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Swiping More, Thinking Less: Using TikTok Hinders Analytic Thinking

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Abstract

The rapid rise and widespread use of short video applications (SVA) have significantly reshaped our understanding of social media, technology, and human social behavior. Particularly among young users, frequent social media usage and continuous swiping through endless video feeds have become pervasive phenomena. Using dual-process theory, this experimental study explored the psychological consequences of using SVA from two studies. Our findings contributed to the understanding of the cognitive implications of SVA use in young adults in the following ways. Watching short videos predicted less analytic thinking that could go beyond initially flawed intuitions in reasoning (Study 1). Additionally, the process of swiping through the short video feeds, rather than the video content itself, negatively influenced users' propensity to think analytically; and the decreased positive affect mediated the effect of TikTok usage on analytic thinking (Study 2). These results showed that users should be aware that the common daily leisure activity of using short video applications increases one's inherent tendency to fast and automatic thinking processing, which can impair their judgment and decision-making in other tasks, such as information discernment. This study indicated the negative implications of artificial intelligence agencies for young adults' thinking processing in psychological and social domains.

Keywords: dual-process theory; short video applications; swipe; analytic thinking; positive affect

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Introduction

Short video applications (SVA), visual products that usually last between 15–30 seconds, have gained global popularity, surpassing other social networking platforms in terms of their growing user base, usage frequency, and average time spent on each usage. TikTok, a leading company in this revolutionary trend, has experienced a rapid rise to prominence, promoting the emergence of more SVA. This trend is also evident in the form of short video functions on existing social media platforms, such as YouTube Shorts, Facebook Reels, and Instagram Reels. As of 2023, TikTok has exceeded the user growth of other major applications (Iqbal, 2023). Specifically, TikTok's user base has expanded to 1.6 billion, with the majority being adults aged between 18–34 (Ceci, 2024), and over 80% of these young users have a college degree and above (MobTech, 2023).

The reason SVA go viral lies in two distinctive features their users have experienced: entertaining content and interactive technology. In terms of content, for instance, TikTok is characterized by an "aesthetic of goofiness" (Kennedy, 2020) that is predominantly filtered out on Instagram. Short, humorous, and creative dance challenges, lip-synching videos, and sketches that encourage meme distribution are TikTok's signature content (Zulli & Zulli, 2022). Therefore, the primary reasons users reported are to discover entertaining videos and to fill up leisure time (Ceci, 2022). Furthermore, the core narrative technique of short video content lies in evoking users' everyday affect. The primary entertaining content and humorous expression could foster intense and authentic emotional

communication (Barta & Andalibi, 2021; Zeng, 2020). Consequently, the immediate gratification of emotions is also a fundamental demand for users.

Regarding interaction, SVA primarily operate through a two-way process: user swiping and content recommendation. Users can swipe through the video feed on their phone screen to watch or skip videos recommended by the application's algorithm, which is based on interaction behavior such as likes, comments, and content creation. As such, SVA users train artificial intelligence to recognize their behavioral patterns, which, in turn, refines content recommendations tailored to their preferences (Kang & Lou, 2022). As a result, their swiping interactions become more efficient, reducing their effort at input. This contributes to the diverse appeal of SVA as they address various human needs, including information access (Song et al., 2021), self-presentation (Scherr & Wang, 2021), and social recognition (Cuesta-Valiño et al., 2022; Vaterlaus & Winter, 2021). Therefore, SVA users often experience emotional resonance and attunement, leading to feelings of joy and excitement.

However, SVA usage may also elicit negative emotions. The simplicity and intuitive design make SVA accessible, requiring no extensive expertise. Alongside the disappearance of the mobile phone's clock upon opening SVA, these features diminish time perception and amplify user immersion, contributing to a negative flow state characterized by depression and a sense of meaninglessness (Csikszentmihalyi, 1997; Roberts & David, 2023; Sagioglou & Greitemeyer, 2014). Besides, harmful biases in content creation and algorithmic delivery may extend the social exclusion of marginalized groups in the real world (Harris et al., 2023; Simpson & Semaan, 2021), posing a threat to the self-concept and emotional health of socially vulnerable individuals. Furthermore, exposure to idealized images of others can induce social comparison, exacerbating user depression (Liang et al., 2020). These factors contribute to a multifaceted emotional landscape associated with SVA usage.

Moreover, SVA can significantly impact users' thinking styles. Continuous swiping on SVA often leads to higher user engagement compared to other social media platforms, involving users in a flow state characterized by deep concentration, temporal distortion, and a sense of control and enjoyment (Nakamura & Csikszentmihalyi, 2002; Roberts & David, 2023). In this state, users tend to exhibit intuitive and rapid cognitive processes (Evans & Stanovich, 2013). For example, swiping on SVA is a quick and seamless way to consume content. A substantial number of users believe in and actively participate in disseminating false news and misinformation (Alonso-López et al., 2021). David and Cambre (2016) conceptualized swiping as a destructive logic against the self and social norm, where the power to approve or reject complex objects is obtained just through a quick, simple, and instant vertical swiping motion. SVA may also encourage controlled and analytic thinking, as it empowers users to control algorithms, express themselves autonomously, and challenge established narratives and social norms (Kennedy, 2020; Stahl & Literat, 2022).

However, literature on the psychological implications of SVA usage on its large number of young users remains understudied (Montag et al., 2021). In this article, we examine the impact of SVA on the thinking process of young users through experimental studies designed using a dual-process theory perspective. Previous research has examined factors influencing social media use, such as identity and personality traits (Seidman, 2013), as well as the emotional and behavioral outcomes, such as depression (Brooks & Longstreet, 2015), addiction behavior (Turel, 2015), and social participation (Boulianne, 2015). The complex psychological needs and motivations of SVA users have also been discussed (Literat & Kligler-Vilenchik, 2021; Meng & Leung, 2021; Yang et al., 2021). However, compared to other social networking platforms, there has been limited research on the psychological consequence of SVA usage on young users, and SVA's general effects on subsequent thinking have not been well-investigated.

Therefore, we examined the use of SVA and their impact on young adult users from a dual process perspective (Type 1 is intuitive, Type 2 is analytic) to identify if users' thinking disposition is unconsciously influenced by watching short videos. The present study improves upon previous research regarding the implicit thinking process as the outcome of SVA usage. To achieve this, we have delineated swiping and entertaining content, both representing key features characterizing the contexts of SVA, as primary predictors of cognitive effect. Additionally, we have included measurements of potential mediators to comprehensively assess and interpret the experiential impact on SVA users. Specifically, we conduct two experiments in TikTok to test three hypotheses: (a) whether SVA usage would decrease analytic thinking (Study 1), (b) the roles that swiping interactive technology and entertainment content played in SVA influence on analytic thinking (Study 2), and (c) whether the perceived cognitive load, affect, or sense of agency constitutes the influence mechanism (Study 2). By elucidating the mechanisms through which users are inclined toward less analytic thinking via swiping and a decrease in positive affect, our findings contribute not only to the growing body of knowledge concerning SVA usage but also

underscore the importance of understanding the cognitive impact that extends beyond user behavior within these applications.

Literature Review

Analytic Thinking

The dual-process theory, which divides how the human brain processes cognitive tasks into two types, is widely used to explain psychological mechanisms related to cognition, reasoning, and decision-making (Dijksterhuis et al., 2006; Evans, 2008; Gervais & Norenzayan, 2012). Individual actors' judgments and decisions are supported by dual processes; however, which process is dominant is influenced by contextual and task-related factors. Stimuli often activate the heuristic Type 1 processing automatically and unconsciously, leading to skilled responses. It relies on intuitions, feelings, and impulses that may be automatically mobilized by genetic, cultural, and personal experiences. On the other hand, analytic thinking is the defining feature of Type 2 processing, which is deliberate, slow, and complex thinking that requires rule-based reflective, rational reasoning analysis, and self-control (Kahneman, 2013; Strack & Deutsch, 2004). According to Evans (2008), strong deductive reasoning instructions may prompt an analytic process intervention to counter the flawed Type 1 thinking, which is more likely to take place in individuals with high cognitive ability or a disposition. While intuitive processing is also referred to as the "automatic mode" of the brain, analytic thinking is the "manual mode", which is more effortful and flexible (Greene, 2014).

The evolution of internet technology has reduced reliance on analytic thinking in Type 2 processing. The functioning of digital devices and the use of multiple social media platforms have depended on the execution of cognitive tasks at the fingertips, thereby creating a modern form of dual-process. For one thing, smartphones help individuals modulate their limited cognitive capacity to other tasks requiring cognitive effort. They can be used as an external thinking tool to offload internal cognitive processes, save cognitive resources, and store working memory (Barr et al., 2015; Sparrow et al., 2011). As a result, individuals tend to rely on smartphones to perform analytic thinking, delegating cognitive efforts to these devices. For another, people habitually respond to ready notifications of information from apps, with attention control disrupted by the reach of smartphones (Kushlev et al., 2016). It results in slower reactions to stimuli outside of the phone (Caird et al., 2008), neglect of the immediate cognitive environment (Strayer & Johnston, 2001), and lower work performance (Adamczyk & Bailey, 2004). To overcome interferences caused by technology and avoid automatic reactions with their disruptive effects, individual actors need to engage in self-monitoring and inhibitory control (Chen et al., 2016; Soror et al., 2015). Otherwise, they may default to Type 1 processing.

In line with this theory, we conducted two experiments to explore the relationship between SVA usage and analytic thinking. Based on the content feature of SVA and how users swipe to watch videos and interact intensively with algorithm-recommended content, we propose the following hypothesis:

H1: SVA usage would reduce analytic thinking.

How SVA Usage Affect Analytic Thinking

Interactive Technology: Swipe. Swiping is a fundamental and effortless touch gesture in smartphone usage, with cognitive benefits in learning and memorization (Appert & Zhai, 2009). Swiping intensifies and enhances visual stimuli, capturing users' attention and increasing their engagement time (Choi et al., 2016; Dou & Sundar, 2016). However, the assessment of swiping gestures is a complex task that cannot be reduced to fixed ergonomic evaluation criteria, such as the minimal action, interface feature, and information density (Scapin & Bastien, 1997). Factors such as user motivations, cognitive complexity, as well as the technological and cultural context, influence both the usage of swiping and its effects. Some research considered swiping as a mediator that bridges the individual flesh with the online community, transcending the boundaries between the mundane and the transcendence (David & Cambre, 2016; Karis, 2020). These studies primarily focus on specific contexts, the construction or disruption of meaning during interactions based on finger movement and connection, while the gesture itself has been less emphasized.

SVA users can control the level of engagement through casual interaction, such as swiping or moving their fingers away, and thus receive more video recommendations from the algorithm, enticed to continue swiping to get

responsive feedback and prolong the time of immersive use (Pohl & Murray-Smith, 2013). Also, in the context of SVA, Swiping is not exactly equivalent to the assessment and rejection in dating applications, as users speed up swiping to adjust algorithmic feedback to compensate for deviations from personal interests or to develop new interests. By leaving content filtering to the algorithm, users swipe to bridge the present and their future anticipations. Moreover, the more videos they view, the more they may feel that the algorithm is more accurate in capturing their preferences, creating a personified impression of the algorithm, increasing trust, and encouraging them to keep swiping (Bhandari & Bimo, 2022).

Therefore, with continuous swiping that facilitates video switching and autoplay functionality, users of SVA are exposed to an increased volume of short videos that prioritize rapid audio-visual stimulation. These videos often feature predictable and easily comprehensible content, imitating and replicating trending topics. Consequently, the usage of SVA through the natural and unconscious act of swiping might accelerate the cognitive processes through which users assimilate information.

Entertaining Content. In contrast to other social media applications, SVA has algorithmic and entertaining video content as its primary feature rather than extended, unfamiliar, or reality-based virtual relationships and communities (Schellewald, 2022). Entertaining video content plays a dominant role in engaging viewers, creating spaces of shared meaning, and providing a means of achieving social connection. SVA, exemplified by platforms like TikTok, have demonstrated their capacity to utilize humor-infused content to disseminate important subjects and induce behavioral changes (Basch et al., 2021; Y. Wang, 2020). Its audio-visual format has seamlessly integrated into individuals' offline experiences, effectively extending its influence beyond the digital realm.

One of the debates surrounding SVA is whether critical attitudes towards them are based on a genuine examination of the platforms and their users or whether scholars have made value judgments based on mere hypothetical inferences (Kauffman et al., 2022). In addition, SVA has opened new communication channels outside of mainstream media and traditional interaction spaces for political communication (Cervi & Marín-Lladó, 2021), health messages (Eghtesadi & Florea, 2020), and public education (Carter et al., 2021). However, studies assessing the quality of short videos suggest that the nonprofessional creator, the content delivery adapted to platform technology and entertainment frameworks may lead to overall low quality (Om et al., 2021; Xu et al., 2021), despite the possibility of eliciting more response and broader dissemination than other platforms. It was also found that people who use social media as their primary means of accessing information are less knowledgeable (Mitchell et al., 2020). Thus, viewing short-form entertainment videos may not encourage analytic thinking and can lead audiences to invest fewer cognitive resources. This article aims to examine the influence of the interactive technology and video content of SVA on users' thinking processes, with a focus on the individual as a technology-affected social cognitive subject.

Overall, the influencing mechanism of SVA on users may encompass two dimensions: interactive technology and information, specifically swiping and entertaining content. There may exist interactive effects between these dimensions, as swiping can influence the efficiency and content of video streams, while the video content, in turn, can shape users' motivation for utilizing the application and their inclination to continue swiping, thereby potentially altering the effects of swiping. Therefore, we propose to control for the factors of swiping and the entertaining value of video content separately in the experiments. We propose the following hypothesis:

H2: SVA usage would reduce analytic thinking, through swiping interactive technology and entertaining content.

Potential Mediating Variables

Affect. Affect and rationality are viewed as dual-process driving forces (Epstein, 1994). Kahneman and Frederick (2007) also revealed through fMRI evidence that choice is usually an emotional response at first. Information systems designed to be hedonic enhance people's intention to continue using them through affective and informational feedback experiences (Hassan et al., 2019; van der Heijden, 2004). It could lead to problematic technology use and even addiction, where users' thinking, emotions, and behaviors are dominated by certain information technology (Griffiths, 2005). Research on SVA users has demonstrated the role of positive affect in exacerbating users' withdrawal symptoms and addiction when using SVA, as maintaining the positive affect of watching short videos requires prolonged use and more frequent interactions, and having to stop using leads to negative affect (Tian et al., 2023). Besides, since watching short videos requires low effort, it may also trigger feelings of listlessness, dissatisfaction, apathy, and mental sluggishness after the usage (Csikszentmihalyi, 1997).

Dual-process theory-based studies analyzing social network sites offer possible explanations of the relationship between affect and thinking processes, with Turel and Qahri-Saremi (2016) defining avoidance of negative emotions and entertainment-seeking affect as traits of Type 1 processing and arguing that it drives people to exhibit strong cognitive-emotional preoccupation, which weakens the cognitive and behavioral control of Type 2 processing. Therefore, within the context of the current study, we propose that affect would mediate the relationship between SVA usage and the decrease in analytic thinking.

Cognitive Load. People's cognitive processing ability is limited and relatively stable. Sweller's (2011) cognitive load theory argues that people's working memory for processing new information is limited in capacity and duration, and that information may create a heavy working memory load. The engagement of working memory is relevant for the functioning of Type 2 processes, as analytic thinking requires available cognitive resources to support the increased cognitive effort. SVA provide a relaxing activity to alleviate cognitive load. Users access video feeds effortlessly with swipe-based interaction techniques (Karr-Wisniewski & Lu, 2010) and novel video content that is free from contextual intricacies (Mayer & Moreno, 2003).

However, SVA might paradoxically result in cognitive overload, leading to a deterioration in analytic thinking. SVA encourage a repetitive, automated usage pattern (Schnauber-Stockmann & Naab, 2019) that can lead SVA users to unconsciously spend substantial time on the endless streaming videos. The prolonged exposure to a rapid succession of short videos in a continuous feed format exacerbates information overload. Moreover, it sustains cognitive arousal even after viewing, contributing to increased fatigue and heightening the negative flow state experienced by users (K. Wang & Scherr, 2022). The physiological and psychological effects diminish individuals' capacity for engaging in analytic thinking. Consequently, rather than relieving users' stress or promoting relaxation, SVA usage may lead to suboptimal performance in subsequent cognitive tasks. Hence, we suggest that the correlation between SVA usage and the decline in analytic thinking might be influenced by cognitive load.

Sense of Agency. Sense of agency refers to the feeling that an individual is a source and dominant agent of their actions and that their actions produce causal effects on the external world (Pacherie, 2007). The sense of agency, which emerges when the expectations of current actions coincide with the actual outcome or arise through post-action meaning attribution, may inherently involve a process of reasoning and analysis (Haggard, 2017; Zapparoli et al., 2020). SVA users cannot directly monitor the algorithmic functioning, but the alignment of recommended videos or interactions with users' expectations may foster a sense of agency. Nevertheless, trusting the platform's intuitive recommendations might lead SVA users to depend on less conscious and analytic thinking.

It is challenging for SVA users to differentiate between outcomes generated by algorithms and those resulting from their actions. Some users maintain the belief in interactions such as likes and comments to influence the algorithm to judge, reason, and display personalized content in line with their interests (Bhandari & Bimo, 2022; Siles et al., 2022). Creator-users seek interaction from others to adjust algorithmic deviations from their expectations, trying to establish defined imagined communities (Jones, 2023). This sense of agency, where the platforms learn to understand and cater to their preferences, contributes to increased user engagement and encourages prolonged usage. The opaqueness of algorithm processing makes individual users misattribute the sense of agency to their effort in training, negotiating, or confronting SVA, even when subjected to the dominance and shaping of the algorithm (Lee et al., 2022; Taylor & Choi, 2022). Therefore, SVA users can offload their self-awareness and analytic thinking to the recommendation algorithms, granting the platforms to execute their thoughts and behavioral intentions.

According to the insights above, we propose the following hypothesis:

H3: The effect of SVA usage on analytic thinking would be mediated by cognitive load, positive affect, or sense of agency.

Study 1

Methods

Participants

For the pilot study, 24 college students were recruited via the Bulletin Board System of a top university in Beijing, China, in January 2022. The procedure was optimized based on their feedback, involving wearing headphones for

sound insulation. A large effect size in the analytic thinking scores (Cohen's d = 0.72) was measured. The minimum sample size was calculated accordingly by G*Power and 56 participants were needed to achieve a power of 0.9, with a significance level of .05 in the independent sample t-test.

Therefore, another 72 college students were recruited in April 2022 in the same way for the formal study, among which 67 valid samples aged between 17 to 31 years (M = 22.72, SD = 3.08) were obtained based on whether they used SVA and answered our questionnaires before. The sample was characterized by a higher representation of females (58%) compared to males, a majority of undergraduate participants (60%) as opposed to postgraduates, and a larger proportion of students majoring in science and engineering disciplines (58%) compared to those in humanities and social sciences.

Procedure

Participants were first required to read and sign the consent form and complete the pre-test questionnaire under our guidance, measuring their demographics, SVA use, need for cognition, and cognitive ability. Afterward, participants were randomly allocated to two groups. The treatment group was instructed to use their mobile phones, log into their TikTok accounts, and engage in a 30-minute session of viewing short videos recommended by the application. This setup aimed to replicate the typical experience of swiping through short videos, simulating a natural user interaction. On the other hand, the control group was directed to use their mobile phones, access their WeChat Reading accounts, and spend 30 minutes reading an e-book of their choice. Both applications held widespread popularity and user account registrations in China. After 30 minutes, participants were asked to complete the post-test questionnaire, including the CRT-3 and the news identification task. The total duration of the experiment was about 45 minutes, and each participant was paid 45 Chinese yuan for their contribution.

Measurement

SVA Usage. A list of SVA in China including TikTok and Bilibili was given. Participants were asked to check the ones they used most frequently. Then they were required to fill in the blank asking the frequency they used the named SVA (times per day), as well as the duration (minutes per session). Participants could verify this by checking Screen Time Management on their phones. The total daily duration of SVA usage was calculated by multiplying the two. The frequency of their interactions, which included actions such as Liking, Commenting, Favoriting, Sharing, and Uploading, was also recorded. Participants rated their interaction frequency on a scale from 1 (*Never used*) to 6 (*Often used*), and the total interaction frequency was calculated by summing these ratings. Finally, we asked them the amount of money they spent on SVA last year, including e-shopping, tips for the streamer/uploader, and paying for the advanced features. Participants could verify the amount by referencing their financial transaction records.

Need for Cognition. The need for cognition was measured by the Short Form of the Need for Cognition Scale developed by Cacioppo et al. (1996). The scale consists of 18 items that assess the motivation of participants to engage in analytic thinking, such as *I would prefer complex to simple problems* and *I would rather do something that requires little thought than something sure to challenge my thinking abilities*. Participants were asked to indicate to what extent each statement was characteristic of themselves, with 1 = *extremely uncharacteristic* and 6 = *extremely characteristic*. Some statements need to be reverse-scored. The total score of need for cognition was calculated by adding them up, ranging from 18 to 108.

Cognitive Ability. Cognitive ability was measured by eight syllogisms reasoning problems developed by Markovits and Nantel (1989). The content of each syllogism is inconsistent with its logical format, for example, *Premise 1: All things that are smoked are good for health. Premise 2: Cigarettes are smoked. Conclusion: Cigarettes are good for the health*., had an implausible conclusion but in a logically valid format. Therefore, these problems have been considered to measure analytic thinking skills of reasoning aside from prior knowledge. One mark was awarded for a correct indication of whether the conclusion followed logically from the premises. The total score was calculated by adding them up, ranging from 0 to 8.

Analytic Thinking. Analytic thinking was measured by the Cognitive Reflection Test (CRT), which was developed by Frederick (2005) with three fill-in-the-blank questions (CRT-3) and extended to seven (CRT-7) by Toplak et al. (2014). For instance, *A bat and a ball cost $1.10 in total. The bat costs $1 more than the ball. How much does the ball cost?* (Correct answer = *5 cents*; intuitive answer = *10 cents*). 10 cents is the first answer that comes to mind in most cases but incorrect (if the bat is 1 dollar more expensive than the ball, the total cost equals twice the price of the

ball plus 1 dollar, thus you have to subtract 1 from 1.10 and then divide by 2 to get the price of the ball), people who write down it is considered to make intuitive default and governed by Type 1 processing; in contrast, the correct answer 5 cents suggests that respondents spend more time and engage in systematic processing to correct the intuitive errors. Individuals who scored higher on the CRT tend to decline their reliance on intuition and heuristics knowledge but turn to analytic and systematic thinking instead. CRT has demonstrated predictive validity, being able to maintain stability even with prior exposure (Bialek & Pennycook, 2018) and across time (Stagnaro et al., 2018), making it a widely used measure of analytic thinking.

News Identification Task Materials. CRT has been used as a measure in people's perception and reasoning of other everyday issues, for instance, the identification of fake news (Pennycook et al., 2020). We considered fake news from three dimensions: Fake vs. Real, China vs. Foreign, and Positive vs. Negative. In line with Pennycook et al. (2018), who distinguished between fake and real news as well as pro-Republican and pro-Democrat news, we introduced an ideological dimension by comparing news related to China and foreign countries. Additionally, we examined the sentiment of the news, as the framing effect (Kahneman, 2013) suggests that people react differently to losses and gains.

Thus, there were 8 news items collected on the Tencent fact-checking platform in total (2×2×2), and each item contained these three dimensions. For instance, *Mike Yeadon, former vice president of Pfizer, exposed that the mRNA vaccine caused nearly 5,000 deaths in the United States* was a piece of negative and fake news about a foreign country, while *China becomes the second country to land on Mars with the successful landing of spacecraft Zhurong carried by Tianwen-1* was a piece of positive and real news about China. For each news item, participants needed to identify whether it was real or fake, with 0 = *Believing it to be fake* and 1 = *Believing it to be real*. For the 4 fake news items, 4 negative items, and 4 foreign items, we added them up to obtain the level of belief in fake news, negative news, and foreign news, which ranged from 0 to 4. People who believed in the news unconditionally were considered to ignore ambiguity, suppress doubt, and be governed by Type 1.

Results

Participants watched SVA for a mean of 76.67 minutes per day and spent 299.26 Chinese Yuan a year on it after removing the extremes. They exhibited a high level of need for cognition, with a mean score of 68.49, and a high level of cognitive ability, with a mean score of 6.22. They scored 2.55 on average in CRT-3, with 65% of participants answering all 3 questions correctly. The mean score for the news identification task was 4.37, with 80% of participants incorrectly identifying three or more headlines.

Table 1. *Independent-Sample t-Tests for Short Video Group and e-Book Group.*

	Short video group		E-book group			
	N = 34		*N* = 33		*t*	*p*
	M	*SD*	*M*	*SD*		
Duration	79.09	71.58	74.18	57.76	0.31	.759
Interaction	14.24	5.43	13.48	5.06	0.58	.561
Consumption	298.25	554.68	300.36	579.57	−0.01	.993
Cognitive need	68	12	69	14.54	−0.31	.760
Cognitive ability	6.09	2.04	6.36	2.28	−0.52	.603
CRT-3	2.41	0.86	2.70	0.47	−1.70*	.048
Fake news	2.15	0.93	1.73	1.04	1.75*	.043
Negative news	2.71	0.94	2.27	1.18	1.67	.050

Note. CRT-3 = Cognitive Reflection Test (three questions).

Statistical tests revealed that before the experiment, there were no significant differences between the treatment group and control group in the aspects of gender ($\chi^2 = 0.15$, $p = .695$), grade ($\chi^2 = 0.42$, $p = .518$), major ($\chi^2 = 3.53$, $p = .060$), SVA usage, need for cognition, and cognitive ability, which indicated that the allocation was randomized and balanced. After the watching/reading task, there was a significant difference in CRT-3 scores between the two groups. Participants who watched short videos got 0.29 more questions wrong ($p = .048$, Cohen's $d = -0.41$). In addition, participants who watched short videos were more likely to believe in fake news ($p = .043$, Cohen's $d = 0.43$) and negative news ($p = .050$, Cohen's $d = 0.41$) than their counterparts reading e-books.

Discussion

Through the randomized experiment, Study 1 suggests that watching short videos for a relatively long time, led to a decrease in analytic thinking compared with reading e-books. This is further confirmed by an increase in the likelihood that video-watching users are more likely to be deceived by fake news and negative news. Taken together, these findings largely confirm hypothesis 1 that SVA usage indeed reduces analytic thinking. However, it is still unclear about the mechanism leading to this effect. It remains to be determined whether the captivating videos or the simplified user interaction plays a more pivotal role and whether cognitive load, positive and negative affect, or the sense of agency serves as mediators. Study 2 follows a 2 (content: cute animals vs. science experiment) by 2 (interaction: swipe vs. no swipe) between-subjects design to explore the underlying mechanism and mediating variables.

Study 2

Methods

Participants

Study 2 was conducted online in July 2022 through Credamo, an online platform providing a reasonably representative sample matched to the Chinese population on age, gender, and occupation. For the pilot study, 48 college students were recruited via Credamo, which could announce the recruitment to samples of specified occupations and education levels. The procedure was optimized according to their feedback, such as removing the display of a countdown. A large difference in analytic thinking scores was observed among the four groups, with a substantial effect size (Cohen's f = 0.30). The minimum sample size was calculated accordingly by G*Power, and 119 participants in total, or 30 participants per group were needed to achieve a power of 0.9, with a significance level of .05 in the two-way analysis of variance.

205 college students were recruited in the same way for the formal study, among which 178 valid samples aged 18 to 30 years were obtained based on the screening of their response time and attention check items. The sample comprised a higher percentage of females (56%) than males, predominantly undergraduates (82%) rather than postgraduates, and a larger proportion of students majoring in science and engineering disciplines (52%) compared to those in humanities and social sciences.

Procedure

Participants were first required to read, sign, and upload the consent form, and fill out the online pre-test questionnaire, measuring their demographics and SVA usage. Next, they needed to install TikTok (if they had not installed it before) and test it to see whether it worked properly. After that, they were randomly presented with one of the four links. Participants needed to click it to jump to a pre-prepared collection of short videos at TikTok, for which they were required to watch for 20 minutes. These short video collections followed a 2 (content: cute animals vs. science experiment) by 2 (interaction: swipe vs. no swipe) design.

Before the viewing session, participants were instructed not to exit the data collection process. To ensure participants' compliance with the video-watching instructions, an attention check was conducted. This involved assessing their knowledge of specific images intentionally embedded within the data collection process. Finally, they were required to complete the post-test questionnaire, measuring cognitive load, positive and negative affect, sense of agency, and analytic thinking. The total duration of the experiment was about 30 minutes, and each participant was paid 10 Chinese yuan for their contribution.

Measurement

Short Video Materials. All short videos in the collection were selected and processed in advance. Two collections themed on cute animals, including 122 short videos coming from the hot list under the tag #animals on TikTok. The mean duration of these videos is 35.3 seconds. The other two collections were related to science experiments, including 103 short videos coming from the hot list under the tag #science experiment on TikTok, with an average

duration of 35.4 seconds. In the two Swipe collections, participants viewed short videos of a same theme, swiping to watch short videos just like they normally used TikTok. In contrast, for the No-Swipe collections, we used video editing software to compile short videos of the same theme into a single continuous video. This prevented participants from freely swiping and instead required them to watch the videos sequentially.

Affect. Affect was measured by the Positive Affect and Negative Affect Scale revised by Qiu et al. (2008) based on the original one developed by Watson et al. (1988), which was more suitable for the Chinese context and had good reliability and validity. Participants were asked to indicate to what extent they felt engaged after watching the videos. A total of 18 items such as "enthusiastic" and "scared" were divided into two subscales named positive affect and negative affect scale respectively, with 1 = *Not at all* and 6 = *Extremely*.

Cognitive Load. Cognitive load was measured by the Workload Profile Index Rating developed by Tsang and Velazquez (1996). It measured subjective cognitive load from eight dimensions: perceptual, response selection and execution, spatial processing, verbal processing, visual processing, auditory processing, manual output, and speech output. Participants were asked to rate the short-video-watching task on a 6-point scale from 1 = *Little attention is required* to 6 = *A lot of attention is required*.

Sense of Agency. Sense of agency was measured by the Sense of Agency Scale developed by Tapal et al. (2017). A total of 11 items assessing the subjective feeling of control over one's actions and thus over external things and the environment were divided into two subscales named sense of positive agency scale and sense of negative agency scale. Participants were asked to indicate to what extent they agree with each statement right now, such as *I am in full control of what I do* and *My actions just happen without my intention*, with 1 = *Strongly disagree* and 6 = *Strongly agree*.

The measurement of SVA usage, analytic thinking, and news identification task materials were the same as in Study 1.

Results

Participants used SVA for a mean of 134.60 minutes per day. The mean score of the sense of positive and negative agency was 22.86 and 14.27, respectively. The mean score of positive and negative affect was 36.04 and 16.24, respectively. The mean score of the cognitive load was 33.74. They scored 2.41 on average in the CRT-3, with 60% of participants answering all 3 questions correctly. The mean score for the news identification task was 4.33, with 84% of participants incorrectly identifying three or more headlines.

The four groups did not differ significantly in the aspects of gender ($\chi^2 = 0.08$, $p = .994$), grade ($\chi^2 = 2.90$, $p = .407$), major ($\chi^2 = 3.88$, $p = .275$), and SVA usage before the experiment, which indicated that the allocation was randomized and balanced. However, there were significant differences between the four groups in CRT-3 scores after watching short videos, $F(3,174) = 3.24$, $p = .023$. Specifically, participants who can swipe up and down got .38 more questions wrong on average ($p = .001$, Cohen's $d = -0.47$), while there was no significant difference between the groups of different video themes, as shown in Figure 1. Moreover, the four groups differed significantly in the news identification task, with participants who could swipe believing more in fake news ($p = .050$, Cohen's $d = 0.25$) and negative news ($p = .009$, Cohen's $d = 0.36$).

It was examined whether positive affect mediated the effect of swipe on analytic thinking, according to the result of ANOVA in Table 2. All the possible mediating variables such as sense of agency, affect, cognitive load, and demographics were first explored for their effects on analytic thinking. Regression analysis revealed that in addition to positive affect ($b = 0.02$, $SE = 0.01$, $p = .003$), sense of positive agency ($b = -0.05$, $SE = 0.02$, $p = .036$) also significantly predicted CRT-3 scores. Therefore, it was included in the analysis.

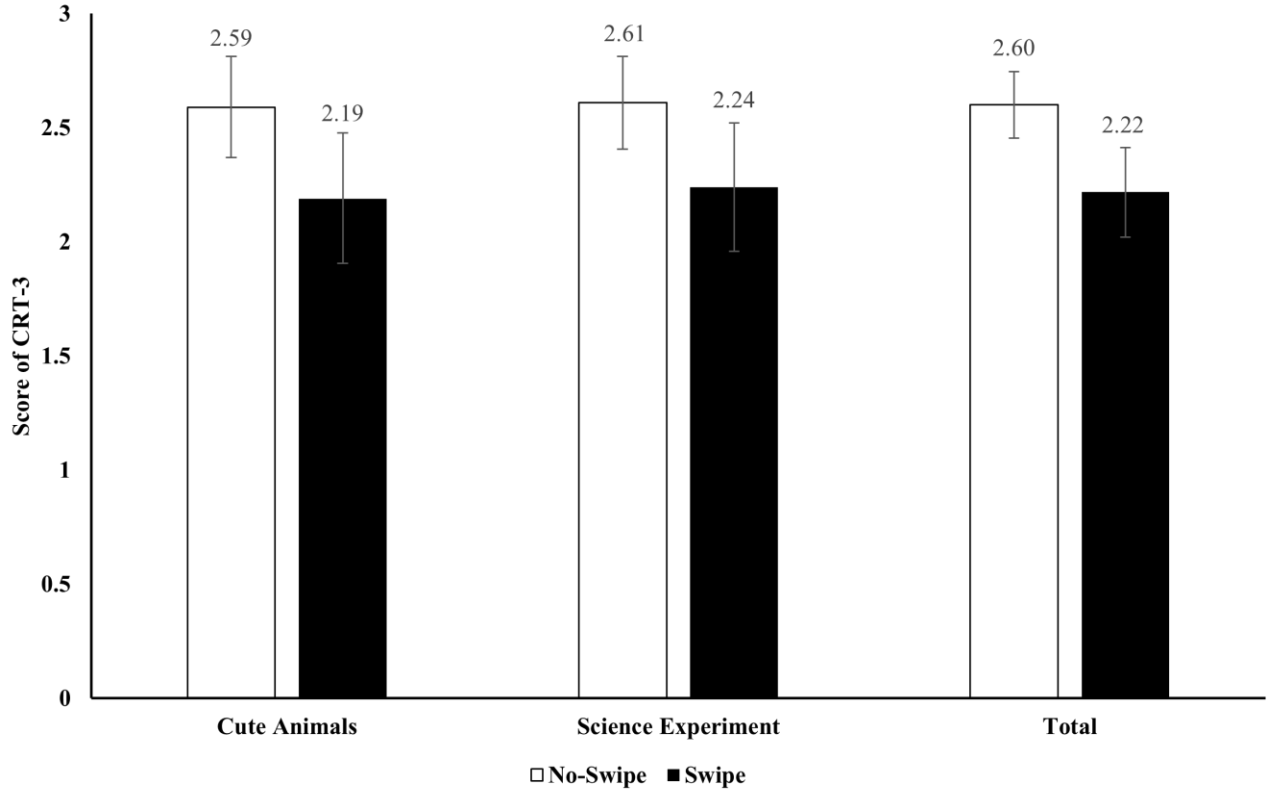
Mediation analysis through structural equation modeling revealed that swipe significantly influenced analytic thinking ($b = -0.29$, $SE = 0.12$, $p = .018$), positive affect significantly impacted analytic thinking ($b = 0.02$, $SE = 0.01$, $p = .010$), and swipe also significantly predicted positive affect ($b = -3.21$, $SE = 1.38$, $p = .020$). At the same time, swipe reduced analytic thinking by reducing positive affect ($b' = -0.08$, $SE = 0.04$, $p = .048$), as shown in Figure 2. The bootstrapping analysis also indicated that the 95% confidence interval for the indirect effect of swipe on analytic thinking was [−0.10, −0.004], without 0 included.

Table 2. *Mean, Standard Deviation, and Two-Way ANOVA of Four Groups.*

	Cute Animals		Science Experiment		
	Swipe	No Swipe	Swipe	No-Swipe	*F* (3,174)
	N = 42	*N* = 44	*N* = 46	*N* = 46	
Duration	143.26 (83.00)	141.08 (76.74)	126.59 (79.91)	128.50 (4.76)	0.53
Interaction	17.74 (3.88)	19.09 (4.27)	18.20 (4.34)	18.65 (17.24)	0.78
CRT-3	2.19 (0.92)	2.59 (0.73)	2.24 (0.95)	2.61 (0.68)	3.24*
Fake news	1.98 (1.05)	1.84 (0.91)	2.22 (0.96)	1.87 (1.07)	1.34
Negative news	2.40 (1.08)	2.34 (1.03)	2.65 (1.02)	2.00 (0.94)	3.20*
SoPA	23.45 (2.44)	22.43 (3.52)	22.63 (3.73)	22.96 (3.20)	0.80
SoNA	14.50 (3.80)	14.18 (5.17)	14.33 (4.68)	14.09 (4.77)	0.07
Positive affect	35.10 (8.54)	37.00 (8.94)	33.80 (11.01)	38.24 (8.34)	2.05
Negative affect	18.07 (6.89)	16.05 (7.63)	15.96 (7.34)	15.02 (5.00)	1.56
Cognitive load	32.48 (5.77)	33.55 (5.97)	34.67 (6.37)	34.15 (5.52)	1.11

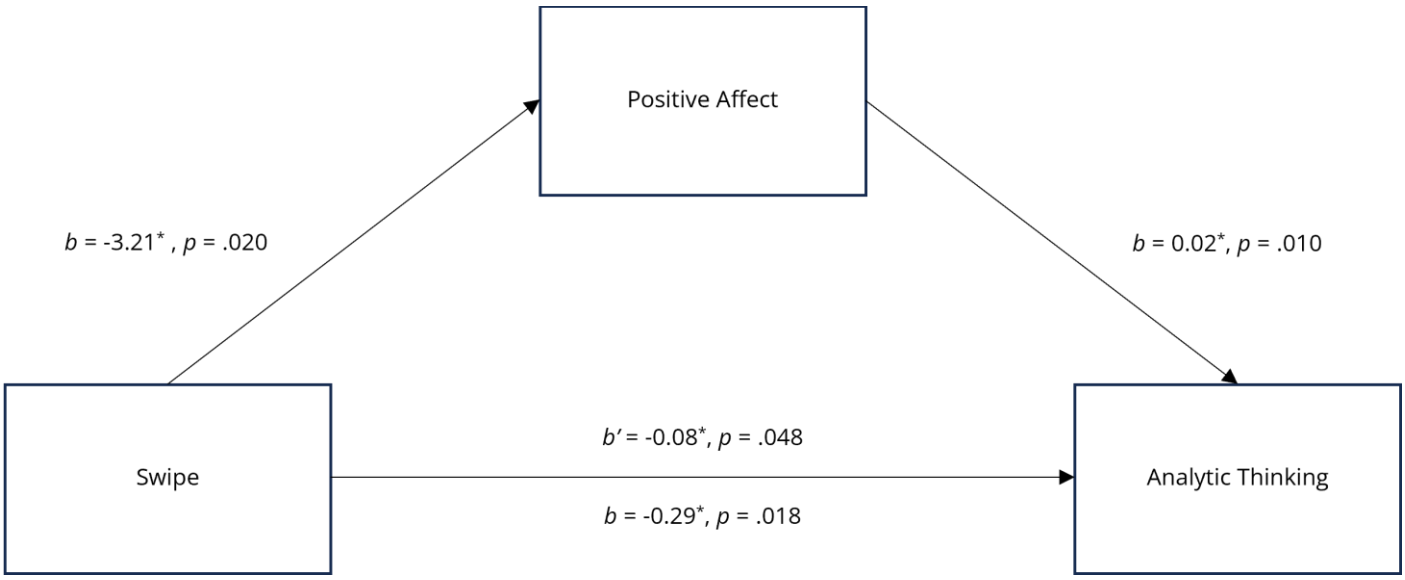
Note. Numbers in parentheses are standard deviations; ***p < .001, **p < .01, *p < .05; SoPA = Sense of Positive Agency; SoNA = Sense of Negative Agency; CRT-3 = Cognitive Reflection Test (three questions).

Figure 1. *The Effect of Swipe on Analytic Thinking.*



Note. 95% confidence interval shown. CRT-3 = Cognitive Reflection Test (three questions).

Figure 2. *The Positive Affect Mediated the Effect of Swipe on Analytic Thinking.*



Note. ***$p < .001$, **$p < .01$, *$p < .05$.

Discussion

Hypothesis 2 examined the primary factor within SVA usage that hinders analytic thinking. For one thing, SVA infiltrated people's offline lives with its audio-visual presentation and predominantly entertaining and comedic content style. For another thing, SVA was characterized by attempts to maximize rapid stimulation through fast-paced and continuous swiping. Study 2 suggested that swiping rather than entertainment content negatively affected analytic thinking and increased the likelihood that users would be deceived by fake news and negative news.

Hypothesis 3 addressed the potential mediators of this effect. Cognitive load is widely recognized as a core explanatory variable in related research. Sense of agency was an important variable in the field of human-computer interaction. Affect also plays an important role in human cognitive behavior. Study 2 suggested that positive affect instead of cognitive load and sense of agency mediate the effect of SVA usage on analytic thinking. Users who swipe to switch videos experience less positive affect and in turn perform worse on CRT.

General Discussion

Findings

This study explores the mechanisms through which SVA influences users' analytic thinking from the perspective of dual-process theory. The main findings are as follows: (a) the usage of SVA is associated with a decline in analytic thinking, leading to higher susceptibility to believing misinformation and negative news; (b) the swipe interaction reduces people's analytic thinking; (c) positive affect mediate the relationship between SVA usage and analytic thinking, with users who swipe experiencing lower levels of positive affect compared to those who do not swipe.

Specifically, SVA users, after receiving an intensive and rapid information flow, tend to make judgments and decisions quickly and intuitively, rather than using slow and analytic thinking processes. Reducing analytic thinking may lower task performance, especially in information discernment issues, as analytic thinking allows people to question, while intuitive thinking is more inclined to uncritically believe in the authenticity of information (Kahneman, 2013). This makes SVA users more susceptible to fake news and more vulnerable to believing in negative information.

Swiping reduces the tendency for analytic thinking, while the content of short videos does not bring about significant differences. The swipe interaction in SVA is characterized by straightforward nature and minimal complexity, enabling users to easily access entertaining information and explore more recommended content that

predicts their preferences. This prompts users to adopt efficient and cognitively resource-saving cognitive strategies without investing more cognitive costs in retrieval, evaluation, and feedback. As the overall entertainment style of short video platforms is characterized by blurred boundaries between different themes and rapid changes, such educational and informative content may not be sufficient to change users' thinking disposition.

We found that positive affect mediates the relationship between swiping and analytic thinking, while cognitive load and the sense of agency were ruled out. Swiping enhances the focus of SVA users, facilitates rapid consumption of content, and fosters a heightened level of engagement. When their interaction with SVA interfaces is stopped, users would experience greater physical and psychological strain. They would feel dissatisfied due to the disruption of the video streaming or perceive time wastage and fear of addiction. Therefore, swiping can lead to a decrease in positive emotions, thus users are less motivated to engage in deliberate analytic thinking.

Furthermore, the study did not observe discernible effects of cognitive load and sense of agency on users' cognitive disposition, which we attribute to the characteristics of SVA and usage duration. Online entertainment would not necessarily prompt individuals to rely more on SVA as an external cognitive tool. Users' expectations regarding the recommended content on SVA may also be less distinct, as SVA's vertical communication provides them with immediate emotional satisfaction rather than a demand for specific information (Shi et al., 2022). Additionally, the influence of cognitive load and sense of agency might require high usage frequency and duration to manifest effectively.

Implications

Theoretical Implications

This paper applies dual-process theory to investigate the cognitive outcomes of SVA usage. It expands the dual-process theory's interpretation to social networking site studies (see also Turel & Qahri-Saremi, 2016), elucidating the influence of swiping in SVA on cognitive processes and explaining the mediating role played by positive affect. Previous comparisons of SVA with other social media have shown that SVA has minimal effects on individuals' social perceptions (Shi et al., 2022) and well-being (Masciantonio et al., 2021). However, our study suggests that these effects could be subtle and unconscious. The use of SVA impacts cognitive processes that are essential for daily analytic decision-making, even through exposure to entertaining content. Consequently, this could result in wider-reaching consequences, increasing users' vulnerability to influences such as fake news, conspiracy theories, populism, and extremism. This susceptibility applies not only to the content discussed in SVA (Weimann & Masri, 2023) but also extends to other information sources that individual actors could get access to, including social networking sites.

This study reveals potential negative cognitive outcomes associated with social media use, addressing concerns related to psychological health as raised in the literature on problematic social media use. It verified the unfavorable consequences of passive and individual leisure activities as described by Csikszentmihalyi (1997). Although using SVA offers an easier approach to initiate relaxation, it might subsequently impede cognitive resource allocation, reduce positive emotions, and manifest temporary addictive tendencies (Osatuyi & Turel, 2018). It also elucidates distinct mechanisms underlying problematic use between SVA and other social media platforms (Smith & Short, 2022).

Furthermore, while previous research has suggested that cognitive styles may change when people use search engines (Barr et al., 2015), we found that utilizing SVA can alter individuals' cognitive styles. This is achieved not by having the application perform cognitive tasks on behalf of users, but rather by swiping and diminishing positive affect. The process of swiping through SVA can be understood as an effort to invest the users' subjectivity into the personification algorithm, where people expect the platform to measure their long-term preferences, understand momentary decisions, and extend them into continuous future content-based responses. However, as the process of swiping intensifies individuals' engagement, the outcome contrasts with their expectations driven by hedonic motives, thereby prompting alterations in cognitive styles. While our findings have documented that SVA usage is associated with reduced analytic thinking, a more in-depth investigation of the correlation between swiping and positive affect is essential to draw definitive conclusions.

Practical Implications

This paper presents several practical implications. Currently, SVA users can regulate their usage by employing the time management feature of SVA to prevent excessive time and energy expenditure. Given the potential emotional and cognitive impacts of swiping, intervention strategies by SVA developers to counter user addiction should include mandatory pause intervals during video streaming to interrupt continuous swiping. Furthermore, an increasing number of users are utilizing SVA as a search engine (Huang, 2022). Prolonged usage, with the attenuation of analytic thinking tendencies, renders them susceptible to biased information. Consequently, platforms should improve their recommendation algorithms, strengthen fact-checking procedures, and implement labels for controversial content. Encouraging users to flag and report false and erroneous information is also recommended.

Swiping for accessing algorithm-recommended content has become a foundational interactive technology. Therefore, cultivating conscious self-control and reflection is imperative for individual users, given the ubiquity of swiping in diverse app interactions. For young users vulnerable to the negative effects of problematic social media use, raising awareness about adverse cognitive reactions to social media and advocating the use of time management tools to quantify energy investment is advisable. This approach helps mitigate unconscious SVA usage during fragmented time segments, reduce anxiety (Lambert et al., 2022), and encourages involvement in more enriching leisure activities, such as sports that facilitate flow experiences. Also, it could promote individuals' access to diverse sources of information. Nonetheless, considering contexts prone to cognitive resource depletion in daily routines, the efficacy of these recommendations in promoting meaningful activities during rest periods merits further exploration.

Furthermore, there has been a growing body of research that emerged after COVID-19, which explored TikTok's potential as an innovative educational tool to improve learning outcomes and thinking abilities (Deng & Yu, 2023; Escamilla-Fajardo et al., 2021). However, this study demonstrates that the risks associated with short video learning may outweigh the benefits. Hence, endeavors to incorporate nascent technologies like SVA into educational enhancement must be undertaken contingent upon the availability of substantial empirical data.

Limitations and Future Directions

The study's participants comprised university students in China, necessitating further exploration of the findings' cross-cultural relevance. Recruiting participants through online experimental platforms could pose challenges in confirming their video viewing statuses. Despite incorporating attention-check video segments, random environmental factors might influence participants' engagement levels, affecting interaction effectiveness. For the mediating mechanisms underlying the reduction in analytic thinking, Study 1 didn't explore the effect of cognitive load and the sense of agency. It also remains to be investigated whether the diminished positive affect results from withdrawal related to cessation or if the usage of SVA itself is perceived as lacking enjoyment.

Future research should encompass a broader demographic spectrum and consider additional social factors associated with the risk of problematic use. For instance, this may include elderly users vulnerable to technology, employees susceptible to burnout and self-depletion, or adolescents with poor mental health. This is vital due to potentially opposing psychological consequences arising from similar leisure activities across diverse demographic characteristics (Bó, 2022; Chao et al., 2023). Moreover, considering the evolving algorithm awareness, future research could identify a broader spectrum of factors that shape users' cognitive and affective processes. Studies could also make more comprehensive comparisons between SVA and other social media platforms, exploring individual demands for social interaction and methods to enhance mental well-being. Lastly, SVA serves as a pivotal platform for disseminating information. Especially since COVID-19, there has been heightened attention and expectation regarding the educational significance of SVA. In spaces centered on entertainment and catering to intuitively oriented users, the pursuit of enhancing the dissemination of public and professional information calls for dedicated investigation.

Conflict of Interest

The authors have no conflicts of interest to declare.

Authors' Contribution

Qian Jiang: conceptualization, investigation, formal analysis, writing—original draft, writing—review & editing. **Liangying Ma:** conceptualization, methodology, investigation, writing—original draft, writing—review & editing.

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Appendix

Demographic Information

1. Are you a college student?
A. Yes, I am B. No, I'm not

2. What is your gender?
A. Male B. Female

3. What is your faculty?
A. Faculty of Sciences
B. Faculty of Information & Engineering
C. Faculty of Humanities
D. Faculty of Social Sciences
E. Faculty of Economics & Management
F. Health Science Center
G. Interdisciplinary

4. What is your grade?
A. Undergraduates
B. Master's degree students
C. Doctoral students

5. What is your monthly living expenses?
A. ￥0-999
B. ￥1,000–1,999
C. ￥2,000–2,999
D. ￥3,000–3,999
E. ￥4,000 and above

Short Video APP Usage

1. Have you ever used an APP to watch short videos?
A. Yes, I have B. No, I'm not
——If you choose A, please answer question 2a and continue to fill in this part of the questionnaire. If you choose B, please answer question 2b and skip this part of the questionnaire.

2. a. Which APP do you most often use to watch short videos?
A. TikTok
B. Kwai
C. Bilibili
D. Weibo
E. Other application

b. What is the main reason that you don't watch short videos?

3. How many times do you use this APP to watch short videos each day? (If less than once, please convert it into a decimal. For example, once every two days is 0.5.)
____ a day.

4. How long do you use this APP to watch short videos each time?
____minutes.

5. How often do you use these operations in the APP when you watch short videos?

	Never 0	1	2	3	4	Often 6
Like						
Comment						
Favorite						
Share						
Upload						

6. How much do you spend on this APP in the last year? (including e-shopping, tips and gifts for the streamer/uploader, and pay for the membership; if there is no consumption, please fill in 0)

Cognitive Reflection Test (Toplak et al., 2005)

For each of the question below, please do your best to answer as accurately as possible.

1. A bat and a ball cost $1.10 in total. The bat costs $1 more than the ball. How much does the ball cost?
   ____ cents [Correct answer = 5 cents; intuitive answer = 10 cents]
2. If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets?
   ____ minutes [Correct answer = 5 minutes; intuitive answer = 100 minutes]
3. In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake?
   ____ days [Correct answer = 47 days; intuitive answer = 24 days]
4. If John can drink one barrel of water in 6 days, and Mary can drink one barrel of water in 12 days, how long would it take them to drink one barrel of water together?
   _____ days [correct answer = 4 days; intuitive answer = 9]
5. Jerry received both the 15th highest and the 15th lowest mark in the class. How many students are in the class?
   _____ students [correct answer = 29 students; intuitive answer = 30]
6. A man buys a pig for $60, sells it for $70, buys it back for $80, and sells it finally for $90. How much has he made?
   _____ dollars [correct answer = $20; intuitive answer = $10]
7. Simon decided to invest $8,000 in the stock market one day early in 2008. Six months after he invested, on July 17, the stocks he had purchased were down 50%. Fortunately for Simon, from July 17 to October 17, the stocks he had purchased went up 75%. At this point, Simon has:
   A. broken even in the stock market,
   B. is ahead of where he began,
   C. has lost money [correct answer = C, because the value at this point is $7,000; intuitive response = B].

Short Form of the Need for Cognition Scale (Cacioppo et al., 1996)

For each of the statement below, please indicate to what extent the statement is characteristic of you.

Extremely uncharacteristic 1	2	3	4	5	Extremely characteristic 6
1. I would prefer complex to simple problems.					
2. I like to have the responsibility of handling a situation that requires a lot of thinking.					
3. Thinking is not my idea of fun. [a]					
4. I would rather do something that requires little thought than something that is sure to challenge my thinking abilities. [a]					
5. I try to anticipate and avoid situations where there is a likely chance I will have to think in depth about something. [a]					
6. I find satisfaction in deliberating hard and for long hours.					
7. I only think as hard as I have to. [a]					
8. I prefer to think about small, daily projects to long-term ones. [a]					
9. I like tasks that require little thought once I've learned them. [a]					
10. The idea of relying on thought to make my way to the top appeals to me.					
11. I really enjoy a task that involves coming up with new solutions to problems.					
12. Learning new ways to think doesn't excite me very much. [a]					
13. I prefer my life to be filled with puzzles that I must solve.					
14. The notion of thinking abstractly is appealing to me.					
15. I would prefer a task that is intellectual, difficult, and important to one that is somewhat important but does not require much thought.					
16. I feel relief rather than satisfaction after completing a task that required a lot of mental effort. [a]					
17. It's enough for me that something gets the job done; I don't care how or why it works. [a]					
18. I usually end up deliberating about issues even when they do not affect me personally.					

[a] Reverse scored.

Syllogistic Reasoning (Markovits & Nantel, 1989)

For each of the problem below, please decide if the given conclusion follows logically from the premises. Circle YES if, and only if, you judge that the conclusion can he derived unequivocally from the given premises, otherwise circle NO.

1. A. YES B. NO

Premise 1: All things that are smoked are good for the health.
Premise 2: Cigarettes are smoked.
Conclusion: Cigarettes are good for the health.

2. A. YES B. NO

Premise 1: All unemployed people are poor.
Premise 2: Rockefeller is not unemployed.
Conclusion: Rockefeller is not poor.

3. A. YES B. NO

Premise 1: All flowers have petals.
Premise 2: Roses have petals.
Conclusion: Roses are flowers.

4. A. YES B. NO

Premise 1: All animals with four legs are dangerous.
Premise 2: Poodles are not dangerous.
Conclusion: Poodles do not have four legs.

5. A. YES B. NO

Premise 1: All mammals walk.
Premise 2: Whales are mammals.
Conclusion: Whales walk.

6. A. YES B. NO

Premise 1: All eastern countries are communist.
Premise 2: Canada is not an eastern country.
Conclusion: Canada is not communist.

7. A. YES B. NO

Premise 1: All animals love water.
Premise 2: Cats do not like water.
Conclusion: Cats are not animals.

8. A. YES B. NO

Premise 1: All things that have a motor need oil.
Premise 2: Automobiles need oil.
Conclusion: Automobiles have motors.

News Identification Task Materials

For each of the headline below, please identify whether it is real without thinking too much. Please do not search for any outside information.

1. UN declares Chinese as a global language and designates April 20 as World Chinese Day.

A. Real news B. fake news

2. China becomes the second country to land on Mars with the successful landing of spacecraft Zhurong carried by Tianwen-1.

A. Real news B. fake news

3. With 600,000 people dying from overwork each year, China has overtaken Japan as the country of largest number of death from overwork.

A. Real news B. fake news

4. More than 100 countries around the world have introduced animal protection laws, but in China there is no criminal liability for the abuse of dogs and cats.

A. Real news B. fake news

5. Built by Germany, sewers in Qingdao shine like the new after more than 100 years of efficient use.

A. Real news B. fake news

6. Please select Real news.

A. Real news B. fake news

7. South Korea's "Great Carpenter and the Art of Traditional Wooden Architecture" project was successfully applied for World Cultural Heritage, and the style of this technique is different from the Chinese mortise and tenon technique.

A. Real news B. fake news

8. Mike Yeadon, former vice president of Pfizer, exposed that the mRNA vaccine caused nearly 5,000 deaths in the United States.

A. Real news B. fake news

9. The children of the rich and famous have priority in admissions to prestigious U.S. schools.

A. Real news B. fake news

Positive Affect and Negative Affect Scale (Qiu et al., 2008)

For each of the affect below, please indicate to what extent you feel this way after watching the short videos.

	Not at all 0	1	2	3	4	Extremely 6
Active [a]						
Enthusiastic [a]						
Pleased [a]						
Cheerful [a]						
Excited [a]						
Proud [a]						
Delighted [a]						
Invigorated [a]						
Grateful [a]						
Ashamed [b]						
Grieved [b]						
Afraid [b]						
Nervous [b]						
Horrified [b]						
Guilty [b]						
Irritable [b]						
Jittery [b]						
Annoyed [b]						

[a] Positive Affect. [b] Negative Affect

Workload Profile Rating Sheet (Tsang & Velazquez, 1996)

For each of the dimension in the workload profile below, please indicate how much cognitive resources you devoted to the short-video-watching task you just finished.

Little 1	2	3	4	5	Much 6
Perceptual/central processing. These are attentional resources required for activities like perceiving (detecting, recognizing, and identifying objects), remembering, problem-solving, and decision making.					
Response processing. These are attentional resources required for response selection and execution. For example, there are three foot pedals in a standard shift automobile; to stop the automobile, we have to select the appropriate pedal and step on it.					
Spatial processing. Some tasks are spatial in nature. Driving, for example, requires paying attention to the position of the car, the distance between the current position of the car and the next stop sign, the geographical direction that the car is heading, etc.					
Verbal processing. Other tasks are verbal in nature. For example, reading involves primarily processing of verbal, linguistic materials.					
Visual processing. Some tasks are performed based on the visual information received. For example, playing basketball requires visual monitoring of the physical location and velocity of the ball. Watching TV is another example of a task that requires visual resources.					
Auditory processing. Other tasks are performed based on auditory information. For example, listening to the person on the other end of the telephone is a task that requires auditory attention. Listening to music is another example.					
Manual responses. Some tasks require considerable attention for producing the manual response as in typing or playing a piano.					
Speech responses. Other tasks require speech responses instead. For example, engaging in a conversation requires attention for producing the speech responses.					

Sense of Agency Scale (Tapal et al., 2017)

For each of the statement below, please indicate to what extent you agree with it after watching the short videos.

Little 1	2	3	4	5	Much 6
1. I am in full control of what I do. [a]					
2. I am just an instrument in the hands of somebody or something else. [b]					
3. My actions just happen without my intention. [b]					
4. My movements are automatic—my body simply makes them. [b]					
5. The outcomes of my actions generally surprise me. [b]					
6. Things I do are subject only to my free will. [a]					
7. The decision whether and when to act is within my hands. [a]					
8. Nothing I do is actually voluntary. [b]					
9. While I am in action, I feel like I am a remote-controlled robot. [b]					
10. My behavior is planned by me from the very beginning to the very end. [a]					
11. I am completely responsible for everything that results from my actions. [a]					

[a] Sense of Positive Agency. [b] Sense of Negative Agency.

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