Current Psychology
https://doi.org/10.1007/s12144-024-05907-8

Why does advertising work? exploring the neural mechanism of concreteness and emotional effects of donation advertising slogans

Dianyuan Zhang[1] · **Jie Yao**[1] · **Wenhao Han**[2]

Accepted: 19 March 2024

Abstract
Advertising is methods to encourage donations, and text is one of the most crucial fundamental elements in advertising. Therefore, we chose advertising slogans as the focus of this study. The main goal of this research is to investigate how the emotional and concrete aspects of advertising slogans can impact information processing procedures and neural mechanisms, ultimately influencing advertising effectiveness. We conducted a two-factor experiment with a 2×2 design, using the ERPs experimental paradigm. The results reveal that slogans with an emotionally positive appeal outperformed in terms of advertising memory (recognition response time) and audience intention (liking, acting, and sharing). Emotional-negative advertising slogans performed better in eliciting early attention (P1). Concrete advertising slogans excelled in enhancing advertising memory (recognition response time, correct recognition rate), as well as in the later stages of information processing stage (N400 and LPC). Furthermore, abstract advertising slogans performed better in capturing early attention (P2) and influencing action intention. We introduce a framework comprising five distinct phases for individuals to process the advertising slogans and emphasize the foundational role of emotions in individual cognition and the processing of advertising. These findings uncover the underlying mechanism behind the effectiveness of donation advertising and provide valuable insights for the design of philanthropic advertising practices.

Keywords Individual donations · Advertising · Concreteness · Valence · ERPs

Introduction

Charitable giving plays a crucial role in resource redistribution, particularly in economically disadvantaged regions and among marginalized populations, thereby contributing to social equity. Individual giving, which includes the donation of time, money, and goods by individuals who directly or indirectly assist recipients through charitable organizations and projects, is a vital form of charitable giving (Winterich & Zhang, 2014). As reported in *The World Giving Index 2022*, individual charitable donations have continued to increase globally since 2019 and reached its highest participation rate in 2022. The primary source of charitable giving is shifting from corporations to individuals. This trend highlights a shift in the structure of charitable giving, underscoring the need to develop effective public awareness strategies to promote and guide charitable behaviors.

Prior research on individual giving has primarily focused on examining the factors that influence donors and charitable organizations in promoting increased individual giving. The former refers to demographic characteristics, personality traits(Ye et al., 2015), and values (Neumayr & Handy, 2019). The latter refers to factors such as the charity's credibility and its establishment date (Graddy & Wang, 2009). In contrast, limited attention has been given to donation advertising, despite it being the most prevalent and effective manner of delivering charity messages to inspire audiences to take action. However, donation advertising will lose its effectiveness if it fails to convey the same 'product' of ideas as commercial advertising and is not presented in a manner that the audience accepts.

Advertising typically includes essential elements such as images, videos, colors, and text. In the age of visual media,

✉ Jie Yao
Vicky213211@163.com

[1] School of Journalism, Fudan University, 220 Handan Road, Shanghai 200433, China

[2] School of Psychology, Shandong Second Medical University, 7166 Baotong West Street, Weifang, Shandong 261053, China

Published online: 17 April 2024

the impact of images, videos (Missaglia et al., 2017), and colors (Choi et al., 2020) as attention-grabbing visual elements has been extensively researched. However, text is often overlooked. Although images, videos, and colors play crucial roles in capturing attention, conveying emotions, and increasing appeal, the effectiveness of communication through these visual elements also relies upon the accompanying text. Text can also serve as an indispensable function in conveying critical information, building trust, and prompting concrete action (Goering et al., 2011). The essence of advertising slogans lies in sentence comprehension, with relevant studies available in psycholinguistics for reference. Therefore, our study examines advertising slogans as a fundamental component of donation advertising. We approach this analysis from both psycholinguistic and advertising marketing perspectives.

Advertising and marketing research indicates that emotional valence (Jiao et al., 2021) and concreteness (Dewi & Ang, 2020) impact advertising effectiveness. However, many questions remain unanswered. Firstly, previous studies have primarily focused on exploring the causal relationship between advertising strategies and effectiveness, neglecting a deeper understanding of how and why advertisements exert their influence. The underlying reasons for the influence of emotion and concreteness remain unclear (Alsharif, Salleh, Alrawad et al., 2023d). Secondly, findings in psycholinguistics regarding lexical concreteness contradict research in advertising and marketing. Advertising research suggests that abstract elements in advertisements are more likely to capture the audience's attention (Dewi & Ang, 2020), while psycholinguistics argues that concrete words outperform abstract ones in memory (Stróżak et al., 2016) and learning (Zhao & Guo, 2023). This contradictory outcome deserves further investigation. The impact of words, whether emotional or concrete, depends on the specific context. Therefore, further research is necessary to explore how findings from the foundational field of psycholinguistics can be extended and applied to the practical scenarios of advertising and marketing. Thirdly, previous research on advertising and marketing has traditionally focused on the communicators in the communication chain, overlooking how audiences process information after encountering advertisements. We aim to explore advertising from the audience's perspective, investigating how audiences process advertisements.

For these reasons, our study has three main objectives. First, we aim to understand why emotional valence and concreteness in donation advertisement slogans are effective. Given the intricate nature of the impact of donation advertisements, our research aims to explore it from multiple dimensions, including advertising attention, comprehension, recognition, and audience intentions. We particularly emphasize not only focusing on the outcomes of emotional valence and concreteness on advertising but also understanding the neural mechanisms behind these results. Secondly, we aim to explore if fundamental findings can be directly applied to practical fields such as advertising and marketing. Closing the gap between research and application is crucial. Our efforts help integrate scholarly findings into the advertising industry's practical requirements. Most importantly, our research starts from the audience's perspective. We aim to investigate how individuals process emotional and concrete information in donation advertisements after being exposed to them. This can expand our understanding of how audiences engage with advertising information, thereby gaining a deeper insight into the inherent mechanisms of advertising effectiveness.

To better achieve the aims of this study, we opt to employ the ERPs technique. Cognitive neuroscientific tools are increasingly being utilized in the field of advertising and marketing to illuminate the unconscious processes of the audience (Alsharif et al., 2023c), including technologies such as EEG, fMRI, and fNIRS (Alsharif, Salleh, & PilelienAlsharif et al., 2023a, b, c). Firstly, much of the prevailing research on donation advertising heavily relies on self-reporting, which is susceptible to the influence of social desirability bias, particularly when investigating topics closely associated with ethics, such as donation advertising. Consequently, articles that rely on self-report data, obtained through questionnaires and interviews, face considerable challenges in terms of reliability and accuracy. The experimental approach adopted here serves to partially mitigate the impact of social desirability bias. Physiological data obtained from Electroencephalography (EEG) equipment is beyond the conscious control of participants, rendering it a more objective measurement. These data faithfully mirror the genuine cognitive processes of participants, making them highly suitable for evaluating the effectiveness of donation advertising (Pilelienė, 2022). Furthermore, another aim of this study is to explore the neural mechanisms that underlie the processing of advertising messages by the audience. ERPs is widely used as an objective measure in cognitive function research, reflecting higher brain activity. Its millisecond-level temporal resolution makes it particularly suitable for examining the cognitive processing mechanisms of the audience at various stages of the communication process (Alsharif, Salleh, Hashem E, Alsharif et al., 2023a, b, c). Hence, we have chosen to utilize the ERPs technique to examine the neural responses of the audience when exposed to advertisements. This represents an extension in addressing the issue of social desirability bias in research methodologies within the field of advertising and marketing.

This study is structured as follows: Section 2 presents the current research on the topic. Section 3 outlines the methods employed in this article. Section 4 presents the results derived from behavioral, self-report, and EEG data. Section 5 discusses the results. Section 6 concludes this research, summarizing its contributions, limitations, and suggesting future research directions.

Current research

Emotional valence and its performance in the context of advertising marketing and psycholinguistics

Emotional appeals are common strategies in advertising creativity. When an advertising slogan incorporates emotion, its effectiveness increases. It is important to distinguish between emotions and feelings. Emotions are physiological and biological responses, while feelings represent the subjective experience and cognition of these emotions. These two aspects are often interconnected, with emotions being more subjective and individualized (Alsharif et al., 2022). In this study, we place greater emphasis on the emotional expression conveyed by the advertising slogan itself, rather than on the receiver's feelings. Emotion in advertising slogans comprises two dimensions: arousal level, which assesses the intensity of the emotion, and valence, which determines whether the emotion is positive or negative (Bliss-Moreau et al., 2020). In our design, we manipulate the arousal level of advertising slogans to investigate the impact of emotions on the effectiveness of advertising slogans. From an emotional perspective, advertising slogans can be classified as either positive or negative. Emotional-positive advertising slogans employ emotionally positive wording, such as 'With your help, people in the affected areas can lead a happier life,' whereas emotional-negative advertising slogans use emotionally negative phrasing, such as 'Without your assistance, people in the affected areas will lead a sorrowful life.' The former expresses positive emotions, like "happiness," while the latter conveys negative emotions, such as "sadness."

Previous research has examined the influence of various emotional expressions in advertising on charitable behavior. Emotional-negative expressions, which encompass inducing feelings of guilt (Urbonavicius et al., 2019), anger, and sadness (Paxton et al., 2020), have been shown to increase charitable behavior. However, it has been suggested that individuals receiving assistance may be reluctant to display their suffering in order to receive help, potentially reinforce social stereotypes. Consequently, there is a growing interest in investigating the motivational impact of positive emotions, such as awe and love (Jiao et al., 2021), which can enhance altruistic behavior. Although previous research has indicated the potential benefits of evoking both positive and negative emotions to encourage pro-social behavior, it remains unclear what specific conditions and mechanisms underlie the effects of these different emotions.

The essence of advertising slogans is the semantic comprehension. When examining its impact, we can draw upon relevant research in the field of psycholinguistics. Psycholinguistics has generated a substantial body of research on the mechanisms of emotion in lexical comprehension, suggesting that emotional words have a processing advantage. Emotional words influence early ERPs components, where emotional-positive words elicit a greater P1 and P2 component in comparison to neutral words, while negative words only evoke a larger P1 component when contrasted with neutral words (Keuper et al., 2013). These findings imply that emotional words are more effective at capturing individual attentional resources, highlighting that the processing of positive and negative valence is not simply a dichotomy. In later ERPs components, emotional words result in a diminished N400 component compared to neutral words (Kanske & Kotz, 2007). The LPC component is also associated with the processing of emotional words, as emotional words triggering a larger LPC component than neutral words (Schindler & Kissler, 2016). Nevertheless, findings related to emotional valence are inconclusive, as some studies suggest that emotional-positive words are associated with a larger LPC component (Delaney-Busch et al., 2016), while others indicate a larger LPC component only for negative words (Hofmann et al., 2009). These disparities may be attributed to the influence of the experimental task and the level of attention.

Most of the research on lexical emotionality in psychology, as outlined in the preceding section, has primarily focused on processing emotional information in individual words, without delving into the nuances of semantic processing. However, understanding the emotional attributes aspects of advertising slogans requires an evaluation within their complete contextual framework. Given that emotional appeals are a conventional strategy in advertising creativity, so it is essential to grasp their functioning within a broader context. Nevertheless, the underlying mechanisms of this strategy remain uncharted.

Concreteness and its performance in the context of advertising marketing and psycholinguistics

Effectively communicating the purpose of a donation to the audience plays a crucial role in enhancing their willingness to participate in donations (Cryder et al., 2013). Statements in donation advertisements can be categorized as either

concrete or abstract based on their level of specificity. A concrete advertisement is characterized by its specificity, providing detailed information that addresses the reader's needs. In contrast, an abstract advertisement conveys a less precise message, requiring more inference and allowing greater room for interpretation by the recipient (Miller et al., 2007). For instance, consider the following expressions: 'With your help, people in the affected areas can live with a smile' and 'With your help, people in the affected areas can live happily.' In these expressions, 'smile' and 'happiness' are concrete words and abstract words, respectively. Both expressions signify an improved life for the donation recipients, but their differing levels of concreteness may result in distinct effects.

For charity donations, research has shown that specifying a particular recipient is more effective than targeting an abstract beneficiary group (Erlandsson et al., 2015). Furthermore, using concrete donation quantifiers has been found to yield better results (Das et al., 2016). This is because concrete wording can enhance individuals' perception of information credibility and transparency (Xiao et al., 2021). In the realm of advertising, some studies have suggested that individuals, relying on specific information, can evaluate the attainability of their goals, as they are more willing to invest time or effort (Kopetz et al., 2012). All of these findings indicate that concrete wording is more effective in eliciting action. However, advertising exerts a multifaceted impact, encompassing various factors such as attention, comprehension, memory, and audience intention. Attention to advertising is a prerequisite for the occurrence of these subsequent effects. Since users have limited cognitive resources, advertising must compete with other messages for their attention (Wojdynski & Evans, 2020). Some studies have suggested that when processing advertising messages, audiences are more inclined to focus on abstract and ambiguous elements (Dewi & Ang, 2020).

In contrast, linguistic research on lexical concreteness has shown that concrete words perform better. Some studies have indicated that the impact of concreteness on lexical processing is primarily observed in the two late components of the N400 and LPC. Concrete words tend to evoke a more pronounced N400 component and a reduced LPC component (Stróżak et al., 2016; Zhao & Guo, 2023). However, in sentence studies, the concreteness effect was found to diminish due to the contextual information provided by the sentence, compensating for the absence of contextual information in abstract words (Bechtold et al., 2023).

The aforementioned review underscores two key points: Firstly, the effects of concreteness in the fields of advertising and psycholinguistics shows contrasting trends. Secondly, research findings on lexical concreteness and sentence concreteness in the field of psycholinguistics exhibit inconsistencies. These observations suggest that studies on the influence of lexical and sentences in psycholinguistics may not fully apply to the examination of concreteness in donation advertising. The effectiveness of donation advertising involves a complex hierarchy. The results concerning advertising attention and donation behavior show discrepancies in terms of concreteness, which necessitate further discussion. Moreover, the neurological mechanisms underpinning the impact of concreteness in advertising have not yet received adequate elucidation.

A review of existing studies reveals that there are still numerous unanswered questions regarding the emotional valence and concreteness of advertising slogans. Based on the preceding discussion, we propose the following questions:

Q1 How does emotional valence influence the effect of donation advertising slogans? What are the underlying neural mechanisms by which emotion impacts advertising effect?

Q2 How does concreteness influence the effect of donation advertising slogans? What are the underlying neurological mechanisms by which concreteness impacts advertising effect?

Q3 What are the neural mechanisms by which advertising works? How do audiences process advertising messages when they are exposed to them?

Donation advertising effectiveness measurement

In this research, we aim to evaluate the effectiveness of donation advertising slogans across four primary dimensions: attention, comprehension, recognition, and audience intention.

Advertising attention refers to the extent of attention the audience gives to the advertisement and is linked to two early attention components: P1 and P2, which may reflect the allocation of individual attention resources (Keuper et al., 2013). Advertising comprehension refers to the audience's understanding of the advertising message and their ability to grasp the intended purpose conveyed by the advertisement. This is associated with the N400 component, which reflects the level of semantic processing (Kutas & Federmeier, 2010).

Furthermore, advertising is closely connected to working memory, which entails the temporary storage and manipulation of information required for task performance. In essence, individuals temporarily retain information acquired from their environment and then engage in various cognitive

processes to guide their future actions. Donation decisions are often impulsive and spontaneous rather than routine occurrences, typically made promptly by individuals. Therefore, working memory plays a significant role in the decision-making process related to donations or consumption. Working memory is associated with the LPC component (Peng et al., 2019), and it is evaluated using measures such as recognition response time and correct recognition rate. Audience intention encompasses their advertising liking and willingness to act, and share. The advertising liking reflects the extent to which the audience experiences pleasure, amusement, and enjoyment after viewing the advertisement. The willingness to act pertains to the audience's inclination to take action in response to the advertisement, while the willingness to share pertains to their readiness to communicate and spread the advertisement.

Materials and methods

Participants

Before conducting the formal experiments, we initially recruited 30 participants aged 18 to 30 (23.6 ± 3.45), evenly divided between 15 males and 15 females. This step aimed to assess and select appropriate experimental materials. We employed G-power 3.1 to calculate the required number of participants. Under the conditions of an effect size of 0.2 and a power of 0.8, a total of 24 participants would be sufficient to meet the experimental. The formal experiments were carried out with 32 participants aged 18 to 30 (23.50 ± 2.94), comprising 16 males and 16 females. Unfortunately, due to an EEG equipment, one male participant was only able to provide behavioral and self-reported data. To avoid potential biases related to familiarity with the experimental materials, the participants in the main experiment were distinct from those involved in the preliminary experiment. Additionally, to ensure participant homogeneity, all participants were non-working college students. In China, college students generally rely on financial support from their parents and government subsidies, resulting in similar economic circumstances among them. All participants had normal or corrected visual acuity, were right-handed, and had no history of psychiatric disorders. The Ethics Committee of Fudan University granted approval for the experiment. Before participating, all participants signed informed consent forms.

Table 1 Statistical Test Results for Experimental Materials

	Main Effect of Emotional Valence	Main Effect of Concreteness
Emotional Valence	$F = 2892.371, p < .001$	$F = 1.103, p = .372$
Concreteness	$F = 0.424, p = .567$	$F = 363.634, p < .001$
Arousal	$F = 0.617, p = .438$	$F = 2.139, p = .152$
Strokes	$F = 0.311, p = .602$	$F = 0.424, p = .575$
Familiarity	$F = 0.650, p = .426$	$F = 2.441, p = .150$

Stimuli

We used a within-subjects design in the experiment, with a 2 (concreteness: concrete-abstract) × 2 (emotional valence: positive-negative) factorial approach. A total of 30 participants were engaged to assess the concreteness (ranging from concrete to abstract), valence (ranging from positive to negative), arousal (low to high), and familiarity (low to high) of 200 experimental words (e.g., when you encounter this word, can you create a specific mental image of the food it represents? For instance, when you see the word "apple", you can form a mental image of a round, red fruit, while with the word "thought", it's difficult to conjure a concrete image.). These words were selected from the CAWS (Wang et al., 2008), with 50 words assigned to each of the four conditions. Ratings were provided on a 5-point scale. Based on the ratings, 144 words were chosen and evenly distributed across the four conditions, resulting in 36 words per condition. We conducted ANOVA on the selected vocabulary, and the results are outlined in Table 1. The emotional tone and concreteness of the vocabulary could be effectively distinguished, and there were no significant differences in terms of arousal, familiarity, and stroke count for the words. For the formal experiment, 96 words were presented as old words, while 48 were introduced as new words. In the recognition experiment, the old words referred to those that had been presented during the learning phase, whereas the new words were similar but distinct from the old words and were introduced during the recognition phase. The new words had not been previously presented during the learning phase.

Each vocabulary item from the formal experiment was transformed into an advertising slogan, resulting in a total of 144 advertising slogans. These slogans were displayed on a 32" Display++monitor with a resolution of 1920×1080 and a refresh rate of 120 Hz, using the Song 4 font. The participants were seated at a distance of 55 cm from the monitor and were instructed to maintain a stable head position throughout the experiment.

Procedure

Figure 1 illustrates the flow of the experimental program implemented using Psychopy.

Before the start of the experiment, participants were provided with the study's context, explaining that the entire advertising slogans were dedicated to soliciting donations in support of those who had been severely affected by the

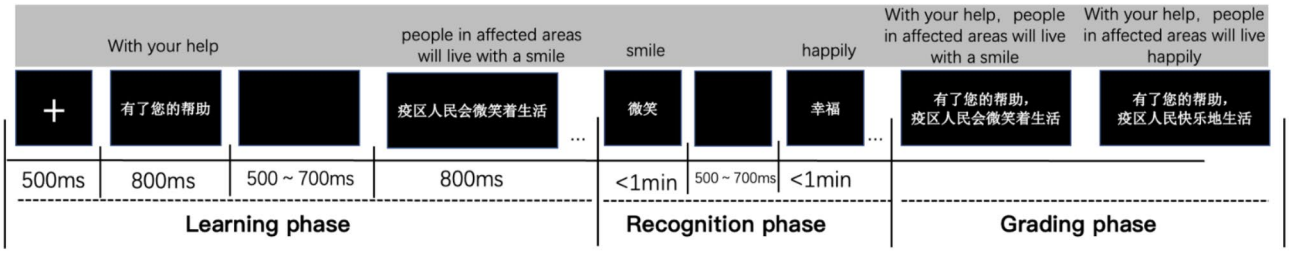

Fig. 1 Experimental procedure. The information presented in the gray background provides an English translation of the Chinese stimulus utilized in this experiment. The figure displays advertising slogans involving positive-concrete and positive-abstract words. We also offer advertising slogans involving negative-concrete and negative-abstract words examples: "Without your assistance, people in the epidemic-stricken areas would live with the pathogen" and "Without your assistance, people in the epidemic-stricken areas would live in desolation"

COVID-19 pandemic. The entire experiment consisted of three stages.

The learning phase consisted of three steps. Step 1: A gaze point was randomly displayed on the screen for 500ms. Step 2: An advertising contextual sentence was presented on the screen for 800ms. The contextual sentences include two fixed sentence patterns: "With your help" and "Without your help," which are paired based on the emotional valence of advertising slogans. Following the display of the scenario sentence, an empty screen was shown for 500ms ∼ 700ms. Step 3: The advertising slogan was randomly presented to participants for 800ms for learning purposes. Subsequently, an empty screen was displayed for 700ms. The three steps above constituted one trial. After 24 trials, the participants proceeded to the recognition phase.

The recognition phase consisted of two steps. Step 1: A total of 24 words were presented individually on the screen. This set included 12 new words that were not encountered by participants during the learning phase, and 12 old words, which participants viewed during the learning phase. Step 2: Participants were instructed to press the left or right keys to indicate whether the word appeared in the learning phase. Once a selection was made, the word disappeared, and the screen remained blank for 500-700ms before proceeding to the next word. The two steps above formed one trial. After completing 24 trials, the participants progressed to the grading phase.

The grading phase also consisted of two steps. Step 1: The 24 slogans used during the learning phase were randomly displayed at the top of the screen, while questions regarding audience willingness were presented at the bottom. Step 2: Participants were asked to rate the advertising slogans using a five-point scale. The experimental task did not have a time limit, and participants were encouraged to respond accurately and promptly. The two steps above constituted one trial. After completing 24 trials, the participants were given a rest.

The four components mentioned above constituted one block. The experiment consisted of four blocks, with each block comprising 24 trials. These 24 trials involved four distinct conditions. Participants were required to take a minimum rest period of 30 s between each block.

Data acquisition

Behavioral and self-report data recording

The dependent variables for the two behavioral data were the correct recognition rate and recognition response time of the advertising slogans. For the three self-reported data, the dependent variables were audience advertising liking, intention to act, and share. All data were automatically collected using Python 3.8.

ERPs Recording

The data was recorded using the Neuronscan Synamp2 Amplifier's 64Ag/AgCl electrodes. The electrodes were arranged according to the International 10–20 system, with bilateral mastoids serving as online references. HEOG electrodes were placed at the outer canthi of the right and left eyes, while VEOG electrodes were affixed above and below the left eye orbit. Scalp resistance for all electrode sites was maintained below 5 kΩ, with data sampled at a frequency of 500 Hz and a bandpass filter set to 0.01–100 Hz.

The data was processed offline using MNE in Python. The continuous data acquired were subjected to offline band-pass filtering ranging from 0.1 to 40 Hz. A whole-brain average reference was applied to the data, and independent component analysis was used to remove artifacts and obtain the artifact-free signal. The segmented data spanned from 200ms before the presentation of the advertising stimulus to 800ms after its appearance. The initial 200ms served as the baseline, and the segmented data were adjusted accordingly. The bands with amplitudes exceeding ± 80 μV were automatically excluded. The bands from each condition were then overlaid and averaged. For the mean peak statistical analysis, based on previous studies on lexical ERPs and

Table 2 Behavioral results

		df	*F*	*p*	η^2_p		*df*	*F*	*p*	η^2_p
Con	CRR	1	0.098	< 0.001	0.373	RRT	1	5.111	< 0.05	0.142
Van		1	18.435	0.757	0.003		1	12.255	< 0.01	0.283
Con× Van		1	2.588	0.118	0.077		1	0.002	0.968	0.0E0

Note Con = concreteness, Van = emotional valence, CRR = correct recognition rate, RRT = recognition response time

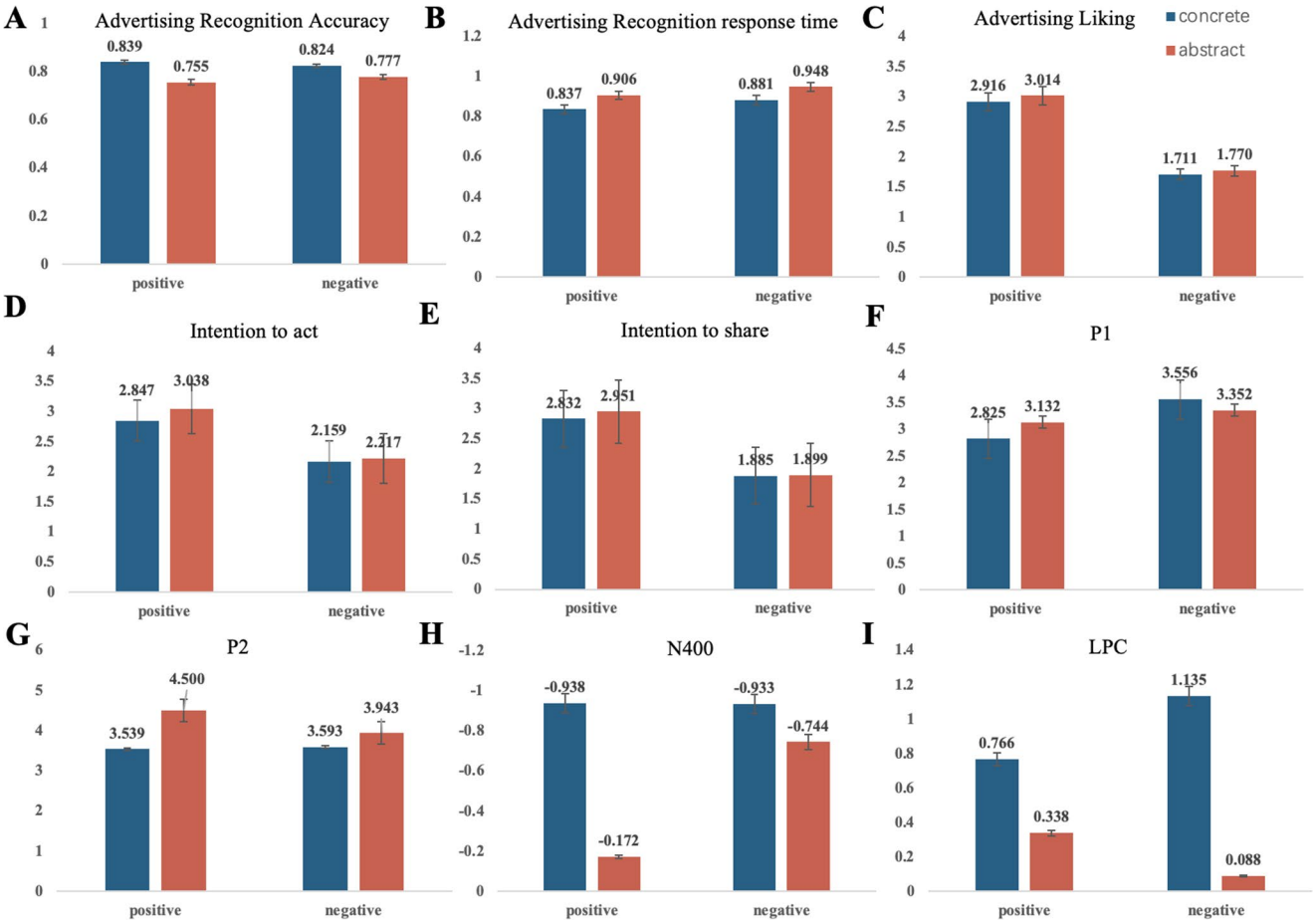

Fig. 2 Shows the bar chart for behavioral data, sell- reported data, and ERPs data_ (**A**)(**B**) respectively illustrate advertising recognition accuracy and response times. (**C**),(**D**) and (**E**) depict liking, intention to act, and intention to share, respeclively represent the P1, P2, N400, and LPC components, measured in microvolts (μV)

the topographic distribution of the overall mean ERPs in this study, the PO4, PO3, and POz electrodes were selected for analyzing the P1 component (time windows: 140ms to 200ms) and P2 component (time windows: 220ms to 300ms). For the N400 component (time windows: 360ms to 420ms) and LPC component (time windows: 630ms to 800ms), the P1, P2, and Pz electrodes were chosen for the mean peak statistical analysis.

Results

We used IBM SPSS Statistics 26 to conduct separate repeated measures ANOVAs on the behavioral data, self-reported data, and ERP data. Greenhouse-Geisser adjustment was applied to correct the degrees of freedom, and post hoc tests were performed using the Bonferroni correction.

Behavioral results

As shown in Table 2; Fig. 2 (A)(B), the main effect of concreteness was significant. Concrete advertisements had a higher correct recognition rate (0.831 ± 0.014) compared

Table 3 Self-report results

	Like			Act			Share		
	Con	Van	Con× Van	Con	Van	Con× Van	Con	Van	Con× Van
df	1	1	1	1	1	1	1	1	1
F	2.988	59.561	0.412	9.825	17.894	2.853	3.726	31.548	1.869
p	0.094	< 0.001	0.525	< 0.01	< 0.001	0.101	0.063	< 0.001	0.181
η^2_p	0.085	0.651	0.013	0.241	0.366	0.084	0.107	0.504	0.057

Note Con = concreteness, Van = emotional valence, Like = advertising liking, Act = willingness to act, Share = willingness to share

Table 4 ERPs results

		df	*F*	*p*	η^2_p		*df*	*F*	*p*	η^2_p
Con	P1	1	0.0E0	1	0.0E0	P2	1	5.515	< 0.05	0.142
Van		1	4.368	< 0.05	0.127		1	0.941	0.340	0.283
Ba		2	4.480	< 0.05	0.236		2	7.073	< 0.05	< 0.000
Con × Van		1	2.326	0.138	0.072		1	1.525	0.226	0.048
Bra ×Van		2	0.0E0	1	0.0E0		2	0.0E0	1	0.0E0
Bra × Con		2	1.420	0.258	0.089		2	0.0E0	1	0.0E0
Bra ×Con× Van		2	2.752	0.08	0.160		2	0.0E0	1	0.0E0
		df	***F***	***p***	$\boldsymbol{\eta^2_p}$		***df***	***F***	***p***	$\boldsymbol{\eta^2_p}$
Con	N400	1	5.700	< 0.05	0.160	LPC	1	6.190	< 0.05	0.171
Van		1	1.352	0.254	0.043		1	0.0E0	1	0.0E0
Bra		2	29.343	< 0.001	0.669		2	17.309	< 0.001	0.544
Con × Van		1	2.159	0.152	0.067		1	1.179	0.286	0.038
Bra ×Van		2	0.0E0	1	0.0E0		2	0.0E0	1	0.0E0
Bra × Con		2	3.422	< 0.05	0.191		2	6.208	< 0.05	0.300
Bra ×Con× Van		2	0.0E0	1	0.0E0		2	0.0E0	1	0.0E0

Note Con = concreteness, Van = emotional valence, Bra = brain area

to abstract advertisements (0.766 ± 0.018). Furthermore, concrete advertisements showed a shorter recognition response time (0.858 ± 0.021) compared to abstract advertisements (0.926 ± 0.024). the main effect of emotion was only significant for recognition response time. Emotional-positive advertisements displayed a shorter recognition response time (0.872 ± 0.019) in comparison to negative ones (0.914 ± 0.024). No interaction effects were observed for either the correct recognition rate or the recognition response time.

Self-report results

As displayed in Table 3; Fig. 2(C)(D)(E), the main effect of emotional valence was significant. Emotional-positive advertisements exhibited a higher liking (2.965 ± 0.153), willingness to take action (3.077 ± 0.153), and share (2.891 ± 0.140) compared to negative ones (1.741 ± 0.92 $_{\text{advertising liking}}$, 2.188 ± 0.160 $_{\text{willingness to act}}$, 1.892 ± 0.129 $_{\text{willingness to share}}$). Moreover, the main effect of concreteness had a significant impact on willingness to take action. Abstract advertisements demonstrated a higher willingness to act (2.627 ± 0.118) compared to concrete advertisements (2.503 ± 0.122). No interaction effects were observed for all self-reported dependent variables.

ERPs results

As shown in Table 4(F), the emotion of donation advertising slogans had a significant effect on the P1 component. Emotional-negative advertising slogans (3.454 ± 0.691 μV) displayed a higher mean amplitude for the P1 component compared to emotional-positive ones (2.978 ± 0.705 μV).

As shown in Table 4(G)(H)(I), concreteness demonstrated a significant effect on the P2, N400, and LPC components. Specifically, abstract advertising slogans (4.222 ± 0.559 μV) exhibited a higher average amplitude for the P2 component compared to concrete ones (3.566 ± 0.604 μV). Furthermore, concrete advertising slogans (-0.936 ± 0.453 μV) displayed a higher mean amplitude for the N400 component compared to abstract ones (-0.458 ± 0.506 μV). Lastly, the mean amplitude of the LPC component for concrete advertising slogans (0.950 ± 0.426 μV) was higher than that of abstract ones (0.213 ± 0.476 μV). For these components, there is no interaction between emotional valence and concreteness.

Brain regions exhibited significant effects on the P1, P2, N400, and LPC components. Specifically, for the P1, P2, and LPC components, the right brain mean amplitude (P1: 3.793 ± 0.795 μV, P2: 4.523 ± 0.663 μV, LPC: 0.942 ± 0.472 μV) was higher than the left brain (P1: 3.337 ± 0.869 μV,

P2: 4.166 ± 0.663 μV, LPC: 0.810 ± 0.431 μV), and both were higher than the midline (P1: 2.519 ± 0.713 μV, P2: 2.993 ± 0.541 μV, LPC: -0.007 ± 0.440 μV). Additionally, the N400 component exhibited a higher midline mean amplitude (-1.636 ± 0.478) compared to the right brain (-0.417 ± 0.537) and the left brain (-0.038 ± 0.456).

Brain regions and concreteness exhibited interactions with the N400 and LPC components. In the case of abstract advertising slogans, the N400 mean amplitude in the midline (-1 ± 0.523 μV) was higher than in the left brain (-0.345 ± 0.504 μV) and the right brain (-0.335 ± 0.580 μV). Moreover, the LPC mean amplitude in the left brain (0.638 ± 0.462 μV) was higher than in the right brain (0.511 ± 0.539 μV) and the midline (-0.511 ± 0.503 μV). Conversely, for concrete advertising slogans, the N400 mean amplitude in the midline (-2 ± 0.449 μV) was higher than in the right brain (-0.499 ± 0.524 μV) and the left brain (-0.429 ± 0.443 μV), whereas the LPC mean amplitude in the right brain (1.373 ± 0.484 μV) was higher than in the left brain (0.981 ± 0.447 μV) and the midline (0.497 ± 0.438 μV).

We generated the topographical maps for each millisecond within the 800ms period following stimulus presentation and produced a video to visualize the dynamic brain activity across various regions during information processing. In Fig. 3(G), we have displayed a screenshot capturing the critical moment of the video, illustrating the breakdown of advertising slogan processing into five stages. Stage I: Within 126ms of the advertising stimulus presentation, only the right and left occipital lobes exhibited activation. Stage II: Between 126ms and 220ms, the intensity of activation in the occipital lobes on both sides of the brain transitioned from no significant difference initially to a noticeably stronger activation on the right side. Additionally, the frontoparietal lobes showed a pattern of activation followed by a decrease, occurring between 126ms and 180ms. During Stage III: From 220ms to 300ms, the focus of brain activation shifted from the parietal lobes to the frontal lobes. Stage IV: Between 300ms and 600ms, there was a shift in brain

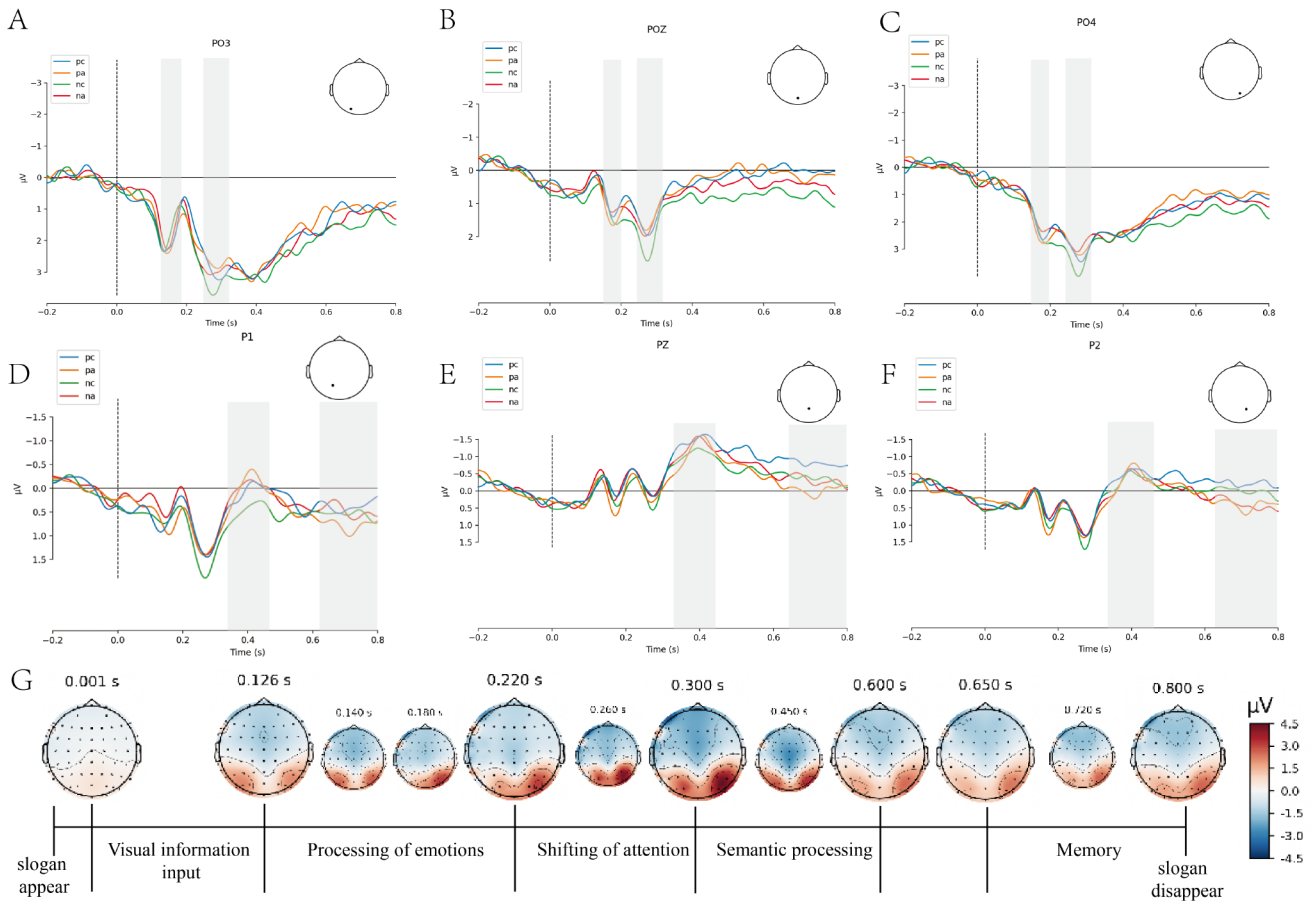

Fig. 3 ERPs results. (**A**)(**B**)(**C**) Grand ERP waveforms of the P1(140 ms-200 ms) and P2(220 ms-300 ms) components for the four conditions at the representative P03 POZ and PO4 sites. (**D**)(**E**)(**F**) Grand ERP waveforms of the N400(360ms-420ms) and LPC(630ms-800ms) components for the four conditions at the representative PI PL and P2 sites. (**G**) Topographic distributions of the brain waves at the representative points, with the 0-800 ms time interval. Legend notes: pc = positive and concrete advertising slogans, pa = positive and abstract advertising slogans, nc = negative and concrete advertising slogans, na = negative and abstract advertising slogans

activity occurred from the frontal lobes back to the parietal lobes. Stage V: After 650ms, the frontoparietal lobes exhibited activation.

Discussions

In the following section, we aim to interpret the information processing process by considering the neural mechanisms underlying the emotions and concreteness of the donation advertising slogans. This interpretation is based on the combination of behavioral results, self-report results, and ERPs results.

The early stage of advertising information processing

Stage I: receiving visual information from advertising slogans

In Stage I, only the left and right occipital lobes were activated, and there was no significant difference in the intensity of activation between the two sides. The occipital lobe houses the visual cortex, which is responsible for processing visual information. Consequently, there is a strong correlation between the occipital lobe and the processing of visual information. In this context, we speculate that during this stage, the visual information presented in the advertisement is undergoing initial processing. Participants visually perceive the ad, leading to the activation of the occipital lobe and involves a bottom-up information transfer process. However, no further processing of the advertisement occurs during this stage, which explains the similar levels of activation observed in both the left and right occipital lobes.

Stage II: attention focused on the emotional content within the advertising slogan

Stage II represents a phase during which the frontoparietal lobe undergoes activation and deactivation processes. Differences in activation between the left and right occipital lobes begin to emerge, and both the occipital and frontoparietal lobes engage in information processing. We speculate that the frontoparietal lobe has already received the advertising information transmitted by the occipital lobe, processed it, and then provided feedback to the occipital lobe, which then engages in top-down information processing.

It is well-established that the right hemisphere of the brain is involved in emotion processing. The activation of the right occipital lobe indicates that the emotions within the advertising text are beginning to have an effect. The frontoparietal area is primarily responsible for processing negative emotions (Niendam et al., 2012), which corresponds to the larger P1 components elicited by emotional-negative advertising slogans, implying that Stage II represents the stage of emotional processing in advertising slogans. The time windows of the P1 component (140ms-200ms) largely overlap with Stage II (126ms-220ms), and emotional-negative advertising slogans evoke a larger P1 component. A larger P1 component indicates a higher allocation of attentional resources (Keuper et al., 2013), suggesting that emotional-negative advertising slogans consume more attentional resources. These findings are consistent with previous research, as negative stimuli are perceived as threats and are closely linked to human survival. The processing of threatening stimuli generally takes priority over the processing of positive stimuli (Ruiz-Padial & Mercado, 2021). Consequently, a negative bias operates in the early stages of the cognitive processing of advertising information. During this stage, emotional-negative advertising slogans effectively capture individuals' attention and heighten their level of alertness.

Additionally, the P1 component is often considered a reflection of early attention bias in automatic processing. Therefore, the processing of emotional-negative advertisements can be categorized as unconscious processing, demonstrating that emotions automatically regulate attentional levels in the early stages of cognitive activity. Early emotional effects stem from conditioned associations between word forms and emotional connotations that are independent of the language system (Kissler et al., 2009). Chinese characters, as a typical pictographic script, have visual characteristics repeatedly associated with their emotional meanings. As a result, participants can access the emotional meaning of characters by perceiving their visual features, which leads to the induction of emotional effects.

Stage III: attention shifts from the emotional content within the advertising slogan to its semantic meaning

In Stage III, the parietal and frontal lobes were sequentially activated, with the left temporal lobe also exhibiting activation. All three brain regions showed a tendency toward left-lateralization. The parietal cortex contains "attentional neurons" that are sensitive to shifts in attention, and conscious lexical processing significantly activates specific areas of the prefrontal cortex and parietal lobes (Dehaene et al., 2001). The left frontal lobe is responsible for selecting and inhibiting semantic information (Lau et al., 2009), while the left temporal lobe is involved in accessing the semantic meaning of words (Hagoort, 2005). These findings indicate that after 220ms, conscious attention becomes prominent in the processing of advertising slogans, and

cognitive resources shift from spontaneous emotions to the slogans themselves.

This conclusion is further supported by the P2 component. The Stage III time window (220 ms to 300 ms) highly overlaps with that of the P2 component (220 ms to 300 ms), resulting in a significantly larger P2 amplitude elicited by abstract advertising slogans. A greater P2 wave amplitude indicates a higher level of attentional engagement (Gibbons et al., 2022), suggesting that abstract advertising text demands greater attentional resources. This outcome is likely due to the vagueness of the information provided by abstract advertising slogans, which imposes a higher cognitive load, consumes more cognitive resources, and thus necessitates increased attentional allocation. Interestingly, previous studies have not identified a P2 effect of concreteness, as concreteness involves semantic processing primarily manifested in some mid-to-late components. We hypothesize that, in this study focusing on advertising slogans, the advertising context serves as a cue for participants, accelerating the processing of concreteness in individuals.

The late stage of advertising information processing

Stage IV: the semantic meaning of the advertising slogan begins to be processed

In Stage IV, activation occurred in brain regions stretching from the frontal to the parietal lobes. The frontal lobe is known for its substantial role in semantic processing of Chinese characters (Zhao et al., 2017). We speculate that this stage pertains to the semantic processing of advertising information, primarily focused on the concreteness semantics of advertising slogans. This conjecture is supported by the N400 component. The time window of the N400 component (360 ms to 420 ms) significantly overlaps with Stage IV (300 ms to 600 ms), and concrete advertising slogans trigger a more pronounced N400 component. This result is consistent with prior research that associates the N400 component to the depth of semantic processing. Concrete advertising slogans establish stronger semantic connections and information retention during memory tasks(Zhao & Guo, 2023). This increased level of word processing leads to a greater amplitude of the N400 component.

Stage V: the advertising information is continuously encoded and memorized

In Stage V, the frontoparietal lobe was reactivated. The parietal lobe is a primary region for cognitive function and short-term memory. The frontoparietal lobe consistently activates during working memory tasks (Berryhill et al., 2011). Therefore, we speculate that Stage V represents the memory phase of advertising information processing.

This observation is supported by the LPC component. The Stage V time window (650ms to 800ms) significantly overlaps with the LPC time window (630ms to 800ms). The LPC component reflects top-down control over working memory storage processes (Gao et al., 2011). Notably, concrete advertising slogans elicited a higher LPC mean amplitude than abstract slogans. This differs from the findings of many psycholinguistic studies (e.g.,Kanske & Kotz, 2007; Stróżak et al., 2016; Zhao & Guo, 2023). This discrepancy may be attributed to differences in experimental tasks, as our recognition experiment diverges from previous attention-based experiments. In addition, it could be the result of the integrated context of information processing in our study within the overall context of advertising slogans, as opposed to isolated word processing in previous experiments (Kanske & Kotz, 2007). This result enlightens us that fundamental lexical processing and context-rich advertising slogans processing are not identical. It underscores the importance of caution when extrapolating foundational research findings to practical applications.

Research has shown that recognition-correct ERPs exhibit a larger late-positive component than recognition-incorrect ERPs (Cadavid & Beato, 2016), which is consistent with our experimental behavioral data. Concrete advertising slogans were remembered correctly and led to faster response times compared to abstract slogans. Therefore, the difference in the LPC component between concrete and abstract advertising slogans may reflect the distinct encoding of memories for these two types of slogans. Lexical processing relies more on contextual information, prior knowledge, and language experience, with concrete words benefiting from richer contextual information compared to abstract words, resulting in quicker processing and comprehension of concrete words (Davis et al., 2020). As a consequence, individuals engage in more intensive memory encoding of concrete advertising slogans, resulting in larger LPC waves at the late processing stage.

It is noteworthy that abstract advertising slogans exhibited higher attention (P2), while concrete advertising slogans outperformed semantic processing (N400) and recognition (LPC, recognition accuracy, and recognition response time). This can be attributed to the content of abstract advertising slogans, which generally contain less explicit information, and feature more conceptual and metaphorical content. Consequently, this necessitates a greater allocation of attention resources for comprehension and coding. However, this doesn't necessarily translate into superior memory performance. Individual levels of attention have no direct causal relationship with memory levels. Attention represents the encoding process in information processing, while memory

encompasses processes such as recognition, retrieval, and recall. There is no significant correlation between attention and memory (Oberauer, 2019).

Furthermore, abstract advertising slogans elicited higher levels of audience intent to take action, whereas they had no effect on likability or sharing intentions. Action intent requires more individual resources, such as money and time, compared to likability and sharing intentions. Therefore, individuals are influenced by both rapid, intuitive reactions to emotions and slower, more analytical thinking processes. Therefore, it is more susceptible to the influence of information concreteness. Additionally, prior research has often suggested that concrete information facilitates charitable behavior (Macdonnell & White, 2015), which is inconsistent with our findings. We propose that this discrepancy may arise from the nature of the concreteness examined. Previous studies have focused on the concreteness of donation recipients or the concreteness of the charitable organization's activities, whereas our study concentrates on the concreteness of donation outcomes. Abstract advertising slogans is often linked to general principles, goals, or values, making it easier to evoke individuals' internal imagination and reasoning (Wang & Lehto, 2019). This provides a space consistent with personal values and experiences, enhancing recognition and further stimulating intent for action. Abstract advertising slogans may prompt associations with broader social impacts and long-term personal goals, thereby promoting donation behavior. In the context of donation outcomes, abstract advertising slogans are generally associated with general principles, goals, or values rather than specific actions or details. Individuals are less likely to get bogged down in details or confusion, making them more likely to be inspired and take action (Choi et al., 2017). This could also account for the differences in previous results.

In summary, a comprehensive analysis of ERPs, behavioral, and self-report results indicates that the ad concreteness is reflected in higher amplitudes of N400 and LPC components compared to abstract advertisements. This suggests that semantic processing and working memory operations are superior for concrete advertisements. This is further corroborated by behavioral data, where the accuracy and response times for concrete advertisements outperform those for abstract advertisements. The P2 component exhibits higher amplitude s for abstract advertisements, indicating higher arousal for abstract content. This implies that abstract advertisements consume more attentional resources, which is manifested in behavioral data by longer response times for abstract advertisements. Notably, the consistency between neural and behavioral responses is evident. However, self-report data diverges, showing that participants rate the appeal of abstract advertisements higher than concrete ad. This suggests that neural and behavioral responses are subconscious, unaffected by social context, whereas self-report data reflects conscious judgments, influenced by individual considerations, social norms, and other factors.

The basic role of emotion in advertising message processing

According to the ERPs results, the P1, P2, N400, and LPC components all exhibited higher mean amplitudes in the right hemisphere compared to the left hemisphere. The EEG topography consistently showed concentrated activation in the right occipital region, with lesser and delayed activation observed in the left hemisphere following stimulation presentation. There are two possible explanations for this phenomenon. One explanation is that Chinese character processing is known to be primarily associated with left hemisphere dominance in the frontal and temporal lobes, while the right hemisphere is dominant in the parietal and occipital lobes (Zhao et al., 2017). Another explanation is that emotions are fundamental in the processing of advertising information. The right hemisphere tends to play a dominant role in emotion perception (Borod et al., 1998). According to the right-brain model, the right hemisphere is responsible for the perception, expression, and experience of emotions, independent of valence. The right parietal and posterior occipital brain regions are associated with emotion perception (Tamagni et al., 2009), consistent with EEG topography in the right hemisphere in our experiments. Therefore, we speculate that emotions significantly influence the processing of advertising information, affecting advertising effectiveness.

Our results support this hypothesis. Although emotions do not affect the ad memory accuracy, emotional-positive advertisements lead to faster recognition and retrieval of advertising messages. This could be attributed to positive expressions enhancing creative thinking, helping individuals connect different concepts and improving memory retrieval (Madan et al., 2019). Furthermore, emotional valence is initially reflected in the P1 component and, while it diminishes in later components, topographical maps consistently show activation in the right hemisphere, associated with emotions. This suggests that emotional processing is faster than semantic processing and consistently assists in the semantic processing of advertising slogans. Emotional-positive advertising slogans also increase audience affinity, engagement, and willingness to share, as they enhance audience intent. This finding is consistent with prior research, demonstrating that perceiving positive impacts leads to greater consideration of the thoughts and feelings of others, resulting in increased charitable behavior (Cavanaugh & Jacquemin, 2015). Therefore, we favor interpreting that

emotions play a pivotal role in both conscious and unconscious processing of advertising slogans.

Additionally, a comprehensive review of ERPs, behavioral, and self-report results on advertising emotional valence reveals that for emotional-negative advertisements, the P1 component is larger than those with emotional-positive ones. This aligns with behavioral data, indicating that emotional-negative advertisements consume considerable attentional resources, leading to increased memory response times. Emotional-positive advertisements outperformed negative ones in self-report measures, consistent with neural responses. The heightened consumption of attentional resources (P1) for emotional-negative advertisements suggests that individuals perceive negative stimuli as threats, prioritizing the treatment of threatening stimuli. However, self-report measurements capture individual tendencies, explaining the favorable perceptions of emotional-positive advertising.

Moreover, this study finds that concreteness and emotional valence of advertising slogans independently influence outcomes, but they do not interact in any dimension of advertising effectiveness. We speculate that the reason behind this phenomenon might be that emotional processing can impact basic information processing abilities, such as working memory and early attention (Krumm et al., 2009). However, concreteness requires semantic processing, which is a more advanced information processing capability, related to higher-order processes like analysis, reasoning, and imagination (Mao et al., 2024), where emotions may have a smaller impact. Since there was no emotion-neutral ad slogan in this experiment for comparison, it is not possible to be determined whether emotions influence semantic processing. We only confirm that emotional valence insignificantly affects the semantic processing of concreteness. In future research, it would be beneficial to include neutral words to further explore the topic.

Conclusion

This study aims to investigate the impact of emotion and concreteness in advertising slogans on an individual's cognitive processes using ERPs. The findings revealed that audiences undergo five stages of processing when engaging with advertising information: perceiving advertising, early processing of advertising emotions (P1), attention shift (P2), semantic processing of advertising slogans (N400), and continuous processing and encoding of advertising memory (LPC). Additionally, we discover that emotion plays a crucial role in donation slogans, facilitating the audience's understanding and recognition of advertising slogans. This conclusion holds significant implications for advertising and marketing.

Contributions

This study makes several valuable contributions to the ongoing debate and existing literature. We have successfully replicated some of the results on the influence of emotion and concreteness in lexical processing. Our findings extend to the context of donation advertising slogans, shedding light on the significance of emotion and concreteness in advertising slogans and the underlying mechanisms at play.

Firstly, past research has focused on establishing causal relationships between emotion, concreteness, and advertising effectiveness. In contrast, our study goes beyond causality to delve into the mechanisms through which emotion and concreteness exert their influence. By building upon the existing foundation of psycholinguistic research and employing EEG technology, we elucidate how emotions and concreteness impact the effectiveness of donation advertisements and the underlying psychological processes involved.

Secondly, we address conflicting findings on concreteness in advertising and psycholinguistics. The observed main effects of concreteness on the P2 component in the advertising context, along with differences in the LPC component compared to previous results, suggest that foundational psycholinguistic research on basic vocabulary may not directly apply to the intricate context of advertising slogans. Individual responses to advertisements involve both unconscious neural-level drives and influences from various contextual factors. Therefore, caution is needed when extending foundational research results to practical applications in the field.

Thirdly, our study confirms that emotion emerges as a pivotal factor in the processing of donation advertising. Emotional-positive advertising enhances recognition and cultivate favorable attitudes towards advertising (liking, acting, and sharing). This finding is an important extension of affective persuasion theory in advertising persuasion research.

Finally, we approach the study from the audience's perspective in the communication chain, rather than the traditional sender's perspective, gaining insights into how advertisements operate and how audiences process advertising information. We propose a model outlining five cognitive processes that audiences undergo following exposure to advertisements. This shift in perspective not only provides new avenues for future research on advertising effectiveness but also offers valuable insights into the mysteries behind effective advertising.

From a practical perspective, our study reveals distinct performances of advertisements with different emotional

valences and levels of concreteness across various dimensions of advertising effectiveness. In the context of donation advertisements, abstract and emotional-positive advertisements are found to be more effective in fostering liking and encouraging action, while concrete and emotional-positive advertisements excel in deepening the impression made by advertising. Different advertisement serve various purposes, such as winning awards, motivating action, enhancing audience memory, and more. Given that advertising creativity and design are complex endeavors, this suggests the need for personalized ad designs aligned with specific advertising goals.

Limitations and future directions

Our study has some limitations that should be acknowledged. First, although we attempted to simulate real advertising slogans as closely as possible in the lab environment, it is essential to recognize that there are significant differences between the controlled setting of a lab and the complexity of real-world advertising. Therefore, the results of our experiment should only be cautiously applied to the development of actual donation advertisements. In addition, the majority of participants in our study were university students. Future studies should include participants from diverse backgrounds and demographics to enhance the comprehensiveness and applicability of our findings to real-world situations. Moreover, while we discuss the fundamental role of emotion in the processing of donation advertisements, further rigorous experimental research is required to delve deeper into this aspect. Future studies could incorporate bilingual materials to disentangle potential factors affecting the right occipital lobe activation, which may be related to Chinese language processing. We hope that future research will adopt a more audience-centric perspective, moving away from the traditional advertiser-centric approach. Such an approach can help unravel the mysteries behind the powerful effects of advertising more effectively.

Author contributions Dianyuan Zhang, Jie Yao, and WenHao Han designed this experiment. Jie Yao and WenHao Han performed this experiment. Jie Yao analyzed the data. Dianyuan Zhang and Jie Yao wrote the manuscript.

Funding This research was supported by the State Key Program of the National Social Science Foundation of China (NO. 21AXW010). This Research was supported by the equipment of Omnimedia Socialisation & Intelligent Communication Research-Learning-Application Laboratory, Yiwu Research Institute, Fudan University.

Data availability The raw data supporting the conclusions of this article are available on the Open Science Framework at https://osf.io/wcju6/.

Declarations

Competing interests There is no competing interest to declare.

References

Alsharif, A. H., Salleh, N. Z. M., Al-Zahrani, S. A., & Khraiwish, A. (2022). Consumer behaviour to be considered in advertising: A systematic analysis and future agenda. *Behavioral Sciences*, *12*(12), 472. https://www.mdpi.com/2076-328X/12/12/472.

Alsharif, A. H., Salleh, N., & Pilelienė, L. (2023a). A comprehensive bibliometric analysis of fNIRS and fMRI technology in neuromarketing. *Scientific Annals of Economics and Business*, *70*(3), 459–472. https://doi.org/10.47743/saeb-2023-0031.

Alsharif, A. H., Salleh, N. Z., Hashem, E., Khraiwish, A. R., Putit, A., L., & Arif, L. S. (2023b). Exploring factors influencing neuromarketing implementation in Malaysian universities: Barriers and enablers. *Sustainability*, *15*(5). https://doi.org/10.3390/su15054603.

Alsharif, A. H., Salleh, N. Z. M., Abdullah, M., Khraiwish, A., & Ashaari, A. (2023c). Neuromarketing tools used in the marketing mix: A systematic literature and future research agenda. *SAGE Open*, *13*(1), 21582440231156563. https://doi.org/10.1177/21582440231156563.

Alsharif, A. H., Salleh, N. Z. M., Alrawad, M., & Lutfi, A. (2023d). Exploring global trends and future directions in advertising research: A focus on consumer behavior. *Current Psychology*. https://doi.org/10.1007/s12144-023-04812-w.

Bechtold, L., Bellebaum, C., & Ghio, M. (2023). When a sunny day gives you butterflies: An electrophysiological investigation of concreteness and context effects in semantic word processing. *Journal of Cognitive Neuroscience*, *35*(2), 241–258. https://doi.org/10.1162/jocn_a_01942.

Berryhill, M. E., Chein, J., & Olson, I. R. (2011). At the intersection of attention and memory: The mechanistic role of the posterior parietal lobe in working memory. *Neuropsychologia*, *49*(5), 1306–1315. https://doi.org/10.1016/j.neuropsychologia.2011.02.033.

Bliss-Moreau, E., Williams, L. A., & Santistevan, A. C. (2020). The immutability of valence and arousal in the foundation of emotion. *Emotion*, *20*(6), 993–1004. https://doi.org/10.1037/emo0000606.

Borod, J., Cicero, B., Obler, L., Welkowitz, J., Erhan, M., Santschi, C., Grunwald, I., Agosti, R., & Whalen, J. (1998). Right hemisphere emotional perception: Evidence across multiple channels. *Neuropsychology*, *12*(3), 446–458. https://doi.org/10.1037//0894-4105.12.3.446.

Cadavid, S., & Beato, M. S. (2016). Memory distortion and its avoidance: An event-related potentials study on false recognition and correct rejection. *Plos One*, *11*(10), e0164024. https://doi.org/10.1371/journal.pone.0164024.

Cavanaugh, J. K., & Jacquemin, S. J. (2015). A large sample comparison of grade based student learning outcomes in online vs. face-to-face courses. *Online Learning*, *19*(2), n2. https://doi.org/10.24059/olj.v19i2.454.

Choi, Y. K., Seo, Y., & Yoon, S. (2017). E-WOM messaging on social media. *Internet Research*, *27*(3), 495–505. https://doi.org/10.1108/IntR-07-2016-0198.

Choi, J., Li, Y. J., Rangan, P., Yin, B., & Singh, S. N. (2020). Opposites attract: Impact of background color on effectiveness of emotional charity appeals. *International Journal of Research in Marketing*, *37*(3), 644–660. https://doi.org/10.1016/j.ijresmar.2020.02.001.

Cryder, C. E., Loewenstein, G., & Seltman, H. (2013). Goal gradient in helping behavior. *Journal of Experimental Social Psychology*, *49*(6), 1078–1083. https://doi.org/10.1016/j.jesp.2013.07.003.

Das, N., Guha, A., Biswas, A., & Krishnan, B. (2016). How product–cause fit and donation quantifier interact in cause-related marketing (CRM) settings: Evidence of the cue congruency effect. *Marketing Letters*, *27*(2), 295–308. https://doi.org/10.1007/s11002-014-9338-6.

Davis, C. P., Altmann, G. T. M., & Yee, E. (2020). Situational systematicity: A role for schema in understanding the differences between abstract and concrete concepts. *Cogn Neuropsychol*, *37*(1–2), 142–153. https://doi.org/10.1080/02643294.2019.1710124.

Dehaene, S., Naccache, L., Cohen, L., Le Bihan, D., Mangin, J. F., Poline, J. B., & Rivière, D. (2001). Cerebral mechanisms of word masking and unconscious repetition priming. *Nature Neuroscience*, *4*, 752–758. https://doi.org/10.1038/89551.

Delaney-Busch, N., Wilkie, G., & Kuperberg, G. (2016). Vivid: How valence and arousal influence word processing under different task demands. *Cognitive Affective & Behavioral Neuroscience*, *16*(3), 415–432. https://doi.org/10.3758/s13415-016-0402-y.

Dewi, I. J., & Ang, S. H. (2020). Assessing the imagination scale's nomological validity: Effect of hedonic versus utilitarian product types and abstract versus concrete advertising execution. *Gadjah Mada International Journal of Business*, *22*(2), 118–136. https://doi.org/10.3316/informit.426806858266781.

Erlandsson, A., Björklund, F., & Bäckström, M. (2015). Emotional reactions, perceived impact and perceived responsibility mediate the identifiable victim effect, proportion dominance effect and in-group effect respectively. *Organizational Behavior and Human Decision Processes*, *127*, 1–14. https://doi.org/10.1016/j.obhdp.2014.11.003.

Gao, Z., Xu, X., Chen, Z., Yin, J., Shen, M., & Shui, R. (2011). Contralateral delay activity tracks object identity information in visual short term memory. *Brain Research*, *1406*, 30–42. https://doi.org/10.1016/j.brainres.2011.06.049.

Gibbons, H., Kirsten, H., & Seib-Pfeifer, L. E. (2022). Attention to affect 2.0: Multiple effects of emotion and attention on event-related potentials of visual word processing in a valence-detection task. *Psychophysiology*, *59*(9), e14059. https://doi.org/10.1111/psyp.14059.

Goering, E., Connor, U. M., Nagelhout, E., & Steinberg, R. (2011). Persuasion in fundraising letters: An interdisciplinary study. *Nonprofit and Voluntary Sector Quarterly*, *40*(2), 228–246. https://doi.org/10.1177/0899764009339216.

Graddy, E., & Wang, L. (2009). Community foundation development and social capital. *Nonprofit and Voluntary Sector Quarterly*, *38*(3), 392–412. https://doi.org/10.1177/0899764008318609.

Hagoort, P. (2005). On Broca, brain, and binding: A new framework. *Trends in Cognitive Sciences*, *9*(9), 416–423. https://doi.org/10.1016/j.tics.2005.07.004.

Hofmann, M. J., Kuchinke, L., Tamm, S., Võ, M. L. H., & Jacobs, A. M. (2009). Affective processing within 1/10th of a second: High arousal is necessary for early facilitative processing of negative but not positive words. *Cognitive Affective & Behavioral Neuroscience*, *9*(4), 389–397. https://doi.org/10.3758/9.4.389.

Jiao, H., Qian, L., Liu, T., & Ma, L. (2021). Why do people support online crowdfunding charities? A case study from China. *Frontiers in Psychology*, *12*, 582508. https://doi.org/10.3389/fpsyg.2021.582508.

Kanske, P., & Kotz, S. A. (2007). Concreteness in emotional words: ERP evidence from a hemifield study. *Brain Research*, *1148*, 138–148. https://doi.org/10.1016/j.brainres.2007.02.044.

Keuper, K., Zwitserlood, P., Rehbein, M. A., Eden, A. S., Laeger, I., Junghöfer, M., Zwanzger, P., & Dobel, C. (2013). Early prefrontal brain responses to the hedonic quality of emotional words – A simultaneous EEG and MEG study. *Plos One*, *8*(8), e70788. https://doi.org/10.1371/journal.pone.0070788.

Kissler, J., Herbert, C., Winkler, I., & Junghofer, M. (2009). Emotion and attention in visual word processing—An ERP study. *Biological Psychology*, *80*(1), 75–83. https://doi.org/10.1016/j.biopsycho.2008.03.004.

Kopetz, C. E., Kruglanski, A. W., Arens, Z. G., Etkin, J., & Johnson, H. M. (2012). The dynamics of consumer behavior: A goal systemic perspective. *Journal of Consumer Psychology*, *22*(2), 208–223. https://doi.org/10.1016/j.jcps.2011.03.001.

Krumm, S., Schmidt-Atzert, L., Buehner, M., Ziegler, M., Michalczyk, K., & Arrow, K. (2009). Storage and non-storage components of working memory predicting reasoning: A simultaneous examination of a wide range of ability factors. *Intelligence*, *37*(4), 347–364. https://doi.org/10.1016/j.intell.2009.02.003.

Kutas, M., & Federmeier, K. D. (2010). Thirty years and counting: Finding meaning in the N400 component of the event-related brain potential (ERP). *Annual Review of Psychology*, *62*(1), 621–647. https://doi.org/10.1146/annurev.psych.093008.131123.

Lau, E., Phillips, C., & Poeppel, D. (2009). A cortical network for semantics: (De)constructing the N400. *Nature Reviews Neuroscience*, *9*, 920–933. https://doi.org/10.1038/nrn2532.

Macdonnell, R., & White, K. (2015). How construals of money versus time impact consumer charitable giving. *Journal of Consumer Research*, *42*(4), 551–563. https://doi.org/10.1093/jcr/ucv042.

Madan, C. R., Scott, S. M. E., & Kensinger, E. A. (2019). Positive emotion enhances association-memory. *Emotion*, *19*(4), 733–740. https://doi.org/10.1037/emo0000465.

Mao, R., He, K., Zhang, X., Chen, G., Ni, J., Yang, Z., & Cambria, E. (2024). A survey on semantic processing techniques. *Information Fusion*, *101*, 101988. https://doi.org/10.1016/j.inffus.2023.101988.

Miller, G. E., Chen, E., & Zhou, E. S. (2007). If it goes up, must it come down? Chronic stress and the hypothalamic-pituitary-adrenocortical axis in humans. *Psychological Bulletin*, *133*(1), 25. https://doi.org/10.1037/0033-2909.133.1.25.

Missaglia, A. L., Oppo, A., Mauri, M., Ghiringhelli, B., Ciceri, A., & Russo, V. (2017). The impact of emotions on recall: An empirical study on social ads. *Journal of Consumer Behaviour*, *16*(5), 424–433. https://doi.org/10.1002/cb.1642.

Neumayr, M., & Handy, F. (2019). Charitable giving: What influences donors' choice among different causes? *VOLUNTAS: International Journal of Voluntary and Nonprofit Organizations*, *30*(4), 783–799. https://doi.org/10.1007/s11266-017-9843-3.

Niendam, T., Laird, A., Ray, K., Dean, Y., Glahn, D., & Carter, C. (2012). Meta-analytic evidence for a superordinate cognitive control network subserving diverse executive functions. *Cognitive Affective & Behavioral Neuroscience*, *12*(2), 241–268. https://doi.org/10.3758/s13415-011-0083-5.

Oberauer, K. (2019). Working memory and attention - A conceptual analysis and review. *J Cogn*, *2*(1), 36. https://doi.org/10.5334/joc.58.

Paxton, P., Velasco, K., & Ressler, R. (2020). Does use of emotion increase donations and volunteers for nonprofits? *American Sociological Review*, *85*, 000312242096010. https://doi.org/10.1177/0003122420960104.

Peng, Y., Liu, Y., & Guo, C. (2019). Examining the neural mechanism behind testing effect with concrete and abstract words. *Neuroreport*, *30*(2), 113–119. https://doi.org/10.1097/WNR.0000000000001169.

Pilelienė, L., Alsharif, H., A., & Bader Alharbi, I. (2022). Scientometric analysis of scientific literature on neuromarketing tools in advertising. *Baltic Journal of Economic Studies*, *8*(5), 1–12. https://doi.org/10.30525/2256-0742/2022-8-5-1-12.

Ruiz-Padial, E., & Mercado, F. (2021). In exogenous attention, time is the clue: Brain and heart interactions to survive threatening stimuli. *Plos One*, *16*(5), e0243117. https://doi.org/10.1371/journal.pone.0243117.

Schindler, S., & Kissler, J. (2016). Selective visual attention to emotional words: Early parallel frontal and visual activations followed by interactive effects in visual cortex. *Human Brain Mapping*, *37*(10), 3575–3587. https://doi.org/10.1002/hbm.23261.

Stróżak, P., Bird, C. W., Corby, K., Frishkoff, G., & Curran, T. (2016). FN400 and LPC memory effects for concrete and abstract words. *Psychophysiology*, *53*(11), 1669–1678. https://doi.org/10.1111/psyp.12730.

Tamagni, C., Mantei, T., & Brugger, P. (2009). Emotion and space: Lateralized emotional word detection depends on line bisection bias. *Neuroscience*, *162*, 1101–1105. https://doi.org/10.1016/j.neuroscience.2009.05.072.

Urbonavicius, S., Adomaviciute, K., Urbutyte, I., & Cherian, J. (2019). Donation to charity and purchase of cause-related products: The influence of existential guilt and experience. *Journal of Consumer Behaviour*, *18*(2), 89–96. https://doi.org/10.1002/cb.1749.

Wang, S., & Lehto, X. (2019). The interplay of travelers' psychological distance, language abstraction, and message appeal type in social media advertising. *Journal of Travel Research*, *59*(8), 1430–1446. https://doi.org/10.1177/0047287519880000.

Wang, Yiniu, Zhou, Li-Ming, Luo, & Yue-jia (2008). Preliminary development and evaluation of affective word system in Chinese. *Chinese Journal of Mental Health*, *08*, 608–612. http://ir.psych.ac.cn/handle/311026/10017.

Winterich, K. P., & Zhang, Y. (2014). Accepting inequality deters responsibility: How power distance decreases charitable behavior. *Journal of Consumer Research*, *41*, 274–293. https://doi.org/10.1086/675927.

Wojdynski, B. W., & Evans, N. J. (2020). The Covert Advertising Recognition and effects (CARE) model: Processes of persuasion in native advertising and other masked formats. *International Journal of Advertising*, *39*(1), 4–31. https://doi.org/10.1080/02650487.2019.1658438.

Xiao, A., Huang, Y., Bortree, D. S., & Waters, R. D. (2021). Designing social media fundraising messages: An experimental approach to understanding how message concreteness and framing influence donation intentions. *Nonprofit and Voluntary Sector Quarterly*, *51*(4), 832–856. https://doi.org/10.1177/08997640211022838.

Ye, N., Teng, L., Yu, Y., & Wang, Y. (2015). What's in it for me? The effect of donation outcomes on donation behavior. *Journal of Business Research*, *68*(3), 480–486. https://doi.org/10.1016/j.jbusres.2014.09.015.

Zhao, J., & Guo, J. (2023). The temporal mechanism of contextual emotions' effects on novel abstract and concrete word learning. *Neuroscience Letters*, *805*, 137227. https://doi.org/10.1016/j.neulet.2023.137227.

Zhao, R., Fan, R., Liu, M., Wang, X., & Yang, J. (2017). Rethinking the function of brain regions for reading Chinese characters in a meta-analysis of fMRI studies. *Journal of Neurolinguistics*, *44*, 120–133. https://doi.org/10.1016/j.jneuroling.2017.04.001.