding the technique of the prolonged process of reaching buying decisions, we collected 40 responses from the participants ($\bar{M}$ =5.95, SD =1.38) and 997 batches of data logs. The questionnaire asks for their agreement on the effectiveness of such a feature, with three options: 'Somewhat Agree', 'Agree', and 'Strongly Agree'. We analyzed 1,780 user activity log data using an inverse Gaussian model. This model used: (1) a categorical variable of the number of times the countdown was unmounted after 'check out' completion, and (2) a categorical variable of the percentage of non-video viewing time in the total system usage time. Participant ID was added as a random effect. Our results are shown in Table3.

Table 3. **An inverse Gaussian mixed model demonstrating the relationships between the number of times the countdown is unmounted after checkout completion, the percentage of non-video views, and impulsive buying. There was a negative correlation between impulsive buying and both variables, although the effects were not statistically significant.**

	β	se	z	p
(Intercept)	-10.184	5.441	-1.872	0.061
Checkout Completion Countdown	9.591	5.437	1.764	0.078
Percentage of Non-video Views	-1.843	1.894	-0.973	0.331

Table3: The model suggests that prolonging the process of reaching buying decisions could slightly alleviate impulsive buying. However, the effect was insignificant (β = -10.184, z = -1.872, p >0.05).

4.2.4 External intervention: Imposing browsing time limits and usage statistics. Several users have noted that the design of the external intervention had a notable impact on their impulsive buying while using *Douyin X*. Additionally, they found it to be very effective in curbing such impulsive buying behaviours.

During the first usage, 4 participants chose to exit *Douyin X* upon encountering the browse time limit conversation box. Many participants pressed the 'Ignore' button at least one time. In total, the participant pressed the 'Ignore' button 83 times. Nevertheless, the participant's assessment of the dialogue box imposing a time restriction on surfing remained polarised, as several participants expressed the view that the inclusion of this functionality was important.

According to P10, *'the intrusive nature of the pop-up window inside the browsing time restriction dialogue box significantly hampers my impulsive buying. This intermittent interruption effectively hinders my indulgence in fantasies.'* P13 expressed appreciation for this particular feature, noting that *'it serves as a reminder of my tendency*

to engage in unproductive time utilization. I also acknowledge that engaging in aimless shopping might potentially trigger impulsive buying behaviours.'

P3 expressed dissatisfaction with the function, stating that it negatively impacted their purchasing experience. P3 first opted out of the feature by selecting the corresponding button; however, it found that it still interfered with one's purchase process.

We collected 40 responses from the participants regarding the constrained browsing time and usage statistics ($\bar{M}$ =5.65, SD =1.44), and 845 batches of data logs regarding the participant activities with *Douyin* were analyzed by the Inverse Gaussian model. We used the following independent variable: (1) a categorical variable represents the number of times users clicked 'ignore' in the browsing activity log, (2) a categorical variable denotes the on and off states of the external control switch, and (3) a categorical variable that indicates the proportion of live video viewing time in the total system usage time. The Participant ID has been incorporated as a random effect.

The questionnaire asks for their agreement on the effectiveness of such a feature, with three options: 'Somewhat Agree', 'Agree', and 'Strongly Agree'. Table4 shows the effectiveness of the constrained browsing time and usage statistics to alleviate impulsive buying (β = 54.845, z = 11.605, p <0.001). This implies that the feature effectively enhances the user's awareness of the temporal progression and serves as a mechanism to redirect their attention from immersive experiences.

Table 4. **The inverse Gaussian mixed model demonstrated a positive correlation between impulsive buying and both the number of times users clicked 'ignore' in the browsing activity log and the on and off states of the external control switch. However, a strong negative correlation existed between impulsive buying and the proportion of live video viewing time. This suggests that constraining browsing time and providing usage statistics effectively alleviates impulsive buying by enhancing users' awareness of temporal progression and redirecting their attention from immersive experiences.**

	β	se	z	p
(Intercept)	54.845	4.726	11.605	0.000
Ignore Clicks	0.902	0.897	1.006	0.314
External Control Switch	11.712	1.604	7.302	0.000
Live Video View Ratio	-63.853	4.893	-13.050	0.000

4.2.5 Questionnaire Result. Figure 5 depicts the results of the questionnaire on the dimension of 'design influencing impulsive buying' with two questions. We performed a Friedman test to compare the mean differences across all four versions on the results related to 'design influencing impulsive buying'.

We report the detailed results of the questionnaire as follows.

Design Influences impulsive buying As for the sub-question (Q1) '*The design of the payment process for the merchandise intervened in my impulsive buying behaviour*', a statistical significance was observed among the four conditions (χ^2 = 28.940, p <0.001). Participants using version 3 (V3) demonstrated the strongest response to the intervention purchase ($\bar{M}$=5.95, SD=1.50). This was closely followed by those using version 1 (V1) with a response that was not significantly different from those using version 2 (V2) ($\bar{M}$_V1=5.55, SD=1.47; $\bar{M}$_V2=5.50, SD=1.47). However, the response of participants using version 4 (V4) was notably lower than the others, indicating the least effective response to the intervention purchase ($\bar{M}$=3.10, SD=1.37). This implies that specific features within the payment process design, namely the 'Visualizing the wallet's balances', 'Enhancing payment friction', 'Extended purchase decision time', and 'Imposing browsing time limits and usage statistics', are pivotal in influencing impulsive buying behaviour.

The sub-question (Q2) '*When I considered purchasing a product, the design of the payment process allowed me to reflect calmly on whether I truly needed the item*' also aligns with the above, with statistical significance being observed (χ^2 = 28.227, p <0.001). Participants interacting with Version 3 (V3) showcased the most pronounced

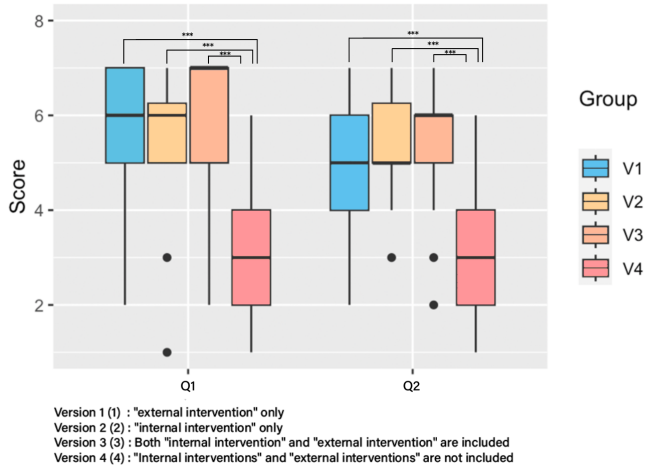

Fig. 5. Results of Design Influences on Impulsive Buying Questions

response, with ($\bar{M}$=5.35, SD=1.31). Those using Version 1 (V1) and Version 2 (V2) provided responses that were almost equivalent, registering ($\bar{M}$=5.00, SD=1.59) and ($\bar{M}$=5.50, SD=1.15), respectively. In contrast, the feedback from participants on Version 4 (V4) was substantially subdued, noted at ($\bar{M}$=3.05, SD=1.54), underscoring its diminished efficacy.

5 DISCUSSION

Our study suggests that a significant number of individuals often engage in impulsive buying behaviour when viewing live e-commerce broadcasts on social media, despite the fact that this is a well-recognised issue in society. This might be prompted by the compelling strategies used by the streamer or by coming across very enticing items while watching the video. By identifying these occurrences of impulsive buying, the HCI community could get a deeper understanding of the underlying process that prompts consumers to make unplanned purchases when interacting with real-time online shopping on social networking platforms. Consequently, our design interventions provide a foundation for understanding how to reduce impulsive buying in the future.

Our findings contribute to the field of live e-commerce by demonstrating that increasing payment friction and visualizing wallet balances can significantly reduce impulsive buying. This work extends the S-O-R framework by integrating cognitive elements from the Theory of Planned Behavior, offering new insights into the psychological mechanisms underlying impulsive behavior on *Douyin*.

5.1 Overuse of Technology Creates impulsive buying

The excessive use of technology in live-streaming e-commerce on social media can lead to impulsive buying, consumer behaviour triggered by immediate response to stimuli without considering potential purchasing outcomes [42]. While browsing live-stream e-commerce on social media, users are often stimulated by prompts, thus triggering a solid desire for purchase [22]. Previous studies have shown a positive correlation between the intensity of social media use and impulsive buying [42]. However, the public's excessive use of technology in live-streaming e-commerce on social media seems to be in a state of contradiction. While substantial research has proved that technology can help boost impulsive buying to increase sales [8, 33, 36, 57], other studies have warned of the addictive nature of excessive use of technology on social media [24, 61]. This has led to a paradoxical situation where people continue to use live-streaming e-commerce on social media for its shopping convenience,

yet stay away for fear of addiction. This has resulted in anxiety about the use of live-streaming e-commerce on social media. Currently, most social media platforms are leveraging technology to help users shop better, but users find it hard to consider their shopping needs rationally. This excessive use of technology may be causing the numerous anxieties that social media brings to users, such as impulsive buying. Users want a better shopping experience on social media and rationally control their purchasing behaviour. This seemingly achievable demand is a difficult gap to bridge for social media platforms. They encourage designers to design profit-maximizing social media shopping systems that let users fully enjoy the addictive pleasure of impulsive buying. This suggests that if the gap between users and social media can be bridged, i.e., the platform allows users to make rational purchases, users will establish a good, trusting, and stable relationship with live-streaming e-commerce on social media.

5.2 Designs that Disrupt impulsive buying

Our findings suggest that incorporating visual cues, such as real-time wallet balances, can empower users to make more deliberate purchase decisions. Designers can adopt these interventions to align platform incentives with user well-being, potentially enhancing long-term brand loyalty.

The prevailing design methodologies used in live e-commerce platforms on social media have resulted in a heightened susceptibility among users to engage in impulsive buying behaviours. In contrast to the payment design that involves expanding the payment process interface and inputting payment information, the live e-commerce platform prioritises the prominence of the 'checkout button'. It aims to streamline the payment process to the greatest extent feasible.

Upon the completion of the first payment, the payment and address details provided by the user will be automatically stored inside the system. Subsequently, when the user selects the 'checkout button,' the system will automatically retrieve and match this stored information. Upon completing the initial payment, the system will automatically store the user's payment and address details. Subsequently, when the user clicks the 'checkout' button, the system will automatically retrieve this information, significantly reducing the cognitive load during the payment process. Consequently, the user's impulsive buying tendencies, triggered by the stimulating nature of live e-commerce, will be less susceptible to interference.

Our experimental results indicate that visualising the wallet's balances, enhancing payment friction, and imposing browsing time limits and usage statistics can assist users in more effectively mitigating impulsive buying induced by the dynamic e-commerce platform.

Nevertheless, the ultimate decision about the utilisation of these designs lies not within the purview of the consumers, but rather rests with the live e-commerce platform. The platform ought to have a neutral stance whereby customers are given the freedom to engage in transactions, although this ideal is not currently being realised. The present recommendations include a range of live-streaming e-commerce platforms, aimed at enhancing the buying experience for customers and facilitating efficient purchasing practises. These proposals aim to mitigate adverse effects associated with impulsive buying, which have the potential to detrimentally impact long-term brand loyalty and public perception.

5.2.1 Enable user page customization. During the interview session, a significant number of participants expressed their limited availability to contemplate their purchase decisions before finalising the payment process after clicking the buy button. As articulated by one user, the system's page layout facilitates an effortless transition from product browsing to the payment page, thereby hindering their ability to examine the product introduction and detailed display thoroughly.

When the payment system integrated inside the platform is used, the transaction is executed instantaneously, leaving little time for contemplation over the need for the products being purchased. The platform should provide users with page design options that align with their browsing patterns, rather than prioritising designs that are

most financially convenient or encourage impulsive buying. According to user feedback, individuals have indicated that a webpage that aligns with their payment and purchasing preferences elicits a more favourable response compared to a webpage just focused on payment efficiency. Despite the availability of multiple payment paths on *Douyin*, most of our participants adhered to the platform's default payment process when making purchases. This finding implies that a mere demonstration of functionality is insufficient. To enhance the purchasing and payment experience, it is imperative for the platform to comprehend consumers' payment and purchasing habits and offer alternative page designs.

5.2.2 Encouraging Participation in Shopping Cooling-off Period. Implementing a shopping cooling-off time, whereby individuals can intervene in their impulse purchasing behaviour by putting chosen products in the shopping cart, can mitigate the inclination to engage in impulsive buying. Several studies have shown that delaying gratification might effectively mitigate impulsive buying behaviour [36]. As articulated by a participant, *'I often find myself acquiring items that I later realise are unnecessary. If allowed to reflect on my purchases calmly, perhaps I would refrain from making them.'* Nevertheless, user feedback regarding this design is varied. Certain users argue that enabling this function may result in missed opportunities to purchase desired goods. They contend that certain products are exclusively available during live broadcasts. If this function is activated, there is a possibility that the goods may have already been sold out by the time they make a well-considered decision to purchase. Several users have proposed potential enhancements to improve the efficacy of this function. These suggestions include including a control button that allows users to activate or deactivate the feature before each transaction and implementing a distinction based on the monetary value to determine whether the feature is enabled or disabled.

This suggests that while the shopping cart design of the cooling-off period can intervene in impulsive buying, it can also impact and disrupt the consumer's live shopping experience. The Federal Trade Commission in the United States has provided a clear definition of the cooling-off period. Although this rule imposes numerous restrictions on its implementation, consumers who meet the criteria can cancel the sale within a specified period. Most live e-commerce platforms in mainland China have introduced relevant return protection mechanisms, such as freight insurance and a seven-day no-reason return policy. However, faced with complex return procedures and time investment, some users hesitate about reverse logistics that bring hassle and trouble [43]. To our knowledge, there are no design intervention measures for the cooling-off period on live e-commerce platforms.

5.2.3 Allow user wallet setup. Discussions have been conducted on how the presentation of wallets influences an individual's spending capacity and consumption desire. According to a user's statement, their preference is to involve banknotes during the transaction due to their ability to precisely represent the amount of money used, offering a more tangible and intuitive experience compared to monthly credit card statements or decreased values shown via mobile payment methods.

Mobile payments have emerged as the prevailing mode of payment in contemporary China [47]. However, investigations have shown that using digital payments may facilitate a psychological detachment between consumers and their monetary transactions, potentially resulting in more impulsive and nonessential expenditures [19, 31].

We suggest incorporating a small widget in the payment interface: visualizing the wallet's balances. The monetary amount in the wallet would decrease correspondingly with the amount spent on purchases. This optional feature could better assist users in allocating their purchasing plans rationally. Stripe, an internet infrastructure for payments, already possesses a feature similar to that of a visualized virtual cash wallet, allowing users to manage their account wealth. However, such an intervention method is virtually non-existent on live e-commerce platforms on social media. The design concept of visualizing the wallet's balances helps to rekindle users' self-awareness and natural selection, as the act of taking out money from the wallet and tallying the bills serves as a frequent reminder that they are making a payment, enabling shoppers to think rationally and resist impulsive buying.

5.2.4 Promote introspection. Enabling individuals to engage in self-monitoring via the provision of a browsing time window on the real-time e-commerce platform, and through a count window showing the number of pop-up windows they have ignored, could potentially lead to a reduction in impulsive buying tendencies. The reception of this feature among users has been varied, as some individuals see it as a hindrance to their fully immersive shopping experience, whilst others have chosen to exit the system, asserting that the design may effectively assist them in avoiding impulsive buying. This finding provides compelling evidence that self-monitoring users' contextual information as they browse real-time e-commerce platforms may be a successful intervention in curbing impulsive buying tendencies. However, it is important to note that this practise may also disrupt the user's immersive shopping experience.

Furthermore, based on the examination of the data, it can be inferred that there exists a positive correlation between the frequency of participants' backstage use and the extent of their impulsive buying behaviour. This finding suggests that individuals who exhibit more mindfulness towards their purchasing habits are more likely to successfully suppress impulsive buying tendencies, decreasing the frequency of impulsive buying activity. While *Douyin* has introduced a mechanism to restrict browsing time, it still lacks the capability to monitor real e-commerce activities, such as tracking the number of goods seen and the cumulative value of things added to the cart [37]. In subsequent periods, it is advisable to consider augmenting the dissemination of user-related data to individuals, enabling their direct involvement in the oversight and administration of the operational platform.

5.3 Balancing Impulse and Intention

Our research provides valuable insights at theoretical, practical, and societal levels. By integrating inhibitory design elements, it extends the S-O-R framework and introduces new perspectives on how design can serve both as a trigger and a constraint for impulsive buying. Future studies can build upon this extended model to explore the interplay between cognitive control mechanisms and emotional triggers in online consumer behavior, bridging gaps with the Theory of Planned Behavior. Practically, the study offers actionable design recommendations for platform developers, including enhancing payment friction, visualizing wallet balances, and setting browsing time limits. These interventions align with a shift toward more ethical, user-centric platform designs aimed at mitigating addictive behaviors. Policymakers can leverage these insights to encourage responsible design practices through policy frameworks that promote consumer well-being, focusing on balancing user engagement with mental health considerations. From a societal perspective, the research highlights the importance of fostering responsible consumption patterns on live e-commerce platforms. As impulsive buying becomes more prevalent in digital environments, there is an urgent need for awareness campaigns and financial literacy education to help consumers make informed decisions. The study also opens avenues for broader discussions on the ethics of technology design, emphasizing the potential for collaborative efforts among designers, regulators, and consumers to create healthier digital ecosystems [53, 54].

5.4 Limitations and Future Work

Our research demonstrates that design has the potential to mitigate impulsive buying behaviour in the context of live social media e-commerce. However, it is vital to acknowledge the limits of our study, which only provide a preliminary understanding of this phenomenon. Therefore, future research should aim to expand upon our findings and further investigate this topic. Our experiment did not evaluate the impact of the product category offered by live e-commerce sellers on impulsive buying behaviour. Future research might study how various item combinations elicit distinct cues in consumers, ultimately impacting their impulsive buying behaviour.

Furthermore, our discussion has been limited to *Douyin*'s design intervention for impulsive buying. It is important to note that many live e-commerce platforms exist within the realm of social media. Consequently, the effectiveness of design interventions for impulsive buying may differ across these platforms. In future research,

we aim to consolidate the knowledge gained from impulsive buying experiences on live e-commerce platforms, including but not limited to *Douyin*, and explore the various design interventions employed for impulsive buying on other live e-commerce platforms.

Due to inherent constraints within the system, our quantitative survey was restricted to the modelling of merely four actual shopping experiences, each lasting for a duration of 10 minutes. Consequently, the level of detail and precision in our data is constrained by the limited sample size of 20 participants. The small sample size may affect the generalcizability and statistical power of our quantitative analysis, potentially limiting the ability to detect significant effects or trends. Future studies should consider larger and more diverse samples to enhance the reliability and validity of the findings.

Additionally, our study may be subject to potential cultural bias, as it primarily focuses on *Douyin* users within a specific cultural context. This poses challenges for generalizing our findings across different platforms and regions, where consumer behaviours and cultural influences may vary significantly. Future research should address cultural diversity and examine how cultural factors interact with design interventions to influence impulsive buying behaviour across various social media e-commerce platforms and geographic regions.

Finally, our experiment was conducted within a single live room on *Douyin*, limiting the representation of other live *Douyin* rooms with different themes or audiences. Subsequent research endeavours will investigate the influence of various room categories on impulsive buying within the same live platform to provide a more comprehensive understanding of the factors that drive impulsive purchasing decisions in live social media e-commerce environments.

6 CONCLUSION

Our study explores how specific design interventions on *Douyin*'s live sales platform influence impulsive buying behavior through the S-O-R framework. We found that visual stimuli, personalized anchors, and frictionless payment systems significantly drive impulsive purchases. However, interventions such as visualizing wallet balances, introducing payment friction, extending decision-making time, and setting browsing limits effectively mitigate these impulses by encouraging more reflective consumption.

For example, displaying account balances increased users' spending awareness, reducing unnecessary purchases, while enhanced payment friction provided a "cooling-off" period for reconsideration. Despite these benefits, user feedback was mixed; some appreciated the reflective features, whereas others were frustrated by disruptions to their shopping experience. This highlights the challenge of balancing impulse control with seamless user engagement.

Our findings indicate that live social media e-commerce platforms are not neutral entities; their design choices significantly influence user behavior and limit consumer autonomy. By adopting ethical design strategies, e-commerce platforms can promote mindful consumption without compromising user satisfaction. This research lays the groundwork for future studies to examine these interventions across different platforms and cultural contexts, aiming to balance consumer autonomy with platform profitability and foster a more ethical online shopping environment.

REFERENCES

[1] Adamczyk, A. (2021). Here's why you probably bought something you saw on tiktok.

[2] Adelaar, T., Chang, S., Lancendorfer, K. M., Lee, B., and Morimoto, M. (2003). Effects of media formats on emotions and impulse buying intent. *Journal of information Technology*, 18(4):247–266.

[3] Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*.

[4] Aruna, S. and Santhi, P. (2016). *Impulse Purchase Behaviour Among Generation-Y*. SSRN.

[5] Baughan, A., Zhang, M. R., Rao, R., Lukoff, K., Schaadhardt, A., Butler, L. D., and Hiniker, A. (2022). "i don't even remember what i read": How design influences dissociation on social media. In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems*, pages 1–13.

[6] Beatty, S. E. and Ferrell, M. E. (1998). Impulse buying: Modeling its precursors. *Journal of retailing*, 74(2):169–191.
[7] Chan, T. K., Cheung, C. M., and Lee, Z. W. (2017). The state of online impulse-buying research: A literature analysis. *Information & Management*, 54(2):204–217.
[8] Chang, H.-J., Eckman, M., and Yan, R.-N. (2011). Application of the stimulus-organism-response model to the retail environment: the role of hedonic motivation in impulse buying behavior. *The International review of retail, distribution and consumer research*, 21(3):233–249.
[9] Chen, C.-C. and Yao, J.-Y. (2018). What drives impulse buying behaviors in a mobile auction? the perspective of the stimulus-organism-response model. *Telematics and Informatics*, 35(5):1249–1262.
[10] Csikszentmihalyi, M., Csikszentmihalyi, M., and Larson, R. (2014). Validity and reliability of the experience-sampling method. *Flow and the foundations of positive psychology: The collected works of Mihaly Csikszentmihalyi*, pages 35–54.
[11] de Guzman, A., Acerit, A., Baui, N. J., Daliri, J., Lazatin, S. C., Porto, P., Rabago, Z., Rodriguez, G., and Valdez, H. M. (2022). Oniomania: A phenomenological study on online shopping addiction. *International Journal of Arts, Sciences and Education*, 3(1):71–85.
[Dhebar et al.] Dhebar, M., Sahu, T., Soni, A., Dewangan, G., and Choithramani, N. Effect of social media on impulsive buying.
[13] Dudarenok, A. (2018). *Digital China: Working with Bloggers, Influencers and KOLs: Learn how to plan marketing campaigns with bloggers in China*. Alarice International Limited.
[14] Eroglu, S. A., Machleit, K. A., and Davis, L. M. (2001). Atmospheric qualities of online retailing: A conceptual model and implications. *Journal of Business research*, 54(2):177–184.
[15] Evans, J. S. B. and Stanovich, K. E. (2013). Dual-process theories of higher cognition: Advancing the debate. *Perspectives on psychological science*, 8(3):223–241.
[16] Eyal, N. (2014). *Hooked: How to build habit-forming products*. Penguin.
[17] Fara, Q. M. and Hartono, A. (2024). The effect of social presence in live streaming shopping on tiktok platform users on impulse buying behavior. *EKOMBIS REVIEW: Jurnal Ilmiah Ekonomi dan Bisnis*, 12(1):331–342.
[18] Freishtat, R. L. and Sandlin, J. A. (2010). Shaping youth discourse about technology: Technological colonization, manifest destiny, and the frontier myth in facebook's public pedagogy. *Educational Studies*, 46(5):503–523.
[19] Gustafson, K. (2015). Mobile payments could make shoppers spend more.
[20] Han, M. C. (2023). Checkout button and online consumer impulse-buying behavior in social commerce: A trust transfer perspective. *Journal of Retailing and Consumer Services*, 74:103431.
[21] Hewei, T. (2022). Influence of online comments on clothing impulse buying behavior in mobile short video app live broadcast. *Frontiers in Psychology*, 13:913073.
[22] Huo, C., Wang, X., Sadiq, M. W., and Pang, M. (2023). Exploring factors affecting consumer's impulse buying behavior in live-streaming shopping: An interactive research based upon sor model. *SAGE Open*, 13(2):21582440231172678.
[23] Kaziukėnas, J. (2023). Tiktok's aggression vs. amazon's passivity.
[24] Khan, N. A., Khan, A. N., and Moin, M. F. (2021). Self-regulation and social media addiction: A multi-wave data analysis in china. *Technology in Society*, 64:101527.
[25] Kiefer, J. and Wynn, H. (1981). Optimum balanced block and latin square designs for correlated observations. *The annals of Statistics*, 9(4):737–757.
[26] Koranti, K., Noviyana, S., Sriyanto, S., and Aryani, N. I. (2024). The effect of discount, promotion, hedonic shopping motivation, shopping lifestyle on impulse buying on tiktok shop users. *Daengku: Journal of Humanities and Social Sciences Innovation*, 4(2):345–355.
[27] Kosinski, M., Matz, S. C., Gosling, S. D., Popov, V., and Stillwell, D. (2015). Facebook as a research tool for the social sciences: Opportunities, challenges, ethical considerations, and practical guidelines. *American psychologist*, 70(6):543.
[28] Kotler, P., Kartajaya, H., and Setiawan, I. (2023). *Marketing 6.0: the future is immersive*. John Wiley & Sons.
[29] Lanette, S., Chua, P. K., Hayes, G., and Mazmanian, M. (2018). How much is' too much'? the role of a smartphone addiction narrative in individuals' experience of use. *Proceedings of the ACM on Human-Computer Interaction*, 2(CSCW):1–22.
[30] Lee, C.-H. and Chen, C.-W. (2021). Impulse buying behaviors in live streaming commerce based on the stimulus-organism-response framework. *Information*, 12(6):241.
[31] Liang, L.-H. (2019). Does e-money make you spend more?
[32] Macït, H. B., Macit, G., and Güngör, O. (2018). A research on social media addiction and dopamine driven feedback. *Mehmet Akif Ersoy Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, 5(3):882–897.
[33] Mason, M. C., Zamparo, G., Marini, A., and Ameen, N. (2022). Glued to your phone? generation z's smartphone addiction and online compulsive buying. *Computers in Human Behavior*, 136:107404.
[34] Mehrabian, A. and Russell, J. A. (1974). *An approach to environmental psychology.* the MIT Press.
[35] Ming, C. W. (2024). Live streaming commerce: Deciphering the elements shaping chinese consumer choices. *Journal of Human Resource and Organizational Behavior*, 1(1):11–32.
[36] Moser, C., Schoenebeck, S. Y., and Resnick, P. (2019). Impulse buying: Design practices and consumer needs. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, pages 1–15.
[37] Mosseri, A. (2021). Raising the standard for protecting teens and supporting parents online. *Retrieved January*, 22:2022.

[38] Müller, A., Mitchell, J. E., and de Zwaan, M. (2015). Compulsive buying. *The American Journal on Addictions*, 24(2):132–137.
[39] Nugraha, Y. D., Permana, R. M. T., and Hadiarti, D. (2024). Impulsive purchase behaviour of z generation of muslim women on tiktok shop: the application of sor framework. *Journal of Islamic Marketing*, 15(2):493–517.
[40] O'Brien, H. L. and Toms, E. G. (2008). What is user engagement? a conceptual framework for defining user engagement with technology. *Journal of the American society for Information Science and Technology*, 59(6):938–955.
[41] Parboteeah, D. V., Valacich, J. S., and Wells, J. D. (2009). The influence of website characteristics on a consumer's urge to buy impulsively. *Information systems research*, 20(1):60–78.
[42] Pellegrino, A., Abe, M., and Shannon, R. (2022). The dark side of social media: content effects on the relationship between materialism and consumption behaviors. *Frontiers in psychology*, 13:870614.
[43] Phau, I., Akintimehin, O. O., Shen, B., and Cheah, I. (2022). "buy, wear, return, repeat": Investigating chinese consumers' attitude and intentions to engage in wardrobing. *Strategic Change*, 31(3):345–356.
[44] Rodrigues, R. I., Lopes, P., and Varela, M. (2021). Factors affecting impulse buying behavior of consumers. *Frontiers in Psychology*, 12:697080.
[45] Rook, D. W. and Fisher, R. J. (1995). Normative influences on impulsive buying behavior. *Journal of consumer research*, 22(3):305–313.
[46] Roy, A., Al Zubayer, T., Tabassum, N., Islam, M. N., and Sattar, M. A. (2022). Curfi: An automated tool to find the best regression analysis model using curve fitting. *Engineering Reports*, 4(12):e12522.
[47] Shen, H., Faklaris, C., Jin, H., Dabbish, L., and Hong, J. I. (2020). 'i can't even buy apples if i don't use mobile pay?' when mobile payments become infrastructural in china. *Proceedings of the ACM on Human-Computer Interaction*, 4(CSCW2):1–26.
[48] Southern, M. G. (2021). It's showtime! how live commerce is transforming the shopping experience.
[49] Southern, M. G. (2022). Tiktok a key part of consumers' path to purchase.
[50] Su, C. (2023). *Douyin, TikTok and China's online screen industry: The rise of short-video platforms*. Taylor & Francis.
[51] Wang, J. and Oh, J. I. (2023). Factors influencing consumers' continuous purchase intentions on tiktok: An examination from the uses and gratifications (u&g) theory perspective. *Sustainability*, 15(13):10028.
[52] Wang, X. and Cao, S. (2024). Harnessing the stream: algorithmic imaginary and coping strategies for live-streaming e-commerce entrepreneurs on douyin. *The Journal of Chinese Sociology*, 11(1):9.
[53] Wei, Z., Xie, Y., Xiao, D., Zhang, S., Hui, P., and Zhou, M. (2024a). Social media discourses on interracial intimacy: Tracking racism and sexism through chinese geo-located social media data. In *Proceedings of the ACM Web Conference 2024*, pages 2337–2346.
[54] Wei, Z., Xu, X., and Hui, P. (2024b). Digital democracy at crossroads: A meta-analysis of web and ai influence on global elections. In *Companion Proceedings of the ACM Web Conference 2024*, pages 1126–1129.
[55] Wells, J. D., Parboteeah, V., and Valacich, J. S. (2011). Online impulse buying: understanding the interplay between consumer impulsiveness and website quality. *Journal of the Association for Information Systems*, 12(1):3.
[56] Wolff, R. (2024). Tiktok is determined to make live shopping mainstream, while amazon leans into shoppable tv.
[57] Xiang, L., Zheng, X., Lee, M. K., and Zhao, D. (2016). Exploring consumers' impulse buying behavior on social commerce platform: The role of parasocial interaction. *International journal of information management*, 36(3):333–347.
[58] Yang, Q. and Lee, Y.-C. (2022). What drives the digital customer experience and customer loyalty in mobile short-form video shopping? evidence from douyin (tiktok). *Sustainability*, 14(17):10890.
[59] Ye, Z. (2023). A brief history of china's livestreaming industry: Evolution along with state–business interactions. *Journal of Digital Media & Policy*.
[60] Zhang, J., Jiang, N., Turner, J. J., and Pahlevan-Sharif, S. (2022). The impact of scarcity on consumers' impulse buying based on the sor theory. *Frontiers in Psychology*, 13:792419.
[61] Zhang, N. and Li, J. (2022). Effect and mechanisms of state boredom on consumers' livestreaming addiction. *Frontiers in Psychology*, 13:826121.
[62] Zhang, Y., Sun, Y., and Wang, N. (2024). Understanding the determinants of gifting and social sharing in live streaming: a dual-attachment perspective. *Industrial Management & Data Systems*, 124(2):564–582.

7 BIOGRAPHY SECTION

Zheng Wei is a PhD candidate in Emerging Interdisciplinary Areas at The Hong Kong University of Science and Technology. His research interests include data visualization, virtual reality, and computational social science, with publications in ACM MM, ACM WWW, ACM CHI and IEEE TVCG.

Lik-Hang Lee is an assistant professor at The Hong Kong Polytechnic University. He received his PhD from HKUST. Previously an assistant professor at KAIST and a postdoc at the University of Oulu, his research focuses on human-centric AR/VR systems, published in venues like ACM CHI and IEEE TVCG.

Wai Tong is an assistant professor in the College of Performance, Visualization and Fine Arts at Texas A&M University. He obtained his Ph.D. in Computer Science and Engineering from the Hong Kong University of Science and Technology. His research interests include data visualization, human-computer interaction, and immersive technology.

Xian Xu, HKUST Research Assistant Professor, PhD Computational Media and Arts (HKUST), MFA & BA Drama (Central Academy of Drama), Oxford & Cambridge visiting fellow, scriptwriter.

Chaozhe ZHANG is a PhD student in Computer Media and Art at the Hong Kong University of Science and Technology (Guangzhou). He also graduated from the same university with a research master's degree in Artificial Intelligence. His research interests include data visualization, human-computer interaction, and artificial intelligence generation.

Huamin Qu, Chair Professor (CSE) and Founding Dean (AIS) at HKUST, Director of VisLab, Coordinator of HCI group, holds PhD from Stony Brook University.

Pan Hui is a Chair Professor at HKUST, Director of the Center for Metaverse and Computational Creativity, and an International Fellow of the Royal Academy of Engineering.