Impact of the normativeness and intelligibility of privacy interpretation information on the willingness to accept targeted advertising —A cognitive load perspective

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Abstract

From the perspective of the user's psychological load, this study examined the cognitive mechanism by which privacy interpretation information affects the willingness to accept targeted advertising. Our findings provide a reference for enterprises seeking to develop and improve privacy interpretation information and reduce advertising avoidance behaviour. Based on information processing theory and cognitive load theory, this study experimentally collected volunteers' electroencephalography (EEG) data, interpreted the EEG results as representing emotions and cognitive load, and analysed the impact of the normativeness and intelligibility of privacy interpretation information on the willingness to accept targeted advertising. Intelligibility significantly affected this willingness. In the case of acceptable transparency, users were more inclined to avoid targeted advertising under low interpretability. Low interpretability caused them to expend more cognitive effort, which induced a larger N2 amplitude. In the case of unacceptable transparency, the opposite conclusion was drawn. In addition, privacy information with high interpretability was more likely to arouse users' emotions and induce a greater amplitude of late positive potential.

Keywords Privacy interpretation information · Targeted advertising · Cognitive load · Event-related potential (ERP)

Introduction

In the era of digital intelligence, the "gold rushing" of data is becoming mainstream in the advertising industry (Chao et al., 2020; Hayes et al., 2021), and with the outbreak of the coronavirus disease 2019 pandemic, the digital consumption of users has accelerated. However, the irregular acquisition and use of personal private information by commercial actors for advertising purposes and the frequent occurrence of privacy breaches have caused users to believe that enterprises are trying to influence and manipulate them. As a result, users perceive that their autonomy and right to information are being violated, which leads to psychological resistance (Martin, 2020), which in turn reduces the user's

willingness to accept targeted advertising (Liu et al., 2018). The willingness of users to accept targeted advertising not only directly affects the product positioning, profitability, and marketing model of the enterprise but also initiates a chain of effects, such as customer churn and trust crisis, which have a serious negative impact on the enterprise (Zhang et al., 2019). How to improve users' willingness to accept targeted advertising and balance the interests of users and enterprises is not only a popular topic and so-called pain point in the industry but also receiving substantial attention in the academic community.

To overcome this problem, certain platforms have developed measures governing how they collect, analyse, and use user privacy information. For example, Twitter, Google, and Facebook offer a button labelled "Why am I seeing this ad?" that when pressed presents an explanation to users of how the platform pushes targeted advertising, thereby increasing users' willingness to accept such ads (Andreou et al., 2018; Wei et al., 2020). At the same time, scholars have noted that by providing interpretations and explanations to users regarding the reasons for and data analytic processes

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behind their recommendations, enterprises and platforms can effectively alleviate users' resistance to targeted advertising (An et al., 2013; Liang et al., 2018; Tucker, 2014). However, the privacy interpretation information provided by the platform is usually presented to the user in obscure legal wording and thus can only play a limited role in fulfilling the platform's obligation of notification (Wang et al., 2020). Since the privacy interpretation information does not consider the users' actual situation, its intelligibility and normativeness are low. As a result, users do not learn much about privacy protection information, and provision of such information becomes pointless, squandering enterprise marketing efforts. Therefore, it is necessary to further clarify the intrinsic impact of the normativeness and intelligibility of privacy interpretation information on users, formulate reasonable and effective wording of such information, and ensure that enterprises accurately understand users' privacy needs. Thus, potentially fostering a willingness to accept targeted advertising is highly important.

Previous studies have investigated the impact of privacy interpretation information on the willingness to accept targeted advertising from the standpoints of information norms, planned behaviour, and persuasive communication (Kim et al., 2018; Li & Sun, 2019; Zarouali et al., 2018). However, the existing theoretical research paradigm is based on a hypothetical response to a hypothetical situation and occasionally does not match the user's real online situation. For example, the theory of planned behaviour suggests that users' willingness to accept targeted advertising is the result of an individual's rational analysis (Kim et al., 2018). However, in the online context, users' willingness to accept targeted advertising is an immediate response, and consumers often do not engage in much rational analysis and do not develop a sense of trust and control. At the same time, according to persuasive communication theory, the purpose of introducing privacy interpretation information by enterprises is to change consumers' concerns regarding privacy and to persuade consumers to accept recommended products. However, in real situations, users do not understand such abstract and vague privacy interpretation information, and their concerns about privacy remain unchanged. In addition, abstract and vague privacy interpretation information could consume cognitive resources, such as attention and emotions, resulting in individual cognitive overload, and the difference in user cognitive load is a key variable that affects individual behavioural decision-making (Conner et al., 2021; Yang et al., 2022). However, there are few studies on privacy interpretation information and individual real-time responses in an online context from the perspective of user cognitive load.

Most previous studies use questionnaire surveys to measure willingness to accept advertisements. However, online users' willingness to accept targeted advertising is a form of instantaneous behaviour, not the result of retrospective processing. Therefore, the data obtained by a questionnaire may deviate from the user's real online behaviour, and the cognitive load at the time of answering the questionnaire will not accurately match that at the moment of decision-making. Thus, such questionnaires cannot capture the state of the individual's cognitive load in real time.

Based on information processing theory (IPT) and cognitive load theory (CLT), this study used event-related potential (ERP) technology to accurately locate the activity of individual cognitive processing and further investigated the intrinsic impact of the normativeness (acceptable vs. unacceptable transparency) and intelligibility (high vs. low interpretability) of privacy interpretation information provided by companies and platforms on consumers' willingness to accept targeted advertising. Based on the user's immediate reaction, this study further revealed the cognitive and neural mechanisms by which privacy interpretation information affects the user's willingness to accept targeted advertising through electroencephalography (EEG) experiments. This innovative empirical approach overcomes the drawbacks of past studies that used retrospective insight into user cognitive load and extends the application of CLT to the areas of targeted advertising and user privacy.

Review of relevant research

Privacy interpretation information

"Privacy interpretation information" refers to the user data that are collected by the recommendation system, how such user information is collected, and how it is obtained and provides the basis and reason for the recommendation to the user (Karwatzki et al., 2017). Privacy interpretation reflects the commitment of Internet enterprises and platforms to individual privacy protection. Privacy interpretation and privacy protection can positively predict users' cognitive trust and emotional trust on the platform (Esmaeilzadeh, 2020; Moon et al., 2022). In the study of recommendation interpretation, scholarly discussion on user privacy protection can be categorized according to the following two aspects.

In terms of presentation form, Capistrano and Chen discussed the impact of observability on privacy interpretation information. Privacy interpretation information that is more conspicuous and easier for users to notice on a website or webpage could significantly enhance the perceived importance of privacy information to users (Capistrano & Chen, 2015). Through comparative experiments, Liu et al. found that website/webpage-provided privacy interpretation information differed from that provided by non-actively

recommended privacy interpretation apps. Through negotiation, actively recommended privacy interpretation apps could alleviate consumers' privacy concerns (Liu et al., 2022). Several studies on AdChoices have found that when the AdChoices icon is used to publicly indicate the use of the target's personal data, consumers are more likely to ignore the persuasive knowledge graph and accept the advertiser's personalized message, as long as the consumers perceive that the ad content is relevant (i.e., targeted to them personally) and the brand is trustworthy (Brinson & Eastin, 2016; Johnson et al., 2020). Elsewhere, features such as personalized notification of privacy interpretation (Seng et al., 2021), personalized explanatory information (Segijn et al., 2021), and content sequence and representation form have been demonstrated to affect users' trust in a platform (Aimeur et al., 2016; Majedi & Barker, 2021). Overall, users are more willing to support websites and mobile applications that publicly use personal privacy information (Reimer & Johnson, 2022).

In terms of content integrity, many scholars recommend that enterprises increase the content integrity of privacy interpretation information, as more corporate transparency can reduce consumers' privacy concerns. Andreou et al. showed that privacy interpretation information is often incomplete in that an interpretation provided by an enterprise can only display one target attribute (such as age/sex/location information); i.e., only the target attribute used by the enterprise is revealed. Thus, the privacy interpretation information that the enterprise provides the user is incomplete (Andreou et al., 2018). Through qualitative research, Wei et al. drew the same conclusion for different types of targeted advertising; that is, the privacy interpretation was incomplete. Consumers desire more detail regarding how advertisements target them. By providing additional detail on how enterprises or platforms collect, use, and locate users, consumers' understanding and trust in privacy interpretation information can be increased (Wei et al., 2020). In addition, scholars have tested the compliance of Internet companies' privacy interpretation content and optimized the privacy interpretation system, thus enhancing consumers' trust in the platform (Hashmi et al., 2021; Luo et al., 2021). However, the literature tends to explain privacy-related matters in a vague, abstract manner, whereas in real-life situations, the collection, analysis, and use of user privacy information by companies is precise and specific. The previous research lacks in-depth discussion on the transparency and interpretability of privacy explanatory information.

Privacy interpretation information and targeted advertising

In recent years, privacy interpretation information has been widely used by Internet enterprises and mobile platforms and become regarded as an important factor that affects users' willingness to accept advertisements. However, the effect of privacy interpretation information on one's willingness to accept advertisements varies. Compared with a recommendation system without interpretation, the increase in the transparency of recommendation systems through privacy interpretation can effectively alleviate the user's risk perception and enhance the user's trust in the recommendation system and improve the advertising effect (Liu et al., 2022; Pu & Chen, 2007). Aguirre et al. found that in the process of personalization, compared with advertisements generated by the implicit collection of user information, public information collection by enterprises can significantly reduce the perceived risk of individuals, and users are more willing to click on personalized advertisements (Aguirre et al., 2015). At the same time, differences in the degree of attention users pay to privacy further affects the optimal pricing of targeted advertising (Duan et al., 2020). In addition, in the context of targeted advertising, privacy interpretation can improve users' perceived control over their private information. The clearer the notification is, the stronger the sense of consumers' perceived control over private information, and the more likely users are to disclose private information to online platforms. In this scenario, users often respond more positively to personalized advertising (Holvoet et al., 2022; Tucker, 2014).

However, while giving users the right to control and know, privacy interpretation is more like a disclaimer (Zalmanson et al., 2022), which is more likely to lead to consumers' resistance (Yu et al., 2016). Based on technology threat avoidance theory, Wang et al. conducted an empirical study on Internet targeted advertising with different privacy salience levels and found that a high level of privacy saliency simultaneously increased users' perceived control and perceived threats, while an increase in perceived threat significantly lowered users' acceptance of Internet targeted advertising (Wang et al., 2020). On the one hand, privacy interpretation information can enable consumers to understand the existing tracking practices of targeted advertising (Bornschein et al., 2020; Schaub et al., 2016) and inform users of the types of personal data used for customized advertising (Stevenson, 2016); on the other hand, privacy interpretation information could increase users' perception of privacy infringement, and consumers could restrict their access to and use of their personal data by platforms, which in turn could lead to a more negative attitude towards targeted advertising (Houghton & Joinson, 2010; Samat et al.,

2017; Stevenson, 2016). In an experimental study, Kim et al. showed that when users find that a platform collects and uses their private information excessively, the individual's sense of control could be weakened, and the user's concern about privacy outweighs the preference for personalized service (Kim et al., 2018). Compared with a platform with a good reputation, when an enterprise with a bad reputation independently makes personalized disclosure to users, consumers believe that the motive of its privacy explanation is insincere, thus reducing the impact on the advertising effect. However, when it is disclosed through other parties, the backfire effect of consumers is reversed, which alleviates users' perception of the platform as insincere and increases their willingness to respond to targeted advertisements (Van, 2022).

In summary, most previous studies have investigated the impact on users' behavioural intentions when treating the user as a rational person. However, what users subjectively perceive involves their overall cognition after rational analysis, which occasionally does not match what their real-time online behavioural decision-making. Most users respond immediately based on the immediate emotional and cognitive overload triggered by privacy interpretation information, and differences in individual cognitive load play a crucial role in users' behavioural intentions. However, few studies have examined the impact of privacy interpretation information on the willingness to accept targeted advertising from the perspective of users' psychological load. By what mechanism do the normativeness and intelligibility of privacy interpretation information influence the willingness to accept targeted advertising? What type of cognitive load does the user work under? To assess the intrinsic impact of privacy interpretation information on targeted advertising, the differences in the cognitive resources invested by users in the processing of privacy interpretation information should be considered in the context of targeted advertising. This study investigated privacy interpretation information and the willingness to accept targeted advertising from the perspective of consumer psychological load based on IPT and CLT and used ERP technology to examine the intrinsic cognitive mechanisms through behavioural and EEG experimental data.

Theoretical basis and research hypothesis

Theoretical basis

According to IPT, cognition is the activity of information processing, and people's behaviour depends on their attention to, memory of, and cognitive processing of information. Cognitive load is introduced based on IPT and is a characteristic variable of cognitive processing. Cognitive load was proposed by Sweller in 1988 and refers to the "mental effort" that individuals are required to exert during information processing to complete tasks (Sweller, 1988). The total amount of cognitive resources that an individual consumes to complete a particular cognitive task represents the cognitive load of that task. The more cognitive resources are consumed by the task, the greater the cognitive load of the individual (Yang et al., 2022). The phenomenon of individual cognitive overload has come to the forefront in the information age. Several studies have noted that cognitive load, as a cognitive factor that affects individuals, plays an increasingly important role in understanding the psychology and behaviour of individuals in the information age (Liang et al., 2015; Xu et al., 2014; Zha et al., 2020). In the area of online shopping, a number of studies have examined the reuse behavioural intention of users with respect to the recommendation system and found that the complexity of product presentation and webpages could affect the user's emotional and cognitive process, with high complexity occasionally leading to emotional and cognitive overload and a negative impact on the user (Xu et al., 2014).

Research hypothesis

Behavioural assumptions

According to the current technical principles of targeted advertising and research results on information flow, the normativeness of privacy interpretation information can be divided into two categories. "Acceptable transparency" refers to information provided based on the browsing history/personal data on a platform, whereas "unacceptable transparency" concerns making inferences about individuals based on their browsing history at third-party websites (Kim et al., 2018). The application of offline information norms to online human–computer interaction requires subjects to respond to the interpreted transparent information. Research results show that an ad recommendation based on inference is equivalent to speculation based on other information, and ad recommendations made through third-party information are tantamount to speaking ill of others behind their backs, which in turn leads to increased resistance to inferred transparent information or transparent information used for third-party recommendation ads (Kim et al., 2018; Xu et al., 2014).

For privacy interpretation based on different information norms, the level of detail of the interpretation could have a differential impact on consumer behaviour. "Intelligibility" refers to the interpretation information that the recommendation system furnished to the consumer, such as which user data are collected by the recommendation

system, how user information is collected, how such information is obtained, and the level of detail of the basis and reasons for the recommendation explained to the user by the recommendation system (Dogruel, 2019). "Low interpretability" refers to characterizing information with abstract and relatively global characteristics, while "high interpretability" refers to characterizing information more accurately and concretely. The complexity of the task determines how much of the individual's cognitive resources are consumed (Xu et al., 2014), and privacy interpretation with different interpretation levels is viewed as involving various levels of task complexity. Compared with specific privacy interpretation, fuzzy privacy interpretation is a more complex task that requires users to consume relatively more cognitive resources to process. Other studies have shown that cognitive load has a significant impact on user behavioural decisions, such as information processing, selective access to information, and information use behaviour (Liang et al., 2015; Sun & Luo, 2021).

Due to the limited cognitive resources and cognitive abilities of consumers, when the information elements of acceptable privacy interpretation are simpler and more specific, the user is required to spend fewer cognitive resources, and the cognitive effort that consumers must exert is also smaller. For an individual, a reasonable level of cognitive load can have a positive impact on the user's behaviour (Liang et al., 2015). Therefore, specific and detailed privacy interpretation could increase consumers' willingness to accept targeted advertising. When an individual processes vague and abstract information, more cognitive resources are consumed, and cognitive overload could have a negative impact on the user's behaviour (Xu et al., 2014). Due to the limited cognitive resources an individual possesses, when the current task requires the consumption of a large amount of such resources, to ensure cognitive efficiency in objective tasks, the individual could produce more resistant behaviours. Based on the preceding discussion, we propose the following hypotheses:

H1: Under unacceptable transparency, consumers are more willing to accept targeted advertising at low interpretability than at high interpretability.

H2: Under acceptable transparency, consumers are more willing to accept targeted advertising at high interpretability than at low interpretability.

ERP hypothesis

Cognitive load is often considered a trait variable. Considering the characteristics of short-term fluctuations in cognitive load, this study used the N2 component to reflect the cognitive process related to cognitive load. Researchers generally believe that N2 is related to cognitive effort and plays an important role in cognition and behavioural decision-making. The N2 component is detectable in leads in the forehead, the central association area of the forehead, and the central area, with a latency of 250–350 ms, and indicates task difficulty and individual cognitive effort. The N2 component is particularly sensitive to conflict detection, and a high-conflict situation can induce a higher N2 amplitude than a low-conflict situation (Schumpe et al., 2017). In the study of behavioural decision-making, the higher the cognitive conflict aroused by the individual in decision-making was, the larger the amplitude of the N2 wave (Folstein & Van, 2008). The more cognitive effort an individual must expend in the decision-making process, the more significant the induced N2 wave amplitude (Sun & Luo, 2021). Individuals have limited cognitive resources, and their resource allocation in the selective attention process is determined by the individual's cognitive load level (Lavie et al., 2004). Generally, the greater the difficulty of the decision-making task is, the more cognitive effort exerted by an individual, which should induce a greater N2 wave amplitude. On this basis, the following hypotheses are proposed:

H3: Under acceptable transparency, high interpretability induces a higher N2 amplitude than low interpretability.

H4: Under unacceptable transparency, low interpretability induces a higher N2 amplitude than high interpretability.

Late positive potential (LPP) typically occurs in the central parietal region, with a latency of 300 ms. LPP mainly reveals the activation of the individual's brain motivation system, which is usually associated with the individual's internal cognition, such as emotional processing, attention, and individual perception (Schupp et al., 2000, 2004). Viewing pictures with emotional content can induce an LPP component, and the amplitude of LPP caused by pictures with positive or negative emotions is greater than the amplitude of LPP caused by pictures with neutral emotions (Cuthbert et al., 2000). In addition, under the condition of highly arousing emotional stimuli, the induced LPP amplitudes are larger than those with low arousal emotional stimuli; i.e., the more attention resources the subject has invested in the stimuli, the greater the LPP amplitude. We hypothesize that under acceptable vs. unacceptable privacy interpretation information regime, the impact of the level of detail of the interpretation on the individual's psychological cognition differs. Under unacceptable privacy interpretation information, privacy interpretation information with high interpretability, i.e., the interpretation information of third-party personalized recommendation advertisements, is more likely to arouse the negative emotions of consumers. On this basis, the following hypothesis is proposed:

H5: In the cognitive process, privacy interpretation has a significant impact on users' emotional arousal. Compared with low interpretability, privacy interpretation information
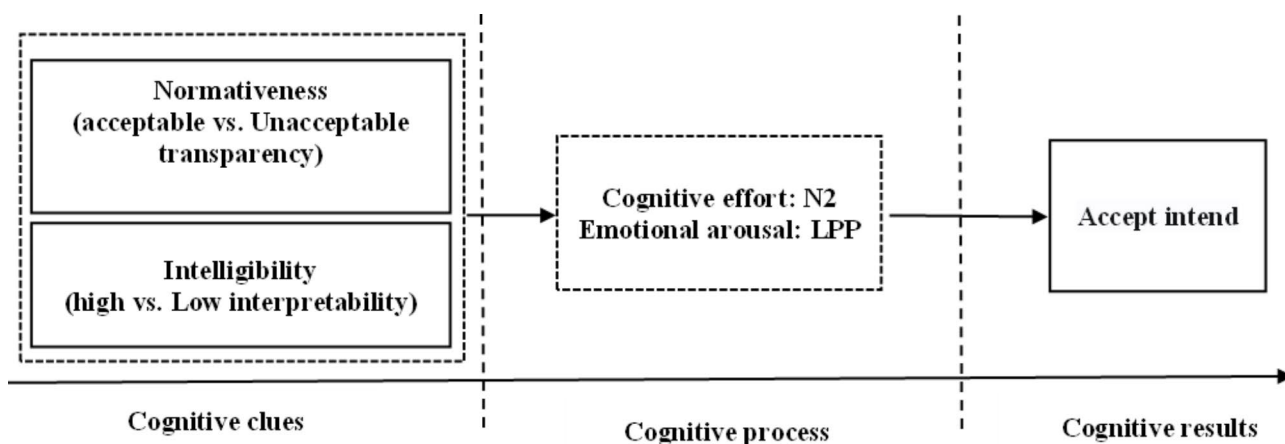
Fig. 1 Research model

with high interpretability can induce more intense emotions, and the LPP amplitude is greater.

Figure 1 presents the theoretical model of this research.
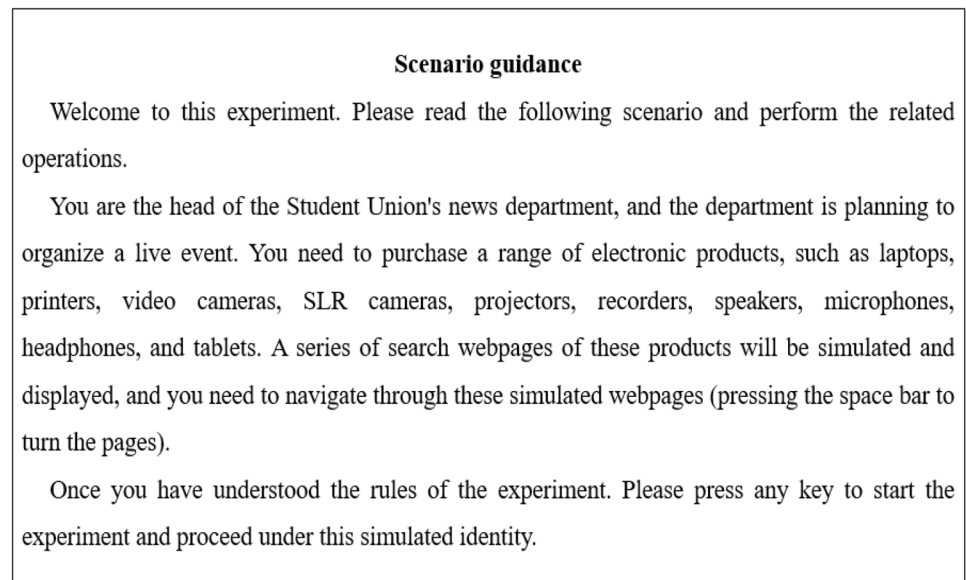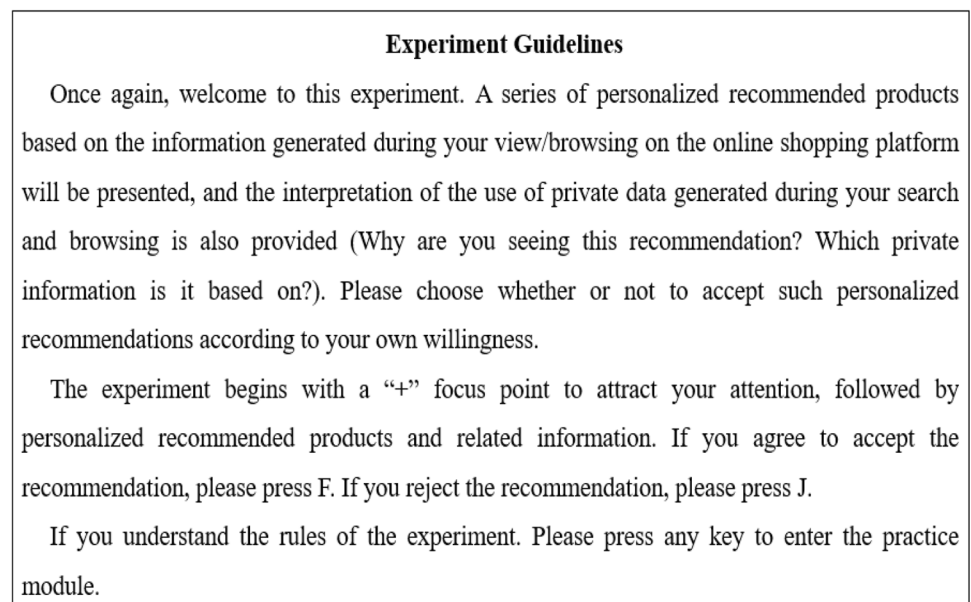
Experiment

Subjects and experimental materials

Prior to performing the experiment, we distributed recruitment advertisements via the official public number of the University and the campus publicity board and in the classroom. These advertisements provided potential applicant an online link and a brief description of the experiment to enable interested individuals to voluntarily apply to participate. To avoid the impact of the subject's prior knowledge of privacy interpretation information on the experiment and to balance the prior-knowledge gap among the subjects, in this study, subjects were screened on an individual basis regarding their knowledge of privacy interpretation information. Individuals with prior knowledge that could significantly affect the experimental results were excluded. All the subjects in this study were undergraduates or postgraduates at the University, and a total of 35 individuals were selected to participate in the experiment. During the experiment, the EEG data for five subjects were invalid and subsequently excluded, leaving a final total of 30 subjects (42.85% male, mean age = 24). All subjects had normal vision or normal vision with correction, were not colour-blind, were right-handed, had no mental illness or any organic disease, and had not participated in similar experiments. Subjects were paid at the end of the experiment. This study adopted a mixed experimental design of 2 (normativeness: acceptable vs. unacceptable transparency, intergroup) × 2 (intelligibility: high vs. low interpretability, intragroup).

According to a report by the China Internet Network Information Center, online shopping is mostly concentrated in three categories: clothing, household essentials, and digital products. To control for the impact of product type, digital products were selected as the experimental stimulus materials in the interest of scientific rigor. These products included laptops, video cameras, single-lens reflex cameras, printers, earphones, voice recorders, microphones, tablets, projectors, and speakers. To control for the effects of the physical properties and brands of the products, the experimental stimulus materials were uniformly processed. The size of the images was 30 × 30 cm, the images were black and white, and the background colour was white. To test the effect of the normativeness of privacy interpretation information, the experiment presented two stimuli: unacceptable transparency and acceptable transparency. In addition, prior to the formal experiment, 30 college students were invited to score the level of detail of the privacy interpretation (1 = not at all, 5 = very specific). After the pretest, the privacy interpretation information was divided into the two categories of high and low interpretability using the dichotomy method. A post hoc test revealed that the high interpretability score was significantly higher than the low interpretability score, with a t value of 11.30 (p < 0.001).

Experimental procedure

During the experiment, the subjects were in a soundproof room and sat quietly on a chair in the most comfortable posture. The seat was 70 cm from the computer screen, and the horizontal and vertical viewing angles were 2.58° and 2.4°, respectively. The chair's seat was adjusted according to the height of the subject to prevent electromyographic interference, which can be triggered when the forehead electrode and the hindbrain electrode are too low or too high. The experiment used the classic oddball paradigm.

Fig. 2 Scenario guidance of the experiment

Scenario guidance

Welcome to this experiment. Please read the following scenario and perform the related operations.

You are the head of the Student Union's news department, and the department is planning to organize a live event. You need to purchase a range of electronic products, such as laptops, printers, video cameras, SLR cameras, projectors, recorders, speakers, microphones, headphones, and tablets. A series of search webpages of these products will be simulated and displayed, and you need to navigate through these simulated webpages (pressing the space bar to turn the pages).

Once you have understood the rules of the experiment. Please press any key to start the experiment and proceed under this simulated identity.

Fig. 3 Instructions for the formal experiment

Experiment Guidelines

Once again, welcome to this experiment. A series of personalized recommended products based on the information generated during your view/browsing on the online shopping platform will be presented, and the interpretation of the use of private data generated during your search and browsing is also provided (Why are you seeing this recommendation? Which private information is it based on?). Please choose whether or not to accept such personalized recommendations according to your own willingness.

The experiment begins with a "+" focus point to attract your attention, followed by personalized recommended products and related information. If you agree to accept the recommendation, please press F. If you reject the recommendation, please press J.

If you understand the rules of the experiment. Please press any key to enter the practice module.

The experiment consisted of two main parts: scenario guidance and a formal experiment. Scenario guidance is explained in Fig. 2. The scenario guidance was a previously collected webpage image of the product. To facilitate understanding, the subjects could autonomously control the simulation interface.

The experiment was divided into the practice stage and the formal experiment stage. The volunteer was presented with four stimuli: the normativeness of privacy interpretation information (acceptable vs. unacceptable transparency) × intelligibility (high vs. low interpretability). In the practice stage, first, the subjects are asked to read the instructions shown in Fig. 3. The purpose of the practice stage was to enable the subjects to familiarize themselves with the experimental procedure and operations. After the practice, the subjects pressed the Q key to start the formal experiment. First, a focus point in the form of a + sign was displayed in the centre of the computer screen for 1000 ms. After a blank screen was displayed for 500–800 ms, four stimulus materials appeared on the screen randomly, and the text was displayed for 5000 ms. After another 500-800-ms blank screen, the next trial started, and subjects were asked to respond by pressing keys corresponding to the privacy interpretation information. The experiment was divided into four blocks, each with 40 trials, for a total of 160 trials. The experimental procedure is presented in Fig. 4.
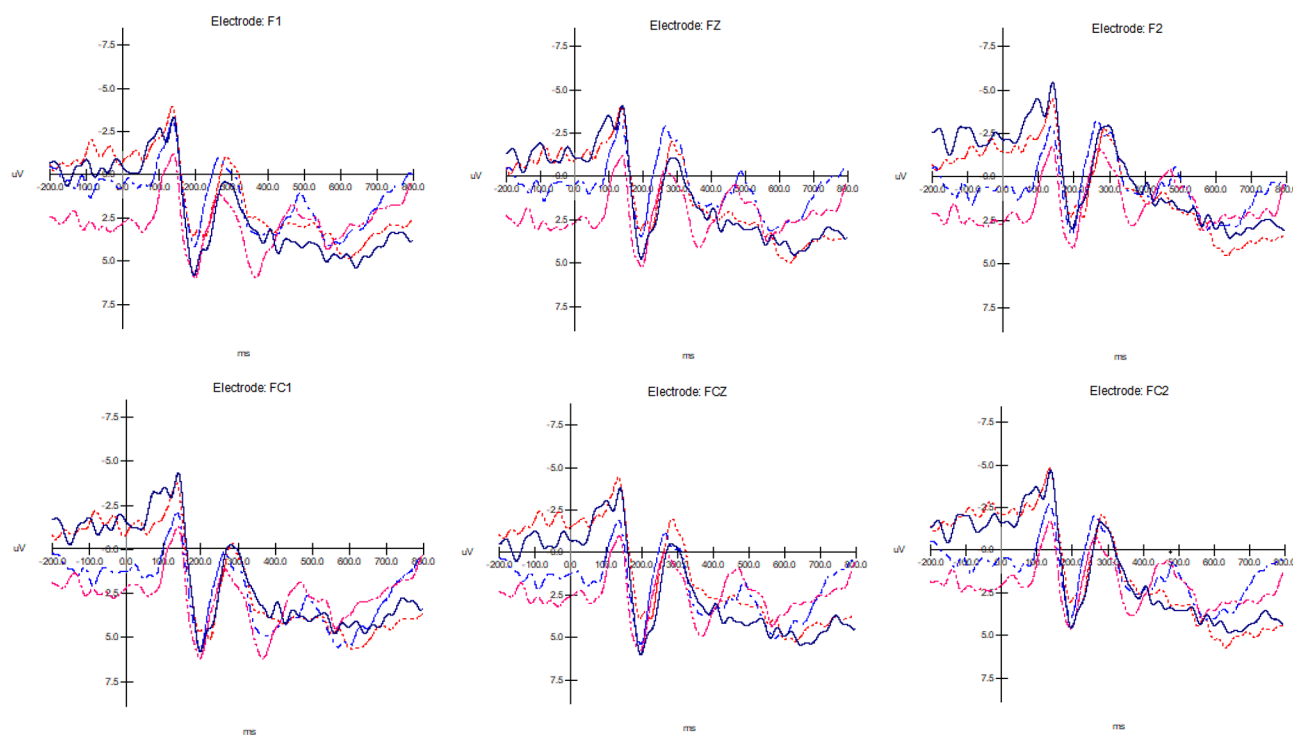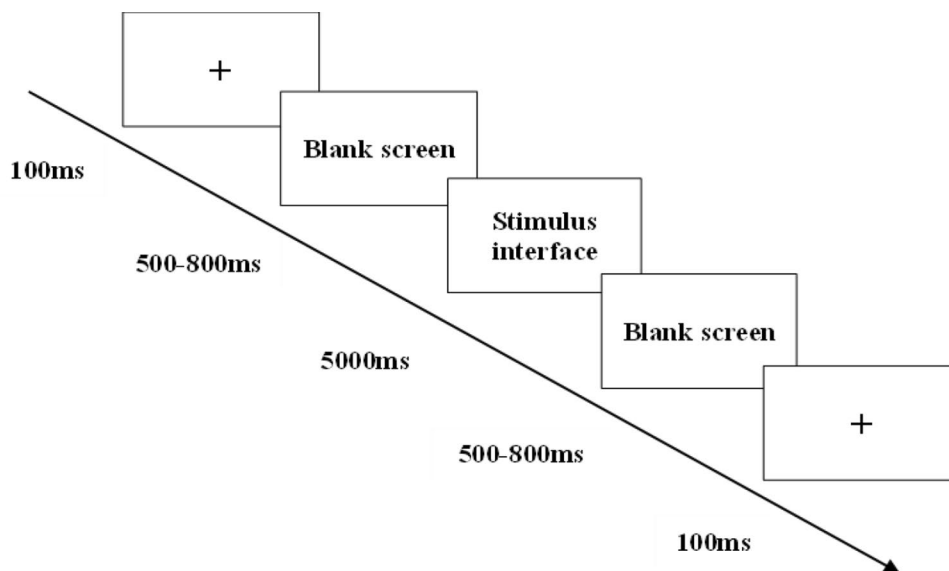
Fig. 4 Experimental flowchart

Fig. 5 Amplitude of the N2 component in the normativeness and intelligibility design

Collection and processing of experimental data

The experimental data collection tool was the American NeuroScan EEG recording and analysis system, and the electrode position was referenced to the 64-channel Quik-Cap developed according to the International 10–20 system. The vertical electrooculogram (VEO) and the horizon electrooculogram (HEO) were recorded. The filter bandpass was 0.01–100 Hz, the sampling frequency was 100 Hz, and the scalp resistance was required to be lower than 5 kΩ. The data processing steps included artefact removal, baseline correction, and superposition averaging. The time interval was 1000 ms, and the baseline time was 200 ms before the stimulation. The time window of the N2 EEG component was 200–300 ms, the time window of the LPP EEG component was 400-520 ms, and the electrodes analysed were F1, FZ, F2, FC1, FCZ, FC2, CP1, CPZ, CP2, P1, PZ, and P2. Greenhouse–Geisser correction was used.

Results

Behavioural results

In the acceptable transparency group, the willingness to accept under high interpretability (M = 0.86, SD = 0.20) was significantly higher than that under low interpretability (M = 0.81, SD = 0.21) (t(28) = 3.68, P < 0.01). In the unacceptable transparency group, the willingness to accept under high interpretability (M = 0.34, SD = 0.23) was significantly lower than that under low interpretability (M = 0.56, SD = 0.28) (t(28) = 5.96, P < 0.001).

Overall results: The willingness to accept under acceptable transparency (M = 0.84, SD = 0.20) was significantly greater than that under unacceptable transparency (M = 0.45, SD = 0.27) (t(29) = 4.87, P < 0.001); the willingness under high interpretability (M = 0.60, SD = 0.28) was significantly lower than that under low interpretability (M = 0.68, SD = 0.33) (t(29) = 2.15, P < 0.05). The intelligibility of privacy interpretation had a significant impact on the subjects' willingness to accept targeted advertising. In the acceptable transparency group, the subjects made reasonable behavioural decisions on the information with high interpretability, while in the unacceptable transparency group, the subjects were more inclined to adopt resistant behaviour to specific, detailed interpretation information. Therefore, Hypothesis 1, Hypothesis 1a, and Hypothesis 1b are supported.

EEG results

This study focused on two EEG components, N2 and LPP. F1, FZ, F2, FC1, FCZ, and FC2 were selected as the electrode sites for the N2 component. CP1, CPZ, CP2, P1, PZ, and P2 were selected as the electrode sites for the LPP component. The amplitudes of the N2 and LPP components were also subjected to repeated-measures analysis of variance (Grant et al., 2022).

N2 component results

Acceptable transparency group: Intelligibility had a significant main effect on the N2 component (F(1,28) = 7.12, P = 0.009). The N2 amplitude under low interpretability (M=-2.33, SD = 0.30) was significantly larger than that under high interpretability (M=-0.84, SD = 0.48) (F(8, 252) = 7.54, P = 0.006), indicating that compared with information with high interpretability, the subjects exerted more cognitive effort on information with low interpretability. The main effect at each electrode site was significant (F(8,252) = 2.27, P = 0.025); the interaction between electrode site and intelligibility was not significant. Therefore, Hypothesis 2a is supported.

Unacceptable transparency group: Intelligibility had a significant main effect on the N2 component (F(1,28) = 9.34, P = 0.002; the N2 amplitude under high interpretability (M=-1.85, SD = 0.47) was significantly greater than that under low interpretability (M=-1.21, SD = 0.32) (F(8, 252) = 7.58, P = 0.006). When the behaviour violated the norms of information exchange, the subjects consumed more attention and cognitive effort. Therefore, Hypothesis 2b is supported.

Intelligibility had a significant main effect on the N2 component (F(1, 28) = 13.98, P = 0.000), indicating that the intelligibility of privacy interpretation information has a significant impact on the cognitive effort of a user. At the same time, the main effect of the interaction term between intelligibility and normativeness was significant (F(1, 28) = 7.71, p = 0.006); the main effect of electrode site was significant (F(8, 252) = 3.26, P = 0.001; but the interaction of electrode site, intelligibility, and normativeness was not significant. Therefore, Hypothesis 2 is supported.

LPP component results

Acceptable transparency group: Intelligibility had a significant main effect on the LPP component (F(1,28) = 16.39, P = 0.000). The LPP amplitude under low interpretability (M = 5.52, SD = 0.35) was significantly smaller than that under high interpretability (M = 7.17, SD = 0.35) (F(8, 252) = 18.55, P = 0.000). The main effect of the electrode site was not significant, and the interaction between the electrode site and intelligibility was not significant.

Unacceptable transparency group: Intelligibility had a significant main effect on the LPP component (F(1, 28) = 7.15, P = 0.008). The LPP amplitude under high interpretability (M = 6.43, SD = 0.35) was significantly greater than that under low interpretability (M = 5.47, SD = 0.21) (F(8, 252) = 7.15, P = 0.008). The main effect of the electrode site was not significant, and the interaction between the electrode site and intelligibility was not significant.

Privacy interpretation information had a significant main effect on the LPP component (F(1, 28) = 23.11, P = 0.000). The main effect of the interaction between intelligibility and normativeness was not significant. The main effect of electrode site was not significant. The interaction of electrode site, intelligibility, and normativeness had no significant effect. Figure 6 shows that there was a significant LPP wave; that is, compared with low interpretability, privacy interpretation information with high interpretability induced more intense emotions in the users. Therefore, Hypothesis 3 is supported.
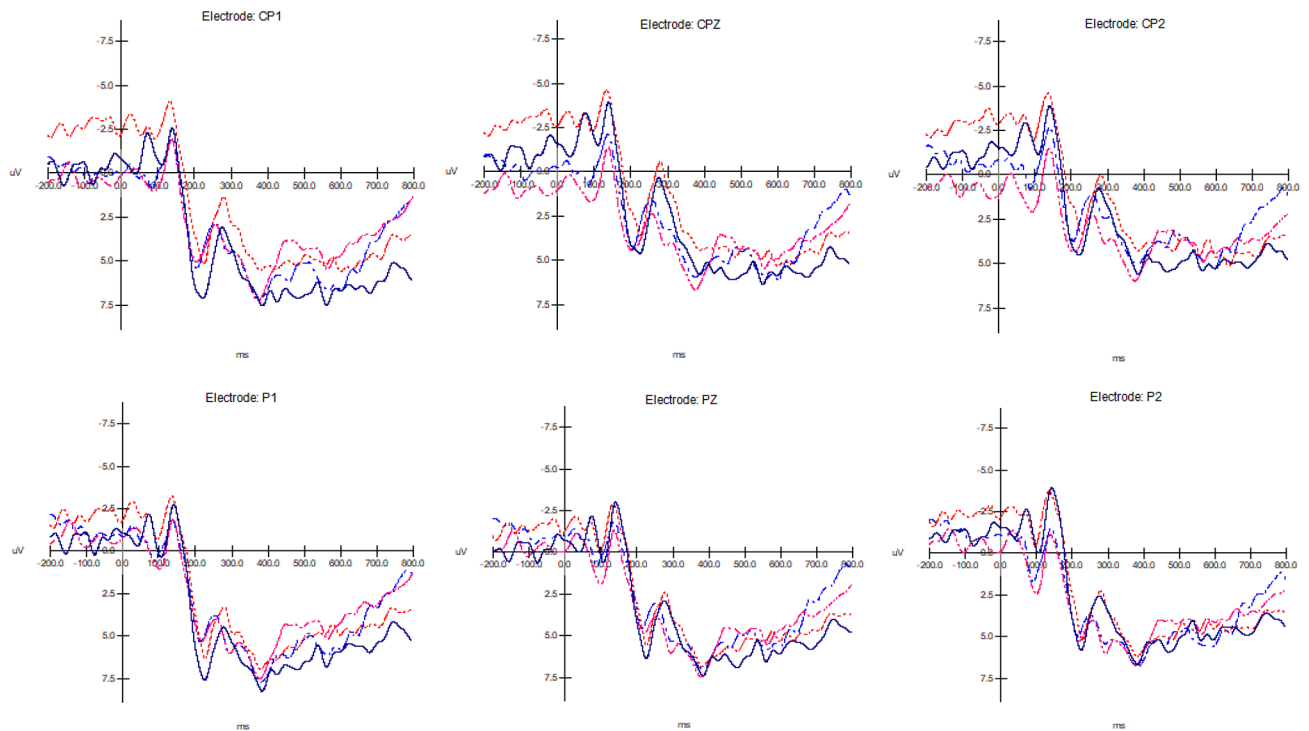
Fig. 6 Amplitude of the LPP component in the normativeness and intelligibility design

Discussion

Conclusion

With the advent of information technology and digital intelligence, targeted advertising has become widely used. However, with the spread and popularization of such advertising, the problem that it advertising more easily exposes users' private information has gradually become prominent. How to overcome the negative impact of users' privacy concerns and balance the relationship between users' private information and the interests of enterprises is a frequently examined topic in the field of online targeted advertising research. Based on IPT and CLT, this study examined the intrinsic impact of the normativeness and intelligibility of privacy interpretation information on consumers' cognitive load. We constructed a research model for the willingness to accept targeted advertising and investigated the cognitive mechanism through which the normativeness and intelligibility of privacy interpretation information impact users willingness to accept targeted advertising. Through EEG data on consumers' neurophysiological indicators gathered by ERP technology, users' intrinsic cognitive patterns were studied. The following conclusions can be drawn.

Intelligibility has different impacts on the willingness of consumers to accept targeted advertising. Specifically, in the unacceptable transparency group, compared with high interpretability, low interpretability made users more willing to accept targeted advertising. In the acceptable transparency group, consumers under high interpretability were more willing to accept targeted advertising than those under low interpretability.

In the acceptable transparency group, compared with high interpretability, the N2 amplitude generated under low interpretability was higher; that is, under acceptable transparency, abstract and vague privacy interpretation consumed more cognitive resources of consumers. In the unacceptable transparency group, the N2 amplitude under high interpretability was higher than that under low interpretability; that is, when the privacy interpretation information violates the norms of information exchange, specific, detailed privacy interpretation can lead to greater cognitive conflict and consume more of the user's cognitive resources.

In the cognition process, privacy interpretation has a significant impact on users' emotional arousal. Compared with low interpretability, high interpretability induces users to feel more intense negative emotions, and thus, their LPP amplitude is larger.

Theoretical contributions

This study makes the following theoretical contributions. First, it examines the impact of privacy interpretation information on users' willingness to accept targeted advertising

from the perspective of cognitive load, which provides a new explanatory mechanism for research on both privacy interpretation information and willingness to accept targeted advertising. In the field of recommendation interpretation, scholars have investigated targeted advertising through vague and holistic privacy interpretation information (Hashmi et al., 2021; Johnson et al., 2020; Liu et al., 2022; Seng et al., 2021; Wei et al., 2020), but the private information of individuals is accurate and specific in reality. Therefore, adopting the perspective of user psychological load, this study examined the impact of the normativeness and intelligibility of privacy interpretation information on the willingness to accept targeted advertising, which not only conforms to the individual's intrinsic cognitive pattern but also provides new ideas for research on privacy interpretation and targeted advertising.

Second, based on CLT, this study expands the scope of research on targeted advertising. Previous studies in this area are mostly based on persuasive communication theory, the theory of planned behaviour (Wang et al., 2020), and technology threat avoidance theory and have held that the user's behavioural decisions are the result of a rational weighing of risks and benefits (Kim et al., 2018; Li & Sun, 2019; Zarouali et al., 2018). Limited by these theories, that research paradigm is based on a hypothetical response to a hypothetical situation because the behavioural decisions that are retrospectively processed by the brain do not correspond to the user's real-time behaviour. In real-life situations, individual decisions concerning one's willingness to accept targeted advertising are immediate and not subject to much rational analysis, and most users are heavily influenced by individual emotions and cognitive load. Therefore, based on CLT, this study examined the cognitive process of users in interpreting the recommendations provided with targeted advertising and further examined the mechanisms of how the normativeness and interpretability of privacy interpretation information affect consumers' cognitive load based on the information processing characteristics of privacy interpretation. Since these mechanisms can affect users' behavioural willingness, we propose targeted measures to reduce users' advertising avoidance behaviour, which expands the theoretical scope of CLT in targeted advertising.

Third, this study used ERPs, offering a new method for future experimental research on the cognitive mechanism of user online behaviour. Traditional research methods, such as questionnaire surveys and interviews, are conducive to the introspective processing of consumers but often cannot reflect the cognitive load of users in real time (Zha et al., 2020). This study used ERP technology to extract the EEG data for the user's intrinsic cognition and real-time emotions, analysed specific psychological phenomena through immediate physiological electrical indicators (Shi & Zhang,

2022), and performed real-time matching measurements of user cognition and responses. ERP technology has the advantages of high temporal resolution and noninvasiveness and can accurately locate the cognitive process and emotional state of users (Alsmadi & Hailat, 2021), making it a useful method for studies in this field.

Practical significance

To improve the willingness of users to accept targeted advertising, this study proposed targeted solutions, which have certain practical significance to platforms and advertisers with respect to their targeted advertising.

First, from the perspective of the problem's source, the standardization and comprehensibility of the privacy interpretation information of Internet enterprises should be adjusted to enhance consumers' willingness to accept targeted advertisements. This study shows that acceptable privacy interpretation information with high interpretability can effectively enhance consumers' willingness to accept targeted advertising, while unacceptable privacy interpretation information with low interpretability can significantly reduce consumers' willingness to accept such advertising. Therefore, Internet companies and mobile platforms should reasonably adjust the normativeness and interpretability of their privacy interpretation information. However, the privacy interpretation information of online targeted advertising is generally vague and abstract. Enterprises often use obscure and complex language to explain how they collect and use consumer privacy data. This effort fulfils their obligation to inform consumers. However, such privacy interpretation information is difficult for consumers to understand and can reduce their willingness to accept targeted advertising. We believe that for privacy interpretation information to be accepted, when the interpretability is not high, the company should redesign the interactive interface of the advertisement and use specific and easy-to-read text when addressing the privacy issues of consumers. In this manner, the consumers' reasonable right to know can be respected, and the willingness of users to accept targeted advertising can be effectively increased.

Second, from the perspective of problem-solving, enterprises should pay attention to the cognitive load privacy interpretation information places on consumers before undertaking precise advertising. When privacy interpretation does not conform to the norms of information exchange, specific and detailed privacy explanations lead to greater cognitive conflicts and strong negative emotions among users. To reduce cognitive load and negative perceptions, consumers usually avoid targeted advertisements. Accordingly, a privacy feedback column or opinion column can be used to adjust the cognitive load and negative emotions of

consumers and provide a reference for the platform operation scheme, which will help improve consumers' willingness to accept targeted advertisements. When privacy interpretation is in line with information exchange norms, exceedingly complex information, such as when excessive professional jargon is present in a text, will increase the cognitive load of users and lead to consumers' paying less attention to targeted advertising. Internet enterprises and platforms could consider providing explanations in the form of illustrations based on simple and easy-to-understand texts in which the cognitive resources required from users are relatively small and at a reasonable level. In this scenario, the introduction of targeted advertisements could stimulate the attention of target audiences, thus improving consumers' willingness to accept targeted advertisements.

Limitations and future prospects

Although this study has theoretical value and practical significance, it has the following shortcomings. On the one hand, the participants were all college undergraduate and graduate students. Although college students are a mainstay of the current consumer base, they evince certain representational limitations in areas such as age, culture, experience, and background. Future studies should investigate more varied samples to arrive at more general conclusions. On the other hand, previous studies have shown that users' willingness to accept targeted advertising is not only affected by the normativeness and interpretability of privacy interpretation information but also regulated by the authority of the platform and the user's risk perception and trust. In this study, due to a small sample size, the impact of these factors could not be fully considered. Future studies could investigate these factors more thoroughly so as to make more persuasive conclusions.

Declarations

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