

DISPERSION OR CONCENTRATION? THE IMPACT OF AD EXHIBITION ON ADVERTISING PLACEMENT AND PLATFORM DEVELOPMENT IN VIDEO PLATFORMS

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ABSTRACT

Both academia and industry seek to design ad features that improve user experience, increase ad effectiveness, and retain users on video platforms. This study investigates ad exhibition, a key advertising strategy that manipulates distribution of ads within videos. Grounded in information processing theory, we examine how ad exhibition influences user cognitive and affective responses, including brand recall, perceived waiting time, purchase intention, and user satisfaction. Results from two online experiments reveal that dispersed ad exhibition enhances brand recall and reduces perceived waiting time; however, this effect is significant only for lengthy videos. Further analysis demonstrates that brand recall mediates the effect of ad exhibition on purchase intention, while perceived waiting time mediates its impact on satisfaction. A controlled lab experiment conducted with a student sample closely simulated real-world scenarios, providing robust evidence for the validity of the aforementioned conclusions. The present research adds to the existing literature on advertising by shedding light on the interaction of advertising. The study offers valuable insights on how to optimize the placement of ads in order to enhance revenue and attract users.

Keywords: Ad exhibition; Brand recall; Perceived waiting time; Video length; Purchase intention

1. Introduction

Advertising plays a pivotal role in promoting products and brands, as well as supporting the revenue models of video platforms. For companies, advertisements are essential tools for attracting potential consumers, enhancing market share, and building brand awareness. Simultaneously, video platforms benefit from advertising as a significant revenue stream, making the strategic design of advertisements a key factor for mutual success. However, advertisements—especially when poorly timed or too lengthy—are often disliked by users, leading to negative reactions (Banerjee & Pal, 2022; Li & Lo, 2015). This dislike is especially pronounced when ads interrupt users before the content they wish to view, prompting video platforms to continually refine their ad strategies to balance viewer satisfaction and economic outcomes.

Traditional media, like television, attempt to distribute advertisements throughout a program's runtime, ensuring that viewers encounter them at intervals. As shown in Figure 1, advertisements are typically fragmented and displayed during intervals in which a television station broadcasts video content. This means that viewers will encounter advertisements multiple times while streaming a particular video. This strategy is potentially perceived as less intrusive and helps maintain focus on the video content. Consequently, platforms like YouTube still favor a dispersed ad strategy, interspersing ads throughout the video. However, many digital platforms recognize that this approach may interrupt the flow of content and negatively affect the user experience (Acquisti & Spiekermann, 2011), prompting a shift in how ads are presented. Online video platforms such as Tencent, iQiyi, and Youku have increasingly moved

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towards concentrating advertisements at the start of videos, thereby minimizing interruptions. The growing shift towards concentrated ads represents an attempt to avoid interruptions, but this strategy may inadvertently contribute to user dissatisfaction due to prolonged initial ad exposure (Wang, Shih, & Peracchio, 2013). We conclude the above strategies and define *the strategic manner in which advertisements are distributed or displayed within a video as the ad exhibition*. This includes decisions on whether to concentrate ads in a specific segment (such as at the beginning or end) or disperse them throughout the video at regular intervals. This variance in ad exhibition practices² motivates this study to explore which strategy—dispersed or concentrated ad exhibition—is more effective for brand promotion and platform sustainability.

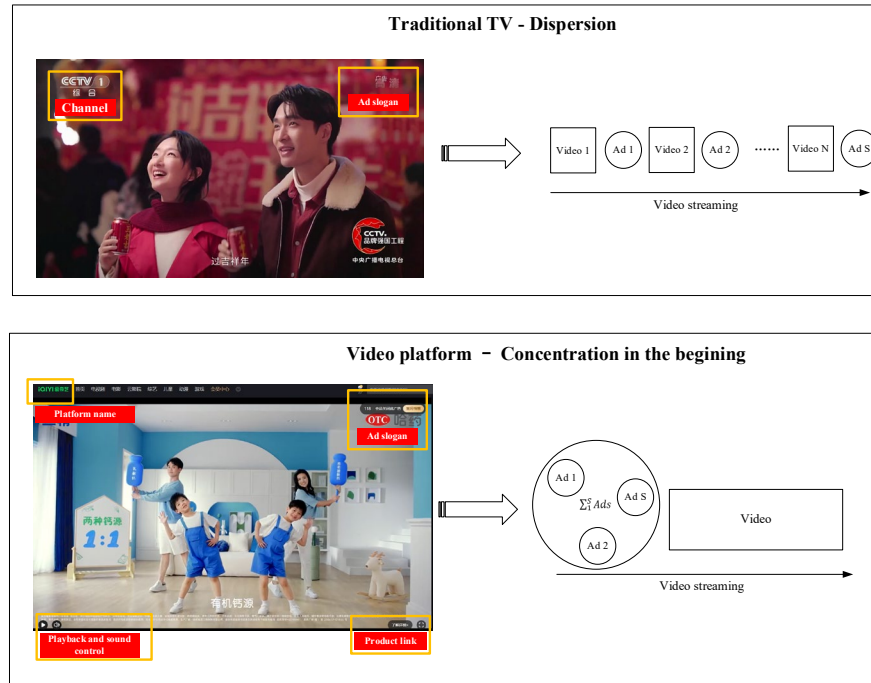


Figure 1. A Comparison of Traditional TV and Video Platforms.

While a rich body of research exists on various aspects of online advertising—such as ad existence (Bellman et al., 2020), ad length (Singh & Cole, 1993), ad value (Bleier & Eisenbeiss, 2015), and ad congruity (Li & Lo, 2015)—limited attention has been given to ad exhibition as a specific design feature. Recent findings in ad features have focused on the interaction of advertising. Most of them have focused on the impact of skippable vs. non-skippable ads on user engagement, and ad effectiveness. For example, bumper ads on YouTube, the short and non-skippable video ads of up to 6 seconds that must be watched before a video can be viewed, are likely to increase users' intention to adopt the platform (Banerjee & Pal, 2022). However, the question of how ads should be exhibited (i.e., dispersed throughout the video or concentrated at the beginning) remains underexplored, resulting in the inability to provide theoretical guidance for video platforms.

As mentioned earlier, the development of video platforms hinges on two key aspects. First, advertising revenue, provides the financial foundation for the platform's daily operations. In order to secure more advertising investments, platforms must ensure the effectiveness of the ads they display. This requires that, after viewing the ads presented on the platform, users develop a stronger impression of the brand, ensuring that when a need arises, they are inclined to purchase products from that brand (Bellman et al., 2020; Singh & Cole, 1993). Second, platform sustainability, which depends on user retention and the ability to cultivate a positive reputation, ultimately enhancing the platform's competitive edge in the market. Since users primarily visit video platforms to watch content rather than advertisements, minimizing the perceived disruption caused by ads may improve their perception of the platform (Brechtman et al., 2016). Therefore, this study examines advertising effectiveness by considering brand recall and purchase intention, and reflects platform sustainability through perceived waiting time and satisfaction. Among them, brand recall refers to the level of awareness that a user has towards a product featured in an advertisement (Bergkvist & Taylor, 2022);

² More practices of ad exhibition are presented in Appendix A.

perceived waiting time refers to individuals' subjective perception and psychological experience of the duration of the wait during a waiting process (Baker & Cameron, 1996); purchase intention is the consumer's likelihood of purchasing a product or service based on their attitude and preferences towards it and satisfaction is a consumer's response to the fulfillment of expectations after purchasing and using a product or service (Zeithaml, Berry, & Parasuraman, 1996).

Additionally, length has frequently been highlighted as a critical factor affecting ad performance in advertising studies (Li & Lo, 2015). Videos of varying lengths increase the cognitive load associated with information processing, thereby intensifying the difficulty of memory-related tasks. In longer videos, users are required to sustain attention for an extended period, continually receiving and processing advertising information. In contrast, shorter videos demand less sustained attention, reducing the cognitive load associated with information processing and making the task of recalling ad content comparatively easier. Given its importance in user-ad interaction, we attempt to incorporate length into our research framework.

To guide the above theoretical and empirical inquiries, we focus on ad exhibition and raise the research question:

(1) How do different ad exhibition strategies affect advertising effectiveness and platform sustainability?

(2) How does video length influence the impact of ad exhibition?

To answer these questions, this study adopts information processing theory and identifies differences in the difficulty of receiving advertising information by starting with perception and recognizing in ad exhibition. The manner in which advertisements are presented creates varying levels of cognitive load for users, influencing their information processing and decision-making processes, such as the processing and recall of information (i.e., brand recall), as well as the analysis, reasoning, selection, and decision-making processes (i.e., product purchase). Furthermore, our study analyzes the relationship between ad exhibition and platform development from the perspective of time perception, along with the dopamine mechanism in the brain. Dispersive ads improve the platform's sustained usage intention by influencing users' subjective waiting time. The results of two online experiments on Amazon Mechanical Turk (MTurk) and a controlled lab experiment shed light on the importance of ad exhibition, making contributions to the existing research. Specifically, we extend the prior studies on the interaction of ad design that have focused on the skippable features. In addition, we contribute to the literature by examining the mediating effect of brand recall and perceived waiting time, which gives suggestions for both advertising efficiency and platform development.

The rest of this paper is organized as follows: Section 2 provides the theoretical foundation that helps Section 3 to create hypotheses and build a research model. Section 4 introduces the experimental stimuli and measurement. Section 5 and Section 6 show the experimental procedure as well as the results of data analysis. The last section discusses the results, implications, limitations, and future directions of this paper.

2. Theoretical Background

2.1. Prior Research on Advertising

Advertising has become intertwined with the evolution of television and the internet, and continues to attract the attention of researchers. To investigate how to maximize the impact of advertising, separate research has indicated different features that can be considered as three categories, i.e., *the existence of advertising*, *the content of advertising*,

Table 1. Past Studies on the Impact of Advertising.

Category	Sources	Advertising design features	Dependent variables	Theory	Main findings
The existence of advertising	Bellman et al. (2020)	<ul style="list-style-type: none"> ● Viewing time ● Product involvement 	<ul style="list-style-type: none"> ● Brand recall ● Purchase intention ● Ad liking 	<ul style="list-style-type: none"> ● Interval outcome estimation theory 	<ul style="list-style-type: none"> ● Top interval of viewing time predicts the greatest ad effectiveness. ● Product relevance increases viewing time.
	Wilbur (2008)	<ul style="list-style-type: none"> ● Video type 	<ul style="list-style-type: none"> ● Ad avoidance 	<ul style="list-style-type: none"> ● None 	<ul style="list-style-type: none"> ● DVR proliferation leads viewers to shift from other forms of ad avoidance to zipping, and may increase ad avoidance.
	Tucker (2014)	<ul style="list-style-type: none"> ● Number of views 	<ul style="list-style-type: none"> ● Ad persuasiveness 	<ul style="list-style-type: none"> ● None 	<ul style="list-style-type: none"> ● Relative ad persuasiveness is on average 10% lower for every one million views that the video ad achieves.
	Arantes et al. (2018)	<ul style="list-style-type: none"> ● User experience 	<ul style="list-style-type: none"> ● The behavior of skipping ads video 	<ul style="list-style-type: none"> ● None 	<ul style="list-style-type: none"> ● Users tend to skip video ads when they are eager to watch the video content. ● Repetition exhibition and long length lead to skip behavior.
The content of advertising	Singh and Cole (1993)	<ul style="list-style-type: none"> ● Ad length ● Ad content ● Ad repetition 	<ul style="list-style-type: none"> ● Brand recall ● Attitude toward brand 	<ul style="list-style-type: none"> ● None 	<ul style="list-style-type: none"> ● Ad length promotes more brand name recall. ● The ad length effect diminishes as repetitions increase, and is better for emotional ads than informational ads. ● Ad length does not affect attitude but it varies across repetition and ad content.
	Li and Lo (2015)	<ul style="list-style-type: none"> ● Ad length ● Ad content 	<ul style="list-style-type: none"> ● Brand recall 	<ul style="list-style-type: none"> ● Cognitive priming theory 	<ul style="list-style-type: none"> ● Long ad length leads to better brand name recognition.
	Joa, Kim and Ha (2018)	<ul style="list-style-type: none"> ● Ad appeals ● Watching contexts 	<ul style="list-style-type: none"> ● Ad viewership 	<ul style="list-style-type: none"> ● Information processing theory ● Elaboration likelihood model 	<ul style="list-style-type: none"> ● Users have higher ad viewership with entertaining advertising than relevant advertising. ● Ad viewership is associated with device, viewing setting and comments.
	McCoy et al. (2008)	<ul style="list-style-type: none"> ● Obscuring of site content 	<ul style="list-style-type: none"> ● Behavioral intentions 	<ul style="list-style-type: none"> ● Theories of attention 	<ul style="list-style-type: none"> ● Prolonged pop-up and banner ads show higher ad recognition rates.
	Jiang et al. (2022)	<ul style="list-style-type: none"> ● Ad authenticity 	<ul style="list-style-type: none"> ● Ad value ● Consumer engagement 	<ul style="list-style-type: none"> ● Advertising value model 	<ul style="list-style-type: none"> ● Informativeness, entertainment, brand essence, realistic plot, and message credibility are positively related to perceived ad value, which increases engagement.
	Lee, Hosanagar and Nair (2018)	<ul style="list-style-type: none"> ● Informative content 	<ul style="list-style-type: none"> ● User engagement 	<ul style="list-style-type: none"> ● None 	<ul style="list-style-type: none"> ● Brand personality related information attract more users. ● Directly informative content is associated with lower levels of engagement.

The interaction of advertising	Joa, Kim and Ha (2018)	<ul style="list-style-type: none"> ● Skippable ads 	<ul style="list-style-type: none"> ● Ad viewership 	<ul style="list-style-type: none"> ● Information processing theory ● Elaboration likelihood model 	<ul style="list-style-type: none"> ● Non-skippable ads show a higher ad viewership than skippable ads.
	Krishnan and Sitaraman (2013)	<ul style="list-style-type: none"> ● Ad position 	<ul style="list-style-type: none"> ● Ad effectiveness 	<ul style="list-style-type: none"> ● None 	<ul style="list-style-type: none"> ● Users have the highest completion and abandonment rates with a mid-roll ad. ● The effect is stronger when interacted with ad length.
	Belanche, Flavián and Pérez-Rueda (2020)	<ul style="list-style-type: none"> ● Skippable ads ● Brand name presentation 	<ul style="list-style-type: none"> ● Brand recall 	<ul style="list-style-type: none"> ● The peak-end rule theory 	<ul style="list-style-type: none"> ● For a Non-skippable ad, users have high brand recall with a post-arousal position strategy. ● For a skippable ad, users have high brand recall with a pre-arousal position strategy.
	Banerjee and Pal (2022)	<ul style="list-style-type: none"> ● Usage motivations 	<ul style="list-style-type: none"> ● User experience 	<ul style="list-style-type: none"> ● Grounded theory 	<ul style="list-style-type: none"> ● Overall experiences are demonstrated for both skippable ads and non-skippable ads.

and the interaction of advertising. These studies sought to examine the variations in ad features for brand promotion, product purchases, and platform engagement issues (see Table 1).

Prior research has examined advertising in various online contexts, including its effectiveness compared to offline media. Online platforms, being more interactive, generally demand more user attention, leading to better ad recall (Wilbur, 2008). In contrast to TV and radio, where ads may serve as background noise, online ads require focused attention (Ha & McCann, 2008). Tucker (2014) highlighted how advertising persuades users to adopt favorable attitudes, while Bellman et al. (2020) compared the impact of video ads and traditional TV ads on viewing time and revenue. Similarly, Arantes et al. (2018) found that YouTube users are often reluctant to engage with ads. These studies focus on the general existence of ads in online media, laying the groundwork for understanding how different ad features interact with user experience. The second line of research focuses on ad content features, such as length, value, size and congruity. Larger and Longer ads often improve brand recall (Chatterjee, 2008; Singh & Cole, 1993), and more personalized or entertaining ads increase engagement (Joa, Kim, & Ha, 2018). Research also shows that informativeness and credibility enhance perceived ad value, influencing user attitudes and purchase intentions (Taylor, Lewin, & Strutton, 2011; Van-Tien Dao et al., 2014).

The interaction of advertising has received more attention recently, which is related to the interactivity between users and the advertising system. Given a closed relationship between ad position and brand recall, advertising is more likely to be completed when it is placed in the middle position or the back position (Krishnan & Sitaraman, 2013). Moreover, Li and Lo (2015) suggest that mid-roll ads are more effective at raising brand awareness than pre-roll or post-roll ads. Relatively few studies till now have examined the role of skippable ads. Users appreciate the flexibility that skippable ads offer, while they express their dislike of mandatory viewing for the non-skippable ads (Banerjee & Pal, 2022). Furthermore, it is found that for skippable ads, brand recall is higher when the brand is displayed at the beginning; on the contrary, non-skippable ads should be displayed at the end (Belanche, Flavián, & Pérez-Rueda, 2020). However, while previous studies inform ad position and ad shippable in general, this study goes a step further by exploring how ad exhibition—the strategic manner in which advertisements are distributed or displayed within a video—interacts with user perception and behavior, which has been less studied. As shown in Figure 2, therefore, we observe a lack of research that theoretically explores and empirically tests the impact of ad exhibition, which could provide a lens to further cover the design of ad features.

Outcomes	<i>Brand (Advertiser)</i>	Bellman et al., 2020 Arantes et al., 2018 Li & Lo, 2015 Tucker, 2014	Joa et al., 2018 Singh & Cole, 1993 McCoy et al., 2008	Krishnan & Sitaraman, 2013 (Position) Belanche et al., 2020 (Skippable) Our study (Exhibition)
	<i>Platform (Company)</i>	Wilbur, 2008 Bellman et al., 2020	Jiang et al., 2022 Lee et al., 2018	Banerjee & Pal, 2022 (Skippable) Our study (Exhibition)
		<i>The existence of advertising</i>	<i>The content of advertising</i>	<i>The interaction of advertising</i>

Ad features

Figure 2. The Position of Our Study on the Literature of Advertising in Video Platforms

2.2. Information Processing Theory

Information processing theory, which stems from cognitive psychology, categorizes the human brain and computer systems at the behavioral level and posits that the former is akin to the latter as an information processing system (McGuire, 1968). This theoretical framework is rooted in the fundamental principles of human cognitive and learning processes. At its core, this approach centers on the conversion of external information into internal knowledge, which encompasses a range of cognitive functions such as perception, attention, memory, thinking, and decision-making.

According to the theory, users first need to import external stimuli as information through sensory systems such as vision, audition, and touch, and then assign meaning to these singular stimuli via perception, which becomes the

information basis for subsequent brain thinking, analysis, and decision-making (Cowan, 2015). Then, users encode, store, and retrieve the input information from the previous stage, reflecting the memory process for the information. Through repeated identification and interpretation of characteristic information about things, impressions are left in the central nervous system, and then encoded and classified, and stored in the memory center. Different advertising exhibition strategies yield varied information and cognitive processes for users. The presentation of ads in a concentrated forces users to process a large amount of information in a short time, potentially leading to cognitive overload. This may hinder users' ability to effectively store and recall brand-related information. In contrast, a dispersed ad spaces out the stimuli, allowing users to engage with the information more gradually, thereby reducing cognitive strain and enhancing brand recall. Additionally, the theory explains how task difficulty influences the process of information processing (Day et al., 2009; Wang & Li, 2022). The level of complexity of a task can directly affect the efficiency of receiving information, which in turn can determine one's ability to retain it in memory.

A complex task significantly increases the amount of cognitive resources required by individuals, exacerbating the cognitive difficulty of information processing. According to information processing theory, the filtering, controlling, retaining, and processing of information all consume cognitive resources. The limited availability of these resources directly determines the complexity and amount of information an individual can handle. When advertisement information exceeds a user's processing capacity, the continuous influx of information competes for limited processing resources, depleting attentional resources (Lavie, 2005). Typically, attentional resources can only be used for one task at a time. When attention is allocated to a high-difficulty task, it may exhaust these resources, leaving insufficient capacity for other tasks. If individuals persist in performing two tasks simultaneously, their performance on both tasks is likely to decline. This depletion of cognitive resources and resulting attentional deficit can affect users' subjective perception of time. Moreover, when cognitive load exceeds an individual's cognitive resource capacity, they are likely to experience negative emotional states (Atiomo, 2020). An overload of information or tasks can lead to feelings of being overwhelmed, resulting in boredom, anxiety, tension, and unease, which can further alter their perception of time (Pekrun et al., 2010).

In varying ad exhibition, differing cognitive processes among users affect memory and time perception. This cognitive information ultimately influences user decisions regarding brands and platforms (Hansen, Lee, & Lee, 2014). Thus, information processing theory not only underpins the inclusion of brand recall and perceived waiting time as key variables in our study but also explains how different ad exhibition strategies influence user cognition and emotional responses. By framing ad exhibition within this theory, we can explore how these cognitive processes affect both purchase intention and satisfaction, offering a deeper understanding of ad interaction in video platforms.

2.3. Time Perception

Time is one of the fundamental dimensions of the objective world, yet each individual's perception of time varies. In the field of psychology, time perception refers to the perception of the continuity and sequentially of objective phenomena. It is related not only to the nature of the stimuli and the context but also to the content, emotions, motivations, and attitudes of the activity (Andersson et al., 2012; Baker & Cameron, 1996). If watching videos is considered the primary purpose of users on video platforms, then the appearance of advertisements may be seen as a waiting process. Previous studies have consistently recognized that differences in the perception of waiting time can have varying consequences. For instance, in the classic case of Houston Airport Complaint³, the differences in waiting times for baggage retrieval determined their satisfaction with the airport.

Previous literature has commonly classified perceived waiting time into objective waiting time and subjective waiting time. Objective waiting time is the actual waiting time and is not disturbed by external factors, whereas subjective waiting time is how individuals perceive, feel, and estimate the length of a time interval. Thus, perceived waiting time is usually adopted to reflect and measure subjective waiting time (Baker & Cameron, 1996; Hornik, 1984), and can be influenced by various variables (Hancock & Rausch, 2010). According to Antonides, Verhoef and van Aalst (2002), an exponential function⁴ describes the relationship between an individual's perceived waiting time and the actual waiting time, which elucidates the variability of perceived waiting time.

³ The Houston airport received a large number of complaints from passengers about the long waiting time in line for their luggage. The airport reduced the average waiting time for passengers to 8 minutes, which is lower than the standard of the same industry. However, passengers still felt it was too slow because they need to walk 1 minute off the plane and wait 7 minutes at the baggage carousel. Later, psychologist Larson suggested that passengers walk 6 minutes and wait 2 minutes. As a result, no one complains anymore.

⁴ $\ln \psi_i = \alpha_1 + \beta_1 \ln t_i + r_1 X_i + \varepsilon_{1i}$, Thereinto, ψ_i is subjective waiting time, α_1 is constant, β_1 is coefficient ($0 < \beta_1 < 1$), t_i is objective waiting time, r_1 is a vector quantity and has both positive and negative value, X_i is the value of the factors in influencing subjective waiting time, ε_{1i} system error.

3. Hypotheses Development

Based on information processing theory, this study focuses on the ad exhibition and attempts to investigate the impact of the ad exhibition on both the brand and platform. To fully understand the underlying mechanism, we run the research model shown in Figure 3, which allows us to examine the role of brand recall and perceived waiting time in enhancing purchase intention and satisfaction, respectively.

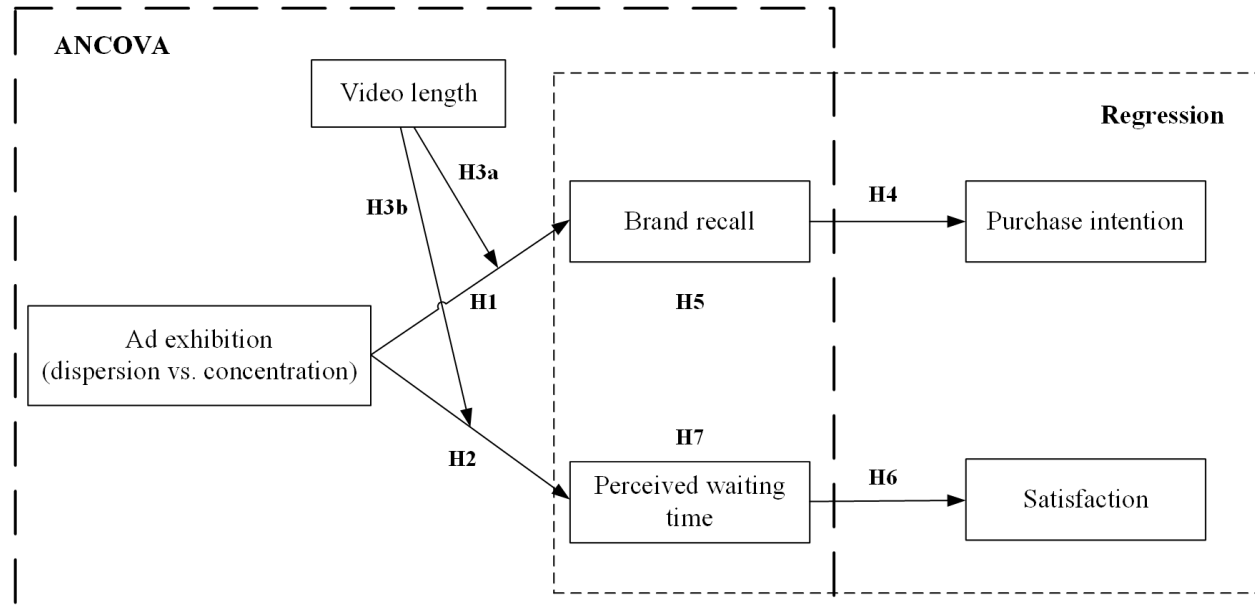


Figure 3. Research Model.

3.1. The Main Effect of Ad Exhibition

According to the information processing theory, users' ability to process and store information depends on how the information is presented and the cognitive load it imposes (McGuire, 1968). The inundation of advertising content not only contributes to a state of information overload but also exacerbates the difficulty for users to perform their tasks (Ha & McCann, 2008; Jacoby, 1984). When ads are concentrated in one block, users are required to process a large amount of information within a short time, potentially leading to cognitive load. This overload makes it difficult for users to effectively retain brand information due to the limitations of user information processing capacity (Puccinelli, Wilcox, & Grewal, 2015). In contrast, dispersed ads throughout a video reduce the cognitive load by allowing users to process information in smaller, more manageable segments. This facilitates better encoding and storage of brand information in memory, thus improving brand recall. As a result, we propose the following hypothesis:

H1: *The advertisements exhibited in dispersion outperform the concentration with respect to the brand recall.*

Moreover, the information processing theory also indicates that user's cognitive capacity is constrained, and how ads are presented may influence their perception of time. Intuitively, advertisements depart from users' main purpose of using video platforms, resulting in a temporal waiting for users to watch the video. Ad exhibition is closely intertwined with the distribution of digital attentional resources, thereby influencing the users' subjective perception of the length of time spent waiting (Buhusi & Meck, 2006). Concentrated ads, shown all at once, consume more cognitive resources, leading users to feel overwhelmed and increasing their perceived waiting time. This occurs because concentrated ads create a heavier cognitive load, making it difficult for users to focus on the primary content, thereby lengthening their subjective sense of waiting. Perceived waiting time is not only influenced by the reduction in attention caused by cognitive load but also by negative emotions. The high cognitive load required by concentrated ads can easily lead users to experience boredom (Tzafilkou, Perifanou, & Economides, 2021), placing them in an unpleasant, unstimulated, and low-arousal state (Bergstein, 2009). This state, induced by prolonged exposure to a monotonous advertising environment, can increase the pacemaker's speed and the accumulation of pulses in the accumulator, resulting in users perceiving the duration as longer (Droit-Volet & Meck, 2007). However, interspersing

ads in a video viewing process can give users a break and help them achieve the purpose of using the video platform more easily and softly.

Furthermore, neurological research shows that midbrain dopamine (DA) neurons in brain affect time perception (Cools, 2008; Noreika, Falter, & Rubia, 2013). In other words, DA affects how people feel about the passage of time over a given period of time in a variety of ways. A recent study by Soares, Atallah and Paton (2016) provides additional evidence that DA reflects and can directly control the judgment of time. By artificially altering the activity of DA in mice through optogenetic methods, it is found that transient activation of DA accelerates the estimation of time, while the inhibition of DA weakens it. The findings reveal the basic logic of the great difference in perceived waiting time. It suggests that when DA levels are low, individuals perceive time as passing more slowly, while higher DA levels accelerate time perception. Advertisements are a mandatory task that users must complete while watching videos. Similar to learning tasks, when engaging with complex new knowledge or skills, high task difficulty and extended duration can suppress dopamine release, leading to fatigue and a sense of frustration (Zhang, Yu, & Han, 2020). For instance, solving complex mathematical problems or studying a new language for an extended period involves sustained high-intensity cognitive effort, which reduces dopamine activation, causing feelings of boredom and stress. In contrast, dispersed ads employ a strategy of breaking information into smaller segments, thereby reducing the overall complexity of the task. Providing users with short breaks between each segment acts as a small reward, which can stimulate dopamine release, resulting in a sense of pleasure (Wise, 2004). Therefore, concentrated ads may inhibit DA activity, leading to the feeling of boredom, stress, or even a nagging sensation that one's life is slipping away. Users' perceived time spent watching the ad is thus increased. On the contrary, dispersed ads, by breaking up ad exposure, are more likely to stimulate DA, making the experience feel shorter and more pleasant. Therefore, we propose the following hypothesis:

H2: *The advertisements exhibited in dispersion outperform the concentration with respect to the perceived waiting time.*

3.2. The Moderating Effect of Video Length

Video length plays a critical moderating role in the effectiveness of ad exhibition, influencing how users process, recall, and respond to advertisements within a video (Yu & Gao, 2022). In longer videos, users have more opportunities for cognitive breaks, which is essential in managing cognitive load. When ads are dispersed throughout a lengthy video, each ad appears at intervals that allow users to rest and re-engage with the content, reducing the risk of cognitive overload. This spaced-out presentation helps users process and store ad information more effectively, ultimately enhancing brand recall. In contrast, concentrated ad in longer videos leads to a higher cognitive load, as users are exposed to multiple ads in one block, overwhelming their cognitive resources and impairing memory retention (Eriksen & Schultz, 1979). For shorter videos, the benefits of dispersed ads are reduced, as users are generally focused on finishing the content and have less need or opportunity for cognitive breaks, diminishing the effect of ad dispersion. Moreover, repetition inhibition further supports the effect of video length on brand recall in dispersed ad. Repetition inhibition occurs when continuous exposure to similar ad content leads to cognitive fatigue and reduced engagement with the material. In a longer video, dispersed ads are spaced apart, presenting each ad exposure as a "new" interaction rather than a repetitive one, thereby reducing cognitive fatigue and enhancing brand recall (Eriksen & Eriksen, 1979).

Furthermore, dopamine (DA) activation plays a role in time perception, and its effects are more pronounced during longer viewing sessions (Campbell & Pearson, 2021). In lengthy videos, dispersed ads may help maintain DA stimulation, reducing perceived waiting time and preventing cognitive fatigue. On the other hand, in shorter videos, the benefits of dispersing ads may diminish, as there is less opportunity for DA activation or cognitive recovery, potentially negating the advantage of dispersion (Goodrich, Schiller, & Galletta, 2015). We thus hypothesize and test the following:

H3a: *Video length will positively moderate the relationship between ad exhibition and brand recall, with the advertisements exhibited in dispersion leading to higher brand recall in longer videos compared to shorter videos.*

H3b: *Video length will positively moderate the relationship between ad exhibition and perceived waiting time, with the advertisements exhibited in dispersion leading to less perceived waiting time in longer videos compared to shorter videos.*

3.3. The Mediating Effect of Brand Recall

It is worth noting that brand recall is not limited to mere recognition of a product, but rather encompasses a more comprehensive understanding of its features, benefits, and overall value proposition. High brand recall reflects the effectiveness of a marketing campaign in communicating key product attributes. Accordingly, brand recall creates a huge association with the brand and product in memory. When users recall a brand, they form a mental image of the product and evaluate its value, which strengthens their association with the brand (Aaker, 2009). This enhanced association increases the likelihood of users becoming potential customers. Many previous studies have substantiated

the notion that endorsing and propagating brands via online media effectively fosters brand recognition, facilitates brand recall among users, and ultimately manifests in user acquisition (Chang & Liu, 2009; Chi, Yeh, & Yang, 2009; Dabbous & Barakat, 2020). Given that ad exhibition can enhance brand recall, we propose that:

H4: *Brand recall is positively related to purchase intention.*

H5: *Brand recall mediates the relationship between ad exhibition and purchase intention, such that dispersed ads will lead to higher purchase intention via improved brand recall.*

3.4. The Impact of Perceived Waiting Time

Previous studies have demonstrated that both objective and perceived waiting time affect individuals' decisions (Rajamma, Paswan, & Hossain, 2009) and overall satisfaction with the service (Taylor, 1994). However, satisfaction is more strongly influenced by users' perception of how long they feel they have waited, rather than the actual waiting time (Wittmann & Paulus, 2008). When users perceive service time as shorter than expected, their satisfaction increases (Kumar, Kalwani, & Dada, 1997).

In line with this, research on information systems often utilizes new technologies and process optimization to minimize users' perceptions of waiting time, as it maximizes user satisfaction and enhances their engagement (Djelassi, Diallo, & Zielke, 2018; Luo et al., 2004). Long waiting times can cause dissatisfaction, discontent, and negative evaluations of the service. In the context of video platforms, advertisements represent a form of "waiting" before users can access the desired content. Users who perceive shorter waiting times are likely to evaluate the platform more favorably, assuming it has fewer ads and thus increasing the likelihood of continued usage. Given that ad exhibition influences perceived waiting time, we hypothesize:

H6: *Perceived waiting time is negatively related to users' satisfaction.*

H7: *Perceived waiting time mediates the relationship between ad exhibition and user satisfaction, such that dispersed ads lead to higher satisfaction through shorter perceived waiting time.*

4. Experimental Stimuli and Measurement

We conducted two online experiments to test our model. Experiment 1 focused on examining the main effects and mediating effects of different ad exhibition, uncovering their impact on both brand recall and video platform sustainability. In Experiment 2, we introduced the moderating role of video length. This experiment served two purposes: first, to validate the results of Experiment 1 and provide robustness evidence, and second, to further explore the applicability of the effects of different ad exhibition. Before the main experiment, a pretest was conducted to select appropriate brands and video materials.

4.1. Participant and Brand Selection

To mitigate participants' bias toward the experimental materials during the formal experiment, we conduct a pretest to identify the video format, brand, advertising content, and duration of the advertisement. We define the sample as the U.S. population and select ads published by Southeast Asian brands for several reasons: (1) Amazon Mechanical Turk (MTurk)⁵ is dominated by the U.S. population and we can get an accurate sample; (2) ensure that the brands are unfamiliar to the participants, thus eliminating the bias in perceiving advertising time caused by repeated viewing of ads or brands; and (3) we can more easily find multiple brands with a lower level of familiarity⁶. To engage participants and encourage them to watch the entire video, we selected content they were relatively familiar with. On the one hand, China, as a well-known country in the East, is in line with the brands' geographical location. On the other hand, the U.S. population may become more interested in China and thus continue the experimental process. Specifically, we chose two promotional videos about China from YouTube for the experiment.

Furthermore, we identify several niche companies from Southeast Asian countries, such as Singapore, Vietnam, and others, for the advertised brands, as listed in Appendix B. It can ensure that the brands are unfamiliar to the participants, thus accurately measuring ad effectiveness and eliminating the bias in perceiving advertising time caused by repeated viewing of ads or brands. These brands are Julie's, Wonda, Vitagen, Maggi, and Mister potato, which are

⁵ We chose this platform for data collection for several reasons: (1) MTurk hosts a large and diverse participant pool. Compared to traditional student samples, MTurk workers tend to be older, have more relevant work experience, and report higher levels of computer and internet knowledge (Buhrmester, Kwang, & Gosling, 2011); (2) MTurk facilitates our experimental design, allowing us to control participants' video-viewing behavior; (3) MTurk enables rapid data collection, allowing us to quickly gather a substantial sample of U.S. participants; and (4) numerous top-tier journals have used MTurk, supporting its validity. Furthermore, to mitigate any concerns about MTurk's potential impact on result validity, we designed our survey and data collection in line with Aguinis, Villamor and Ramani (2021)'s 10 best-practice recommendations.

⁶ We have used several brands in Australia before and found that the participants' familiarity with the brands was significantly different in the different ad exhibition strategies, suggesting a poor result.

all food-related and have official accounts on YouTube. On YouTube, they post ads with multiple time lengths, such as 6s, 15s, 30s, 60s, etc., helping us to vary the duration of the ads in the video.

4.2. Procedure

We perform an online experiment on MTurk by publishing a task to invite participants to join in the experiment. In the beginning, participants were told that they would be viewing several snack brands. Then, they are shown each brand logo and asked how familiar they are with each brand by using Likert five-level scale ranging from 1- “Not familiar at all” to 5 - “Extremely familiar”. When a participant’s response shows a high level of familiarity with a brand (score greater than or equal to 3), we would ask them to give a product of that brand to ensure authenticity. If the question fails to answer or the product doesn't belong to the brand, the answer will be eliminated. A total of 62 questionnaires are received, and 56 valid questionnaires are obtained by excluding 6 invalid responses.

4.3. Results

We calculate the participants’ familiarity with each brand by the metrics of mean, medium, and standard deviation. Table 2 shows that the mean value of each brand is close to 1 and all medium value is 1, indicating that users are generally less familiar with each brand. In addition, we also compare the mean of user familiarity between these brands. The results also confirm that users are not familiar with all five brands ($F_{4,55} = 0.91, p = 0.456$).

Table 2. Pre-test Results for Brand Familiarity (N = 56).

Brand names	Julie’s	Wonda	Vitagen	Maggi	Mister potato
Mean	1.04	1.09	1.16	1.38	1.09
Medium	1.00	1.00	1.00	1.00	1.00
St. Dev	0.27	0.29	0.46	0.91	0.45

4.4. Experimental stimuli

We use the brands and their ads in the pretest as the content of our experiment. In this study, the experimental stimuli are around the exhibition of ads and the overall duration of a video. Ad exhibition is categorized into two strategies: dispersion and concentration. In the dispersion condition, five ads from different brands are evenly distributed throughout the video, with equal intervals of video content between each ad. Users gradually encounter these ads as they watch the video. In the concentration condition, the five ads from different brands are played sequentially at the beginning of the video. The video content starts only after all ads have been shown. For video length, the official YouTube filtering criterion for video length—under 4 minutes, 4–20 minutes for an episode of 20 minutes or more—is the basic basis for the selection of videos of various durations. Also, it is suggested that the ideal length of a YouTube video is 5-15 minutes (Sahni, 2023). However, in the online experiment, excessive advertising time may lead to an increase in time spent on finishing the experiment, thus causing the participants to leave the experiment and making it difficult to guarantee the effectiveness of the experiment. In light of the foregoing, we set the short video length to around 4 minutes, and long to approximately 8 minutes.

4.5. Measurement

All variables in this study were measured using scales that have been empirically validated in previous literature. Brand recall was measured using Belanche, Flavián and Pérez-Rueda (2020)’s method, where participants were presented with several brand names and asked to identify the brands featured in the video. We recorded the number of correct responses, with the final score representing their brand recall. Perceived wait time was measured by asking participants to estimate the total time spent watching all the ads in the video (Antonides, Verhoef, & van Aalst, 2002; Pruyn & Smidts, 1998). Purchase intention was measured using the scale of Gao, Jiang and Guo (2023), which includes three items: “I will buy the products of the brands that appeared in the video”; “I intend to purchase the products of the brands featured in the video”; “I will consider the brands shown in the video as my first choice when shopping.” The measurement of satisfaction was adapted from Bhattacharjee (2001), where participants were asked to rate their overall experience with the video platform across four dimensions: “very dissatisfied / very satisfied”; “very displeased / very pleased”; “very frustrated / very contented”; “Absolutely terrible / Absolutely delighted”. All items were measured using a 7-point Likert scale, ranging from “1” (Strongly Disagree) to “7” (Strongly Agree).

5. Study 1

5.1. Experimental Design and Procedure

In study 1, we adopt a 2-level (ad exhibition: dispersion vs. concentration) between-subject design. At the beginning of the experiment, we told the participants about a video platform called McMix that would be launched soon and gave them the background:

“McMix is a video platform that offers users a wide variety of genres and themes. Similar to other platforms, McMix boosts revenue by introducing advertising commercials. However, the addition of ads may give users a bad

impression of the platform. To provide a better user experience, we will solicit your feedback by presenting a real video on McMix.”

Participants are then instructed that they would like to improve the platform by collecting feedback on their viewing of the videos before McMix is released. At the same time, we told the participants that the platform had created an official channel on YouTube and posted a user-generated video on McMix, considering that the platform was still in beta testing. Since we want the participants to be fully immersed in the video and watch the entire video, we give them the content and time length of the video before watching it and ask them if they are interested in it. Only those who are interested can be able to continue the experiment.

After that, participants will be randomly assigned to one of two conditions to watch a YouTube video that includes the platform’s logo (see Appendix C). The video content is a promotional video of a city of China from YouTube, with a duration of approximately 6 minutes to ensure generalization in video length. To ensure that the participants watch the entire video, we perform several operations in Qualtrics. First, when embedding the YouTube video, participants are only able to click on the video to play and pause it, but not to drag the video progress and observe the time bar. Second, the maximum page time is set based on the total video length and ads. The response that exceeds this time would be ended to avoid the situation where the participants leave and let the video play. Finally, we add a 5s play time for the McMix logo at the end of the video and let them choose which of the four logos appears in the video after viewing.

Participants who watch the video in its entirety are asked to choose the brands featured in the video from a list of 12 options. We also ask participants to estimate the duration of all the ads in the video and to respond in seconds. Our question for assessing the perceived wait time is “Please recall the video and write down how long were you exposed to the ads in the video (in seconds).” They are then required to give their answer on purchase intention and satisfaction. Afterward, to verify whether the manipulation of the ad exhibition was successful, participants are asked to determine whether the ads in the video they watched are dispersed throughout the content or concentrated at the beginning using a 7-point Likert scale, ranging from “1” (dispersed throughout the content) to “7” (concentrated at the beginning). Similar to the pretest, participants are asked to evaluate their familiarity with the brands featured in the video. Finally, we collected participants’ demographic information, the purpose of YouTube viewing, and the frequency of watching.

5.2. Sample

The online experiment was conducted on Mturk. We used a sample from the United States to minimize the participants’ familiarity with the brands and their products as much as possible. Workers on Mturk were selected as participants. Once the task we publish is accepted, the participants start the experiment. Before collecting data, we used G*power software to determine the sample size. Setting the significance level (α) to 0.05, effect size to 0.5, and power to 0.95, a two-tailed t-test indicates that the total required sample size is 210. As a result, 300 Mturk workers participated in this study. After excluding those with incomplete or inattentive responses, 272 valid questionnaires remained for analysis. Among them, 52.6% are male. Over 50% of participants are above 36 years old, with a broadly distribute range of annual incomes. The majority report watching videos primarily for leisure and entertainment and frequently access YouTube for this purpose, as shown in Table 3.

Table 3. Descriptive Statistics of Study 1(N = 272).

Variables		Frequency (N)	Percent (%)
Gender	Male	143	52.6
	Female	127	46.7
	Non-binary/third gender	1	.4
	Other	1	.4
Age	Under 18	0	0
	19-25	11	4.0
	26-35	68	25.0
	36-45	78	28.7
	Above 46	115	42.3
Income	Under \$20,000	40	14.7
	\$20,000 to \$ 39,999	47	17.3
	\$40,000 to \$ 59,999	62	22.8
	\$60,000 to \$ 79,999	35	12.9

	\$80,000 to \$ 99,999	33	12.1
	\$100,000+	55	20.2
Watching purpose	Leisure	219	80.5
	Working	36	13.2
	Other	17	6.3
Watching frequency	Never	8	2.9
	Rarely	23	8.5
	Sometimes	75	27.6
	Often	123	45.2
	Always	43	15.8

Additionally, we find that participants are generally unfamiliar with these brands ($\text{Mean}_{\text{Julie's}} = 0.49$, $\text{SD}_{\text{Julie's}} = 1.14$; $\text{Mean}_{\text{Wonda}} = 0.58$, $\text{SD}_{\text{Wonda}} = 1.30$; $\text{Mean}_{\text{Vitagen}} = 0.76$, $\text{SD}_{\text{Vitagen}} = 1.27$; $\text{Mean}_{\text{Maggi}} = 0.97$, $\text{SD}_{\text{Maggi}} = 1.49$; $\text{Mean}_{\text{Mister potato}} = 0.67$, $\text{SD}_{\text{Mister potato}} = 1.30$). This confirms the findings from our pretest. Finally, we assess the reliability and validity of the purchase intention and satisfaction. For purchase intention, the composite reliability (CR) is 0.97, with a Cronbach's alpha of 0.96, and factor loadings ranging from 0.95 to 0.97, all exceeding the 0.7 threshold, indicating good reliability. For satisfaction, the composite reliability is 0.98, Cronbach's alpha is 0.97, and factor loadings ranged from 0.95 to 0.97, meeting acceptable standards. The correlation between purchase intention and satisfaction is 0.63, which is less than the square root of the average variance extracted (AVE), demonstrating discriminant validity.

5.3. Results

Manipulation Check. We first conducted a manipulation check on the experimental stimuli. We set 1 and 7 to represent dispersed ads and concentrated ads, respectively. The closer a participant's selection is to 1, the more they perceive the advertisement as being dispersed throughout the video, and vice versa, the more they perceive it as concentrated. The results show that participants in the dispersion group perceived the ads as more spread throughout the video ($\text{Mean} = 1.98$, $\text{SD} = 1.89$), while those in the concentration group rated the ads as more concentrated at the beginning of the video ($\text{Mean} = 5.95$, $\text{SD} = 1.83$). The difference between the two groups is significant ($p < 0.001$), indicating that the ad exhibition manipulation is successful.

Main effect. An independent samples t-test is performed to validate our hypotheses, using brand familiarity, gender, age, income, watching purpose, and watching frequency as control variables. There are significant differences between the dispersion and concentration conditions in both brand recall and perceived waiting time. Compared to the concentration, the dispersion results in higher brand recall ($M_{\text{concentration}} = 2.23$, $\text{SD} = 1.49$; $M_{\text{dispersion}} = 2.63$, $\text{SD} = 1.33$; $p = 0.22$) and a shorter perceived ad-waiting time ($M_{\text{concentration}} = 53.45$, $\text{SD} = 70.69$; $M_{\text{dispersion}} = 27.20$, $\text{SD} = 48.54$; $p < 0.001$), supporting H1 and H2.

Mediating effect. We use Hayes PROCESS Model 4 to explore the mediating effect of brand recall and perceived waiting time. Specifically, we consider the ad exhibition as the independent variable and code -1 for concentration ad exhibition and 1 for dispersion ad exhibition and include demographic characteristics as control variables. The result shows that brand recall is positively associated with purchase intention ($\beta = 0.20$, $p = 0.007$) and mediates the relationship between ad exhibition and purchase intention (Effect = 0.07, Boot SE = 0.05, LLCI = 0.01, ULCI = 0.20). Thus, H4 and H5 are supported. In addition, it is also found that perceived waiting time has a negative impact on satisfaction ($\beta = -0.01$, $p = 0.003$), supporting H6. Perceived waiting time also mediates the relationship between ad exhibition and satisfaction (Effect = 0.13, Boot SE = 0.08, LLCI = 0.01, ULCI = 0.30).

6. Study 2

6.1. Experimental Design and Procedure

Study 2 uses a 2 (ad exhibition: dispersion vs. concentration) * 2 (video length: short vs. long) between-subject design. We define the sample as the U.S. population and use the video, brands, and their ads in the pre-test as the content of our experiment. The procedure for Study 2 followed the same structure as Study 1, with one key difference: participants were not only assigned to different ad exhibition, but the length of the video they watched was also randomly varied. Similarly, Study 2 used a promotional video of China to maintain participants' interest. After watching the video, participants were asked to recall the brands featured in the ads, report their perceived total ad viewing time, indicate their purchase intention, satisfaction, assess their familiarity with the brands, and answer other control variable-related questions. To check the manipulation of ad exhibition, participants were asked, as in Study 1,

to determine whether the ads were dispersed throughout the video or concentrated at the beginning. The test for video length was conducted by asking participants whether they perceived the video as relatively long or short.

We set the significance level to 0.05, effect size to 0.25, and power to 0.95, a four-group F-test indicates that the total required sample size is 280. Therefore, 350 questionnaires were distributed on Mutrak, and after excluding inattentive and incomplete responses, 322 valid responses remained. The composite reliability of satisfaction in these samples is 0.950, with a Cronbach's alpha of 0.93, factor loadings ranging from 0.87 to 0.92, and an average variance extracted (AVE) of 0.825. In addition, the correlation between perceived waiting time and satisfaction is -0.277, which is below the square root of the AVE value of 0.908, indicating adequate discriminant validity. Table 4 provides demographic information, indicating that the majority of participants are male, with approximately one-third falling within the 26-35 age range. Half of the participants report an annual income exceeding \$60,000. Most of them frequently watch videos primarily for entertainment purposes.

Table 4. Descriptive Statistics of Study 2 (N = 322).

Variables		Frequency (N)	Percent (%)
Gender	Male	238	73.5
	Female	82	25.3
	Non-binary/third gender	2	0.6
	Other	0	0
Age	Under 18	0	0
	19-25	87	27.0
	26-35	108	33.3
	36-45	69	21.4
	Above 46	58	17.9
Income	Under \$20,000	12	3.7
	\$20,000 to \$ 39,999	47	14.5
	\$40,000 to \$ 59,999	69	21.4
	\$60,000 to \$ 79,999	97	30.1
	\$80,000 to \$ 99,999	65	20.1
	\$100,000+	32	9.9
Watching purpose	Leisure	201	62.4
	Working	112	34.8
	Other	9	2.8
Watching frequency	Never	0	0
	Rarely	16	5.0
	Sometimes	130	40.4
	Often	96	29.8
	Always	80	24.8

6.2. Results

Manipulation Check. We use independent samples t-test to test our experimental stimuli. The results show that participants in the dispersion condition are more inclined to perceive the advertisements as dispersed within the video (Mean = 4.73, SD = 2.25). In contrast, those in the concentration condition perceive the advertisements as primarily located at the video's onset (Mean = 6.23, SD = 0.96). The difference in dispersion and concentration is significant ($F_{1, 321} = 136.55, p < 0.001$). Also, there are significant differences between the long and the short video conditions ($F_{1, 321} = 0.87, p = 0.042$), with participants in each condition correctly perceiving the corresponding video length ($M_{\text{long}} = 5.72, SD = 1.34; M_{\text{short}} = 5.41, SD = 1.42$).

Brand recall. A two-way ANCOVA is performed to validate our hypotheses, with brand familiarity, gender, age, income, watching purpose, and watching frequency serving as control variables. The results suggest a significant main effect of ad exhibition on brand recall ($F(3,319) = 15.13, p < 0.001$). Displaying ads to users in a video in a dispersed manner enhances the user's memory of the ad brands. In addition, a significant interaction effect between ad exhibition

and video length on brand recall is revealed ($F(3, 319) = 21.92, p < 0.001$). The results of the simple effect in Figure 4 indicate that when video length is short, dispersing ads into video or not has no significant impact on brand recall compared with concentrated ads ($M_{\text{concentration}} = 3.13, SD = 0.16; M_{\text{dispersion}} = 3.01, SD = 0.14; p = 0.579$); However, dispersive ads increase more brand recall than concentrated ads with a long video length ($M_{\text{concentration}} = 2.35, SD = 0.16; M_{\text{dispersion}} = 3.69, SD = 0.16; p < 0.001$). H1 and H3a are supported.

Perceived waiting time. We take the logarithm of the perceived waiting time to let the data meet the assumptions as much as possible and let the variance be constant. The results show that the main effects of ad exhibition ($F(3, 319) = 24.50, p < 0.001$) and video length ($F(3, 319) = 12.21, p < 0.001$) are significant, which suggests that the dispersive ads can decrease the user's perception of the overall duration of the ad. There is also a significant interaction effect ($F(1, 319) = 7.26, p = 0.007$; see Figure 5). It indicates that dispersive ads decrease perceived waiting time in long video length ($M_{\text{concentration}} = 4.28, SD = 0.15; M_{\text{dispersion}} = 3.17, SD = 0.15; p < 0.001$), while no significant difference between two ad exhibitions with a short video length ($M_{\text{concentration}} = 3.37, SD = 0.15; M_{\text{dispersion}} = 3.04, SD = 0.13; p = 0.101$). H2 and H3b are supported.

Moderated Mediating effect. We run PROCESS Model 7 to examine the remaining hypotheses (Hayes, 2013). We find that brand recall significantly influences purchase intention ($\beta = 0.19, p < 0.001$). Further, a decrease in perceived waiting time would significantly increase satisfaction ($\beta = -0.24, p < 0.001$). Considering the possibility of the impact of ad exhibition on user purchase intention through brand recall, we conduct a moderated mediation test using the bias-corrected accelerated bootstrap method of Process. By running Model 7, we assess the indirect path between ad exhibition and purchase intention with different levels of video length. Table 5 presents the results that only when the video length is long enough does the brand recall mediate the impact of ad exhibition on purchase intent because 95% confidence intervals (CI) from 5000 bootstrap samples are statistically greater than 0. Additionally, the index of moderated mediation does not contain 0, supporting the above effect. The same method is used to determine whether users are eager to keep using the platform. The results in Table 5 suggest that the impact of ad exhibition on satisfaction is mediated by perceived waiting time with long video length. Moreover, the index of moderated mediation is statistically greater than 0, demonstrating the moderated mediation effect. These results support H4-H7.

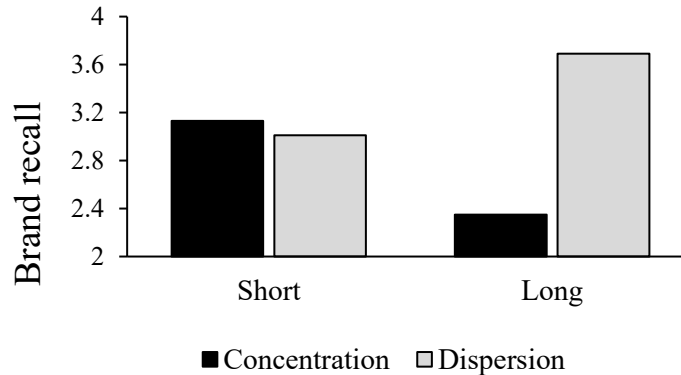


Figure 4. The Impact of Ad Exhibition and Video Length on Brand Recall

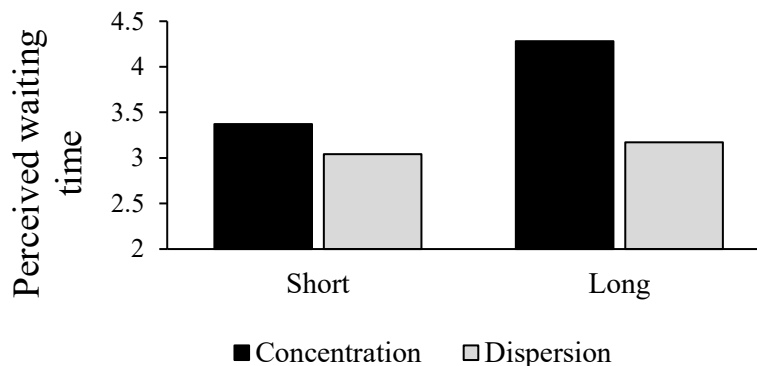


Figure 5. The Impact of Ad Exhibition and Video Length on Perceived Waiting Time

Table 5. Indirect Effect of Brand Recall and Perceived Waiting Time with Video Length

Indirect path	Video length	Effect	Boot SE	Bootstrap 90% CI	
				LLCI	ULCI
Ad exhibition -> brand recall -> purchase intention	Short	-0.02	0.09	-0.11	0.06
	Long	0.25	0.08	0.11	0.41
	Index of moderated mediation	0.27	0.09	0.11	0.47
Ad exhibition -> perceived waiting time -> satisfaction	Short	0.08	0.05	-0.01	0.19
	Long	0.26	0.09	0.11	0.46
	Index of moderated mediation	0.18	0.09	0.04	0.39

LLCI: Lower 95% level confidence interval, ULCI: Upper level 95% confidence interval; Number of bootstraps = 5000, Confidence intervals = 0.95

7. Robustness check

Through two online scenario experiments, the role of ad exhibition in platform satisfaction and brand product purchase is clarified. However, these experiments may not fully capture the complexity of real-world advertisement encounters on video platforms. Participants might find it challenging to fully imagine and engage with the presented scenarios, potentially affecting ecological validity. To better reflect users' real behaviors when faced with different ad exhibitions, we followed the approach of Zhang et al. (2023) by utilizing a student sample to conduct a controlled lab experiment that closely simulate real-world scenarios, thereby demonstrating the robustness of the aforementioned results. Given that the two experiments effectively validated the mechanisms of brand recall and perceived waiting time, this experiment primarily focused on capturing user actions regarding satisfaction and product purchase.

7.1. Procedure

The experimental stimuli are consistent with Study 2, including two factors: ad exhibition (dispersion vs. concentration) and video length (short vs. long). We collaborate with the Psychology Department of a university in central China, which is recruiting participants for a AI psychological counseling experiment (hereafter referred to as Experiment R). During the recruitment process, potential participants are informed that they are signing up for Experiment R. The recruitment posts provided a brief description of Experiment R, stating that the experiment would not exceed 60 minutes and that participants would receive a compensation of 30 RMB. The recruitment materials did not disclose that participants would be exposed to our experimental stimuli. A total of 124 undergraduate and graduate students are recruited as subjects for the on-campus experiment.

Our experiment aims to simulate a realistic service experience, consisting of three stages: customers entering the platform (Stage 1), watching video while waiting for service (Stage 2), and finally receiving the service (Stage 3). Specifically, Stage 1 lasted approximately 15 minutes. Upon arrival at the computer lab, participants are randomly assigned to computer terminals. Researchers then provided around 15 minutes of instructions, explaining the duration and process of Experiment R, and informing participants that before starting Experiment R, they need to create a dedicated account and configure the AI equipment for localized operation. During this setup, a video would be provided to pass the time.

After the instructions, the experiment moves to Stage 2, lasting 10 minutes. Participants wait at their computers, watching one of the four different videos presented in Study 2. Unlike Study 2, a “like” button appeared at the end of the video. Clicking the button indicates the participant's satisfaction with the viewing experience. Additionally, product links are provided, with the brand's initial letter displayed as an image to cue brand recall. Participants could freely click on the product links, with each click counted as 1, representing the number of products they intend to purchase. After the waiting period, participants proceed to Experiment R (the procedure of which, according to Zhang et al. (2023) is unrelated to this study and thus omitted). Upon completing Experiment R, participants are paid in cash and quietly left the room. In addition, participants' age and gender are recorded.

7.2. Results

A two-way ANCOVA is performed with age and gender serving as control variables. For the intensity of purchase, the results indicate that the main effect of ad exhibition is significant ($F(3,121) = 4.66, p = 0.03$), and the main effect of video length is marginally significant ($F(3,121) = 3.61, p = 0.06$). Furthermore, the interaction effect between the two variables is significant ($F(1, 121) = 21.00, p < 0.001$). The results of the simple effect indicate that when video length is short, dispersing ads into video has no significant impact on purchase intention compared with concentrated ads ($M_{\text{concentration}} = 2.94, SD = 1.59; M_{\text{dispersion}} = 2.32, SD = 1.52; p = 0.15$); However, dispersive ads increase more purchase intention than concentrated ads with a long video length ($M_{\text{concentration}} = 2.48, SD = 1.65; M_{\text{dispersion}} = 4.09, SD = 1.24; p < 0.001$).

For the video likes. The results show that the main effects of ad exhibition ($F(1, 121) = 4.46, p = 0.04$) and video length ($F(1, 121) = 3.73, p = 0.05$) are significant. Here is also a significant interaction effect ($F(1, 121) = 12.50, p < .001$). It indicates that dispersive ads increase user satisfaction in long video length ($M_{\text{concentration}} = 0.48, SD = 0.51; M_{\text{dispersion}} = 0.91, SD = 0.29; p < 0.001$), while no significant difference between two ad exhibitions with a short video length ($M_{\text{concentration}} = 0.65, SD = 0.49; M_{\text{dispersion}} = 0.57, SD = 0.50; p = 0.28$).

8. Discussion

Advertising is a common way to monetize video platforms. The evolution of time has brought along a continuous adaptation of ad exhibition. However, existing literature rarely focuses on this type of user-ad interaction, leaving the effects of ad exhibition largely unknown. Addressing the practical application differences between dispersed and concentrated ad exhibition strategies, this study builds a theoretical model based on information processing theory to explore their roles in promoting brand promotion and platform sustainability. Through two online scenario-based experiments and a lab experiment, our findings provide evidence for an effective ad exhibition strategy.

Specifically, our study reveals that different ad exhibition strategies significantly influence users' perceptions of both brands and platforms. On the one hand, compared to concentrated ads before the video content, dispersed ads throughout the video enhance brand recall. This effect occurs because dispersion allows for information processing over longer intervals within the video, with these breaks helping to redistribute users' attention and cognitive resources, thereby reducing the cognitive load associated with a single ad display. With a smaller amount of information to process at once, users can more easily receive and remember brand information from the ads, enhancing brand recall. In contrast, concentration delivers a large volume of information within a short period, which may lead to cognitive overload. When the information load exceeds users' processing capacity, they find it more difficult to effectively encode and store this information in memory. Additionally, the results demonstrate the mediating effect of brand recall. Specifically, dispersed display advertising enhances users' brand recall, thereby indirectly increasing purchase intention. This finding indicates that brand recall is not merely a cognitive response to advertising content but serves as a crucial link between ad exposure and consumer purchasing behavior. Dispersed ads effectively reduce users' cognitive load, enabling them to process and retain brand information more thoroughly. This cognitive advantage facilitates easier retrieval of relevant brands when users are faced with purchasing decisions, which subsequently increases their inclination to purchase the brand's products. In contrast, concentrated ads may lead to information overload, potentially limiting the storage and retrieval of brand information in users' memory, thereby diminishing its impact on purchase intention.

On the other hand, compared to concentration, dispersion reduces users' perception of ad duration. With a lower cognitive load each time they view an ad, users can more easily process the information, allowing them to stay more focused on the video itself. This diminishes the intrusive feeling of the ads, making the ad duration shorter. The alternation of ads and video integrates ads into the viewing experience, so users no longer feel they are "waiting" but instead continuing the task. This integration of ads with video content reduces users' focus on time, making the ad duration seem shorter. Furthermore, this perception can shape attitudes toward the platform, confirming the mediating role of perceived wait time. Specifically, dispersed ads enhance user satisfaction with the platform by reducing perceived waiting time. This finding underscores the critical role of perceived waiting time in shaping user experience and satisfaction. Concentrated ads, which is presented at the beginning of videos, increases task difficulty, leading to a gradual decline in user attention and the potential for negative feelings such as boredom, ultimately resulting in unfavorable evaluations of the platform. Conversely, dispersed ads alleviate cognitive load, facilitating easier acceptance and processing of advertising information. Users expend fewer cognitive resources on viewing ads, and the intervals between ads may serve as breaks in video consumption, thereby activating the DA mechanism to diminish time perception. This reduction in perceived waiting time allows users to focus more intently on video content, mitigating aversion to advertisements and enhancing the overall viewing experience and satisfaction.

Furthermore, the findings reveal that the above effects occur primarily with longer videos. In shorter videos, users have limited time to exhaust cognitive resources or truly experience the intervals between ads and video content, making the cognitive rest effect of dispersed ads less effective. Users likely focus more on finishing the video quickly, paying less attention to ad exhibition, thus diminishing the impact of dispersed ads. In contrast, with longer videos, users have more time and cognitive resources to process and recover their focus. Dispersed ads presented with longer intervals allow users cognitive rest periods as they watch the video, gradually processing each ad and avoiding cognitive overload. This interval-based cognitive rest effect is especially pronounced in longer videos, as users have enough time to recover their focus and re-engage with ad content. Additionally, in shorter videos, dopamine level changes are insufficient to create significant differences in time perception and enjoyment since the video duration itself is limited, leaving users with less time to experience substantial dopamine fluctuations.

8.1. Implications

Our findings have theoretical and practical implications linked to our hypotheses. First, our study introduces a novel interactive design approach within the domain of online advertising on video platforms, which has been underexplored in prior research. While existing literature has outlined several features of platform interactivity, such as image motion (Lee, Chen, & Ilie, 2012), relatively little attention has been directed towards the interactive design of advertisements. A few studies have identified the skippable feature of ads, suggesting that allowing users to skip ads not only enhances brand perception (Belanche, Flavián, & Pérez-Rueda, 2020) but also increases user engagement with the platform (Banerjee & Pal, 2022). By addressing this gap, this study contributes to advertising theory by establishing a new framework for understanding how ad exhibition impacts user perceptions and memory retention. Our study focuses specifically on the interactive design features of advertisements, demonstrating the role of ad exhibition and analyzing in detail how ads should be dispersed in video platforms. The findings may be a starting point for the streaming of ad exhibition, which provides new directions and ideas for the design of ad features.

This study makes theoretical contributions by applying and extending the information processing theory. Concentrated ads create a high cognitive load due to their continuous nature, potentially leading to cognitive overload and diminished memory retention. In contrast, dispersed ads allow for cognitive “breaks,” enabling users to process information in smaller segments and enhancing memory encoding. This nuanced understanding of how ad exhibition affects cognitive load and brand recall extends cognitive load theory by introducing ad strategies as a significant determinant of cognitive processing in digital media environments. It also enriches information processing theory by showing how ad exhibition can improve or hinder user engagement with and retention of ad content, providing a refined view of ad effectiveness. In addition, this study also contributes to the literature on time perception and emotional responses to digital ads. The explored mechanism of DA and cognitive load deepens the understanding of how the presentation of advertisement impacts subjective time perception in video platforms, linking ad exhibition directly to neurological processes associated with DA activation.

Third, this study contributes to the literature on advertising by exploring the underlying mechanism of brand recall, perceived waiting time, and satisfaction. We have successfully confirmed the mediating function of brand recall in light of novel situational and advertising design approaches, thereby contributing to the advancement of advertising research. We also find a mediating role of perceived waiting time and satisfaction and identify the conditional impact of adding video length. Our study introduces time perception into advertising research, greatly enriching and filling the gap. The last theoretical implication is associated with the moderating effect of video length. By demonstrating that the benefits of dispersed ads are more pronounced in longer videos, this research establishes video length as a contextual factor that shapes how users perceive and interact with ads. The interaction between video length and ad exhibition provides a more nuanced framework for understanding ad effectiveness in different video contexts, expanding advertising theory to account for the temporal dimension of digital media consumption.

Our study also offers valuable insights for practitioners. Video platforms currently lack a unified approach for ad exhibition. Platforms like YouTube typically distribute ads throughout the viewing process, a strategy similar to traditional television media, while other major platforms, such as Tencent and Netflix, tend to concentrate ads at the beginning of videos. Amidst this variability, our findings provide a foundation for understanding the practical effectiveness of both strategies. Overall, distributing ads within videos can effectively enhance brand recall and reduce the perceived waiting time for ads. In practice, when users encounter ads unrelated to their primary viewing tasks, they often attempt to skip these ads by diverting attention, using technology to bypass them, and other means. However, employing a dispersed ad strategy can help capture user attention on the ad itself without imposing excessive cognitive load. This approach can also enhance their mood through DA activation. Additionally, platform operators are advised to take video length into account when setting ad exhibition strategies. For short videos, although no significant differences emerged between the two strategies, concentrated ads may offer a slight advantage as they reduce interruptions and align with users’ preference for quick-viewing. However, for long videos, a dispersion strategy is optimal. Ad exhibition tailored to video length not only help practitioners increase viewers’ likelihood to engage with ads and consider purchases but also improve user retention, supporting the platform’s sustainable growth.

8.2. Limitations and Future Research

We also acknowledge some limitations that provide ample opportunities for future research. Our study is primarily designed to examine the role of ad exhibition through an experimental approach, which fixes the number of ad dispersion. Future research is able to quantify the number of ad dispersion or the time intervals of ads, use modeling to find tradeoffs that satisfy users’ continuous intention and deeply analyze how ad exhibition should be designed. Alternatively, field experiments can be conducted to simulate more realistic scenarios and complex advertisement exhibition strategies. The second interesting limitation that needs further study in the future is the multiple revenue channels. This study mainly considers advertising as a revenue channel; however, mainstream video platforms usually also incorporate paid membership to skip ads. Although dispersive ads interrupt users many times to bring negative

emotions, they may be more driven to open membership to get rid of advertising. Future research starts from two revenue channels and explores the differences between advertising revenue and membership revenue under different ad exhibition to find an optimal equilibrium. Third, in designing the experiment, we place the ad exhibition at the beginning of the video, taking into account the operational realities of television and various online video platforms, thus employing a universally applicable approach. However, based on the definition of ad exhibition, ads could also be placed in the middle or at the end of the video. Previous research suggests that placing ads in the middle of a video may be most effective due to the “rise-peak-decline” trend of user attention during video viewing (Dardis et al., 2016). This pattern could potentially influence the effect of ad exhibition. Beyond ad position, future research could further explore the impact of other potential moderating variables, such as the consistency between the ad and video content (Li & Lo, 2015), as well as the perceived value of the ads, etc. Fourth, our study primarily focuses on the YouTube platform, so we selected a U.S. sample and Asian brands, which may limit the generalizability of our findings. Future research could consider using U.S. or European brands in an Asian context to replicate our study, thereby enhancing its robustness. The last limitation pertains to the adverse impacts of ad exhibition. Existing research has indicated that exposing users to multiple viewings of advertisements can generate a feeling of intrusiveness (Li, Edwards, & Lee, 2002). Users with dispersion of ads may be annoyed with the platform and driving them away for repeated interruption. However, due to the limitations of the scope of this study, future research could explore this aspect more comprehensively.

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APPENDIXES

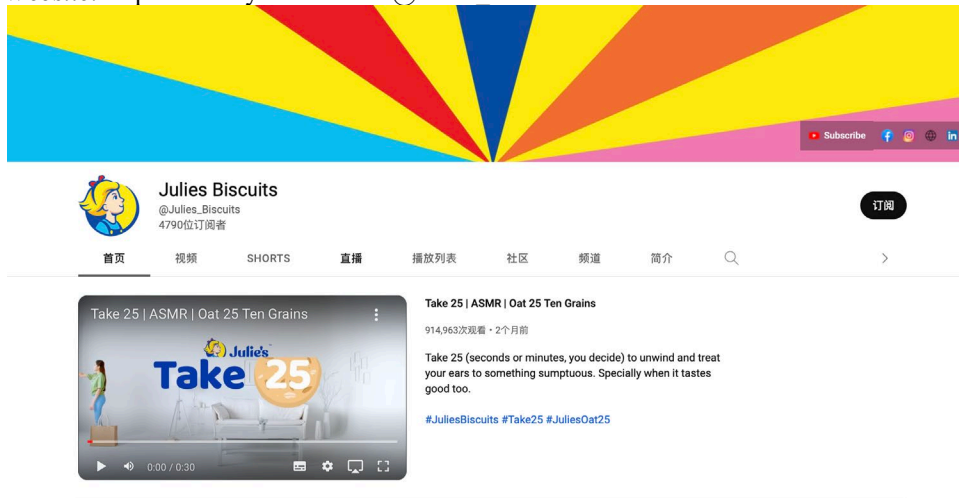
Appendix A. Platform Practices of Ad Exhibition

Media	Dominant ad exhibition strategies	Type	Country
Television	Dispersion	TV station	No limited
YouTube	Dispersion	Video platform	USA
BiliBili	Dispersion	Video platform	China
Facebook Watch	Dispersion	Video platform	USA
Hotstar	Dispersion	Video platform	India
GloboPlay	Dispersion	Video platform	Brazil
Netflix	Concentration	Video platform	USA
Tencent Video	Concentration	Video platform	China
Youku	Concentration	Video platform	China
Crave	Concentration	Video platform	Canada
iQiyi	Concentration	Video platform	China
TVNZ	Concentration	Video platform	New Zealand

Appendix B. Brands' Account on YouTube and Selected Ads

(1) Julie's

Website: https://www.youtube.com/@Julies_Biscuits



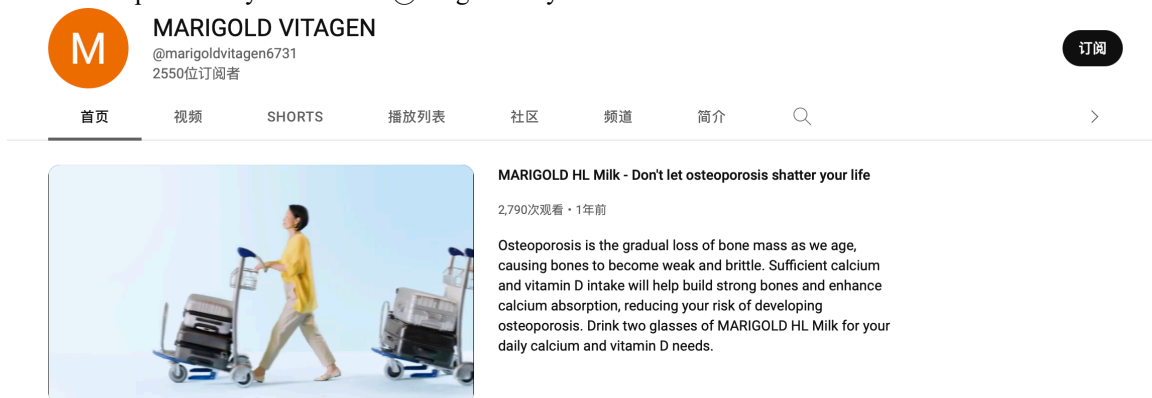
(2) Wonda

Website: <https://www.youtube.com/@wondacoffeemalaysia2544>



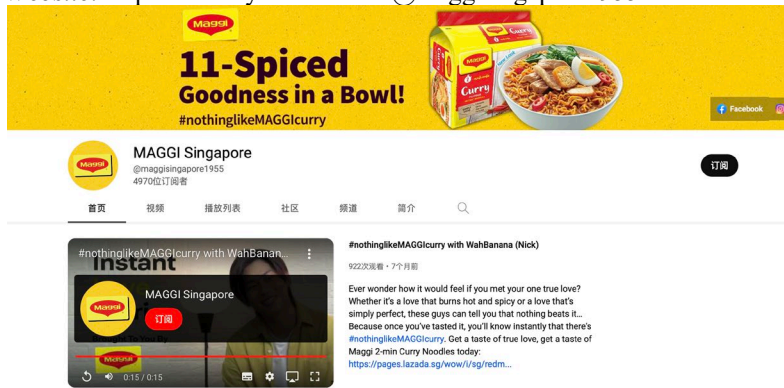
(3) Vitagen

Website: <https://www.youtube.com/@vitagenmalaysia6149>



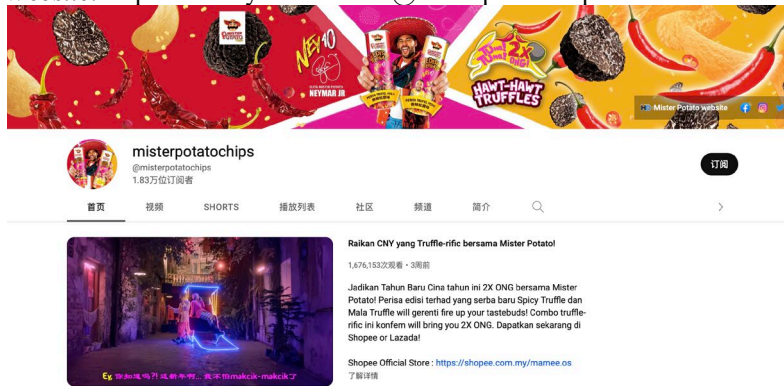
(4) Maggi

Website: <https://www.youtube.com/@maggisingapore1955>



(5) Mister Potato

Website: <https://www.youtube.com/@misterpotatochips>



Appendix C. Video and Logo of McMix

Table C1. The Subject and URL of the Video Watched by Each User in Study 1

Group	Subject and URL of the video		
Concentration	Subject: Welcome to Beijing!	Dispersion,	Subject: Welcome to Beijing~
	Video URL: https://youtu.be/E7Nmndi-ROKk		Video URL: https://youtu.be/ug1T8UIUX4Y

Table C2. The Subject and URL of the Video Watched by Each User in Study 2

Group	Subject and URL of the video		
(Concentration, Short)	Subject: Welcome to China!	(Concentration, Long)	Subject: Welcome to China*
	Video URL: https://youtu.be/rHWN0SO_sDY		Video URL: https://youtu.be/P5i5t0hzHO8
(Dispersive, Short)	Subject: Welcome to China~	(Dispersive, 15s) (T3)	Subject: Welcome to China^
	Video URL: https://youtu.be/eQqUaquuoIQ		Video URL: https://youtu.be/dtDuxFKrpYo

McMix Logo:



Other Confounding Logo:

