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Mechanism of implicit moral decision in the context of non-deceptive counterfeit luxury consumption

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Abstract

The implicit moral decision exists widely in our daily life, such as the non-deceptive counterfeit luxury consumption, but its moral decision mechanism remains to be clarified. This study is dedicated to studying how moral beliefs affect individuals' moral decision process and decision outcomes in implicit moral decisions, as well as the effect of attitude function, which can impact the implicit degree of moral decision. We employed transcranial direct current stimulation (tDCS) to examine neural underlying and effect of moral belief on counterfeit luxury consumption. In this study, we adopted 2 (stimulation group: active vs. sham, between-subject) × 2 (attitude function: social-adjustive vs. value-expressive, within-subject) mixed design. 58 participants were randomly assigned to either active or sham tDCS groups (a-tDCS vs. s-tDCS). Our results showed that the moral belief of counterfeit luxury consumption was higher for a-tDCS group (left anodal/right cathodal tDCS over dorsolateral prefrontal cortex) than s-tDCS group (sham stimulation). The counterfeit luxury purchase intention of s-tDCS group is higher. Moreover, we also found reaction time of value-expressive function is longer for a-tDCS group. Hence, these results suggested that moral beliefs can change implicit moral decisions, which is also related to left dorsolateral prefrontal cortex (DLPFC). Besides, attitude functions can affect the relationship between moral beliefs and moral decision processes. In summary, the current study's research findings can help understand and solve the social problems caused by implicit moral decisions.

Keywords Implicit moral decision · Moral belief · Transcranial direct current stimulation (tDCS) · Left dorsolateral prefrontal cortex (DLPFC) · Counterfeit luxury consumption

Introduction

Imagine if you want to own a beautiful luxury, but the price far exceeds your budgetary constraints. At this time, you find that a small shop sells almost identical versions of your desired product, which is not licensed and authorized by the original brand but can be obtained at a much lower price. At this point, you need to make a trade-off between benefit and moral condemnation. Non-deceptive counterfeit luxury consumption occurs when transpires knowingly and deliberately acquire counterfeit products (Sharma & Chan, 2017), which is also considered as a moral decision (Wang et al., 2019). Diverging from the traditional moral decision, it is more implicit, and has the following two apparent characteristics:

First, damaging consequences caused by non-deceptive consumption of counterfeit luxury are challenging to assess. Previous studies have posited that the magnitude of results is considered one of the determinants of the intensity of moral issues (Anderson & Burchell, 2021; Tsalikis et al., 2008).

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Traditional moral cognition regards to risk, harm, or threat as central reference points of magnitude, which is called centrally immoral (Buchtel et al., 2015). Unlike the traditional consequences of moral decisions, such as casualties or property damage, consumers need help perceiving and evaluating counterfeit luxury consumption's consequences. Despite counterfeit activities resulting in multibillion-dollar losses for affected companies (Randhawa et al., 2015; Wiedmann et al., 2012), consumers, by and large, do not perceive their actions as deleterious to specific industries or as potentially contributing to social costs (Riquelme et al., 2012). This leaded most consumers to overlook the adverse impacts of counterfeit luxury (Phau & Teah, 2009). Thus, the moral decisions of consumption of counterfeit luxury are relatively vague, non-specific, and indirect, requiring more effort from consumers to recognize the possible social risks and economic hazards.

Second, consumers exhibited a greater propensity to justify and rationalize their deliberate consumption of counterfeit luxury (Khan et al., 2021), which resulted in blurred moral boundaries. Although it was recognized that consumer behavior in purchasing counterfeit luxury goods is an immoral behavior, it is easy to justify and rationalize this kind of immoral behavior (Chen et al., 2018). When confronted with counterfeits, consumers may compromise their moral principles and justify their purchase by rationalizing that fake luxury goods are not as heinous as other nefarious activities people engage in (Chen et al., 2018). Additionally, consumers are spurred by the desire to evade guilt in their efforts to rationalize these immoral behaviors (Zampetakis, 2014). However, in the context of traditional moral decisions, such as cheating, which is a typical immoral behavior and difficult to rationalize (Wiltermuth, 2011).

It is worth noting that the extent to which counterfeit luxury consumption is rationalized may be influenced by the attitude functions of luxury brands (Wilcox et al., 2009). Luxury brands fulfill two distinct attitude functions: the social-adjustive and value-expressive functions (Ryu et al., 2023; Shavitt, 1990). The social-adjustive function pertains to self-presentation, wherein luxury consumption aids in the establishment of social conformity or approval, facilitating the development of connections or affiliations with others (Han et al., 2010). In cases where counterfeit luxury fulfills the social-adjustive function, rationalization becomes less straightforward, as it entails the deception of others and may elicit negative moral sentiments like guilt and shame (Zampetakis, 2014). Conversely, the value-expressive function relates to self-expression, with counterfeit luxury potentially signifying affluence or personal style. This assists consumers in crafting an identity in line with the luxury brand and aligning with their set of values (Ngo et al., 2020). When counterfeit luxury serves the value-expressive function, consumers are more inclined to rationalize their behavior, viewing counterfeit luxury as a more cost-effective alternative that allows them to expend less capital while obtaining products of comparable quality and functionality to genuine counterpart (Wilcox et al., 2009). As a result, this made the moral boundaries of counterfeit luxury consumption blurred (Jiang et al., 2019).

Hence, a conspicuous distinction arises between implicit and traditional moral decisions. But research on the moral decision mechanism under implicit moral decisions still needs to be completed. This study takes the non-deceptive consumption of counterfeit luxury as an example. It is dedicated to discussing three key questions: (1) For the implicit moral decision, where the damaging consequences are difficult to assess and the blurred moral boundaries, whether improving moral beliefs can affect individuals' immoral decision; (2) Whether the implicit moral decision have the same neural underlying as traditional moral decision; (3) While it is established that attitude functions can influence the extent of behavior rationalization in counterfeit luxury shopping, can they also moderate the impact of moral beliefs on implicit moral decision-making?

To investigate the a forementioned issues, a thorough understanding of the neural processing mechanisms is imperative. Functional magnetic resonance imaging (fMRI) research has robustly revealed a pronounced connection between moral beliefs and the activation of the dorsolateral prefrontal cortex (DLPFC) (Greene et al., 2001; Xia et al., 2021). The decision-making process, entailing moral trade-offs between honesty and economic interests, exhibits a notable correlation with left DLPFC activity (Qu et al., 2020). Damage to the left DLPFC diminishes the impact of honesty behavior on economic games, particularly when motivation of honest clash with self-interest (Zhu et al., 2014). Additionally, investigations utilizing transcranial direct current stimulation (tDCS) revealed that anodal stimulation of the left DLPFC notably amplifies participants' moral beliefs, fostering increased honesty and mitigating malicious intentions (Fan et al., 2020; Kuehne et al., 2015). In conclusion, the left DLPFC is pivotal in processing moral beliefs and making moral decisions in traditional moral dilemmas. This study hypothesizes that anodal transcranial direct current stimulation of the left DLPFC (a-tDCS) will increase moral beliefs regarding counterfeit luxury consumption.

Moral beliefs significantly influence participants' preferences for purchasing counterfeit luxury goods. Morally conscientious consumers, in particular, were less inclined to prioritize the potential benefits of such goods, emphasizing moral concerns and thereby dampening their willingness to make these purchases (Wilcox et al., 2009). Furthermore, studies have shown that consumers possessing robust moral beliefs are more prone to view the acquisition of counterfeit luxury goods as unethical (Wang et al., 2019). Therefore, this study hypothesizes that an

increase in moral beliefs regarding counterfeit luxury consumption will diminish the intention to purchase counterfeit luxury goods.

In moral decision-making, reaction time (RT) serves as a crucial indicator frequently employed to identify the level of cognitive involvement in the moral decision-making process (Fan et al., 2020; Greene & Paxton, 2009). Due to the conflict between the utilitarian value orientation of gains and the risks of violating moral beliefs, the recruitment of cognitive processes by the DLPFC is necessary to resolve this conflict, resulting in prolonged RTs (Greene et al., 2004). In this study, cognitive conflict may also arise in the process of counterfeit luxury consumption due to moral considerations. This process involving abstract reasoning and cognitive engagement may significantly lengthen RTs but is subject to modulation by attitude functions (Fecteau et al., 2007; Zhang et al., 2019).

The social-adjustive function can reduce implicit moral decision-making in counterfeit luxury consumption. In other words, when exposed to social-adjustive function, the decision-making process of counterfeit luxury consumption becomes more similar to traditional moral decision-making, making it less likely to be rationalized when purchasing counterfeit goods (Wang et al., 2020). In addition, due to clearer moral boundaries and strengthened moral beliefs, consumers are more likely to make relevant decisions (Ngo et al., 2020; Wang et al., 2020). Conversely, the value-expressive function increases the implicitness of moral decision-making in counterfeit luxury consumption, blurring the boundaries of moral decision-making (Eastman et al., 2021). When moral beliefs are triggered, consumers are required to engage in more cognitive processing to weigh moral issues and potential benefits associated with counterfeit luxury consumption (Moll et al., 2005). Therefore, this study hypothesizes that value-expressive function will increase individuals' RT in making implicit moral decisions.

In summary, this study takes the non-deceptive consumption of counterfeit luxury as an example to study how moral beliefs affect individuals' moral decision process and decision outcomes in implicit moral decisions, as well as the moderating effect of attitude functions, which can help to clarify the difference between implicit and traditional moral decisions.

Methods

We adopted a single-blind and 2 (stimulation group: active vs. sham, between-subject) × 2 (attitude function: social-adjustive vs. value-expressive, within-subject) mixed design. The tDCS was applied using bihemispheric stimulation, which was compared to sham stimulation.

Participants

Given our intention to conduct a 2 × 2 mixed repeated-measures analysis of variance (ANOVA), we used G*Power to estimate sample size (Faul et al., 2007). The parameters were set as follows: a power with 0.95, an effect size of at least 0.25(f), an alpha of 0.05, a default measurement correlation of 0.5, and a non-sphericity correlation value (ε) of 1. The results indicated that a minimum of 36 subjects were required for this study, with a larger sample size being preferable.

Considering the G*Power results, 58 healthy graduate and undergraduate students (27 Males, 31 Females, M_{age} = 23.086, SD = 2.202, from 18 to 27 years old) were recruited to attend this study, randomly allocated into active group (a-tDCS) or sham group (s-tDCS), with a 20 CNY participation fee. All participants had either normal vision or vision corrected to normal, and no history of neurological disorders or mental diseases. This study was conducted with approval of the principles set forth in the Declaration of Helsinki and the Ethics Committee (Approval Number: 2022BC030). Prior to the commencement of experiment, participants need to write informed consent.

Materials and procedure

We chose watches as the product category because both genders publicly consume them and have a high rate of counterfeiting. Referring to previous studies on luxury goods in Chinese culture, we selected Longines watches as the stimul (Donze, 2020). Longines has been in the Chinese market since 1832, which is a representative luxury brand and has a high degree of localization. Longines enjoys heightened awareness and familiarity among Chinese consumers (Kim et al., 2017).

We downloaded watch pictures from Longines's official webpage (https://www.longines.cn/) as our experiment materials; the images were processed by 7.0 (Adobe Systems Incorporated, San Jose, California, USA) with white background and size 360 × 270 pixels. Advertising is a valuable tool to manipulate consumers' attitude function toward products (Shavitt, 1990), which is much more prominent for luxury goods (Choi et al., 2020). Previous literature has adopted it to manipulate the function of participants' attitudes toward counterfeit luxury products (Wilcox et al., 2009). Referring to the above research, we also manipulate consumers' attitude functions to counterfeit luxury consumption through advertising in the current study. Both advertisements featured an image of a Longines watch and a succinct description, after which the content varied based on the ad copy condition (see Fig. 1). In the social-adjustive advertisement copy (SAAC), participants were urged to "wear a Longines to get noticed, be admired and enhance

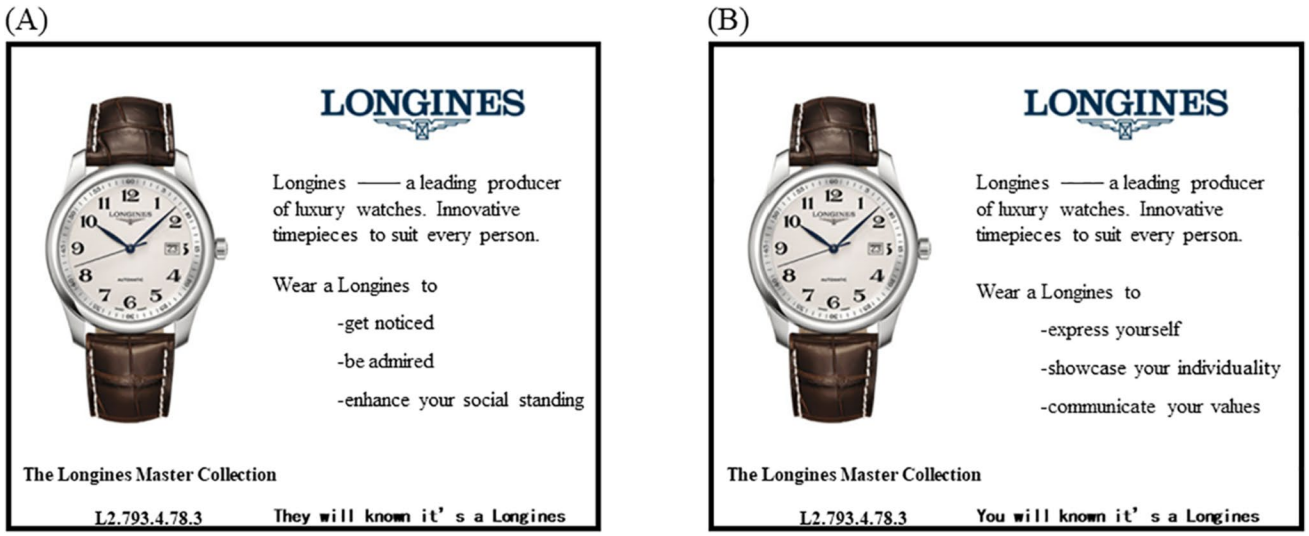

Fig. 1 Stimulation sample: **A** Social-adjustive Ad Copy; **B** Value-expressive Ad Copy

your social standing." with the tagline "They will know it is a Longines." Conversely, in the value-expressive advertisement copy (VEAC), participants were prompted to "wear a Longines to express yourself, showcase your individuality, and communicate your values." with the tagline "You will know it is a Longines." Each advertisement was tailored to the gender of the participants, with both male and female versions available.

To gauge our manipulation's effectiveness, we conducted a pretest to compare the difference in the attitude functions towards the two kinds of advertisement. Another 90 participants (M_{age} = 22.763, SD = 1.742) were recruited from the same university (no overlapping with the participants in the following experiment). We adopted the previous study's four-item, five-point Likert scale (= 0.90) (Wilcox et al., 2009). As anticipated, the ANOVA results revealed that participants who viewed the SAAC rated the Longines higher on the social-adjustive function than value-expressive function ($M_{social-adjustive}$ = 4.589, $M_{value-expressive}$ = 4.172, t (44) = -2.983, p = 0.005). Conversely, participants who viewed the VEAC rated the Longines lower on the social-adjustive function than value-expressive function ($M_{social-adjustive}$ = 3.933, $M_{value-expressive}$ = 4.167, t(44) = 2.250; p = 0.030). This confirmed successful manipulation of the attitude function.

In each trial of the formal experiment, a fixation was displayed. Subsequently, one kind of ad copy appeared with a seven-point Likert scale (1 = "I would definitely not purchase the watch," and 7 = "I would definitely purchase the watch") beneath it. Participants used the mouse to indicate their purchase intentions. Given that there were 40 different stimulations, each participant should experience 40 trials. The trial sequence was randomized. We show the whole procedure in Fig. 2. Then, after the experiment, a five-point Likert scale used to measure the moral belief of purchase intention towards counterfeit products (Wilcox et al., 2009), with a three-item semantic differential scale (1 = "I feel the purchase intention towards counterfeit products is immoral" and 5 = "I feel the purchase intention towards counterfeit products is moral"; 1 = "I feel the purchase intention towards counterfeit products is unethical" and 5 = "I feel the purchase intention towards counterfeit products is ethical"; 1 = "I feel the purchase intention towards counterfeit products is insincere" and 5 = "I feel the purchase intention towards counterfeit products is sincere").

tDCS stimulation

tDCS, a painless and non-invasive brain stimulation (NIBS) technique, utilizes low-intensity direct current (e.g., 1-2mA) to modulate spontaneous cortical activity (Woods et al., 2016). The stimulation involves two electrodes (5 × 7 cm) covered with a saline-soaked sponge, and the constant direct current is transmitted by a battery-driven noninvasive stimulator (Soterix Medical, America), controlled through a Bluetooth signal. This method, known for its safety, can induce and modulate cortical excitability in the target area without causing physiological harm (Ye et al., 2015). Anodal stimulation, as observed in previous studies, enhances cortical excitability, while cathodal stimulation inhibits it (Nitsche & Paulus, 2000). In the current study, the target brain area we want to induce the cortical excitability is the left DLPFC, closely linked to moral belief (Greene et al., 2001, 2004). When targeting the left DLPFC, noninvasive brain stimulation induces local and distant changes within the dynamic neural network. This encompasses interhemispheric effects

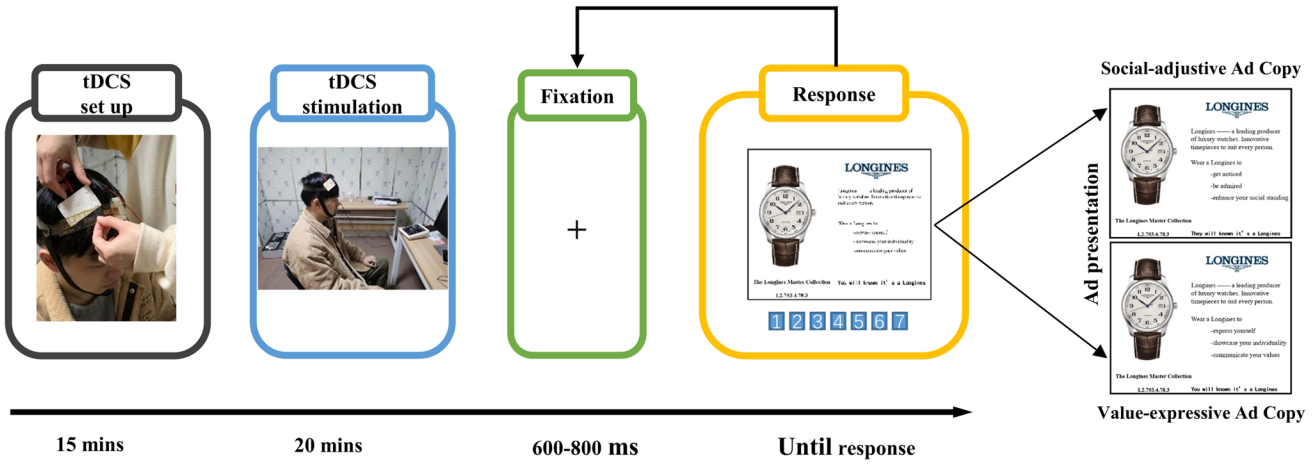

Fig. 2 Experiment procedure. Each trial began with a fixation cross for 600-800ms. Then, participants needed to watch an ad of watch (SAAC or VEAC). After that, they were asked to rate their purchase intention with a seven-point Likert scale. Finally, the moral belief was measured on a five-point Likert scale

that alter activity in homologous regions of the unstimulated hemisphere (Lindenberg et al., 2010). Thus, we employed a bihemispheric stimulation approach by applying opposite polarity stimulation to the right and left DLPFC. Specifically, we applied anodal stimulation to the left hemisphere and cathodal stimulation to right hemisphere.

The DLPFC was reported localized with location F3 (left) and F4 (right) on an EEG cap in conformity with the international 10–20 System (Herwig et al., 2003). Therefore, for a-tDCS, anodal electrode was placed over F3, while cathodal electrode was placed over F4 (Fig. 3). During s-tDCS, the electrode arrangement mirrored that of a-tDCS. We used this bifrontal electrode montage to improve the activity of the left DLPFC and diminish right side simultaneously. In accordance with prior research (Kuehne et al., 2015), each participant underwent a 20-minute session of tDCS at 2 mA, with a 30-second fade-in period preceding the commencement of the formal task. These parameters, deemed safe, can guarantee consistent stimulation effects (Utz et al., 2010). For s-tDCS, the stimulator was deactivated following a 30-second fade-out period. This sham stimulation methodology has been validated for reliability (Gandiga et al., 2006). Importantly, all participants were kept uninformed of the specific stimulation conditions.

Results

Moral belief for counterfeit luxury consumption

Results show that Cronbach's α coefficient of the scale of moral belief is 0.753, indicating a high internal consistency. Independent sample t-tests show that significant effect on moral belief between groups ($t = 2.273$, $p = 0.027$). The s-tDCS showed ($M_{s-tDCS} = 2.563$, $SD = 0.882$) significantly

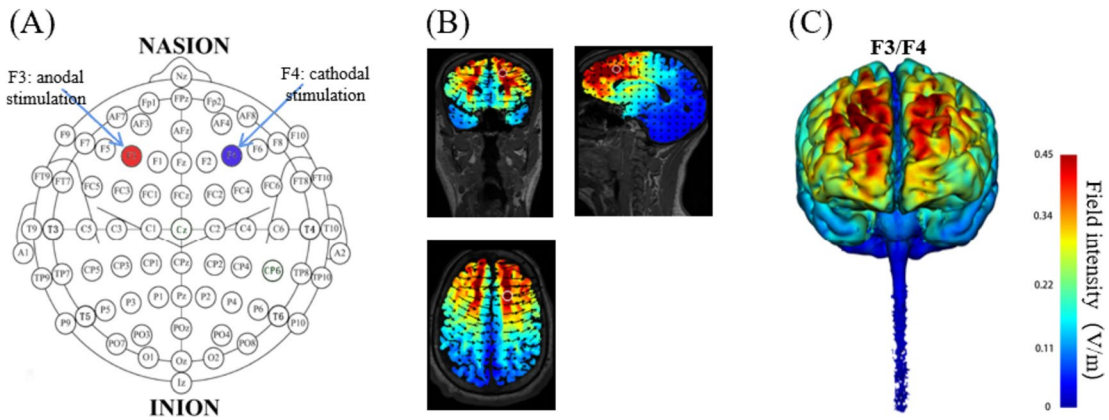

Fig. 3 tDCS effect. **A** tDCS stimulation electrodes. **B** Direct current flow distribution in the brain. **C** Electrical field modeling

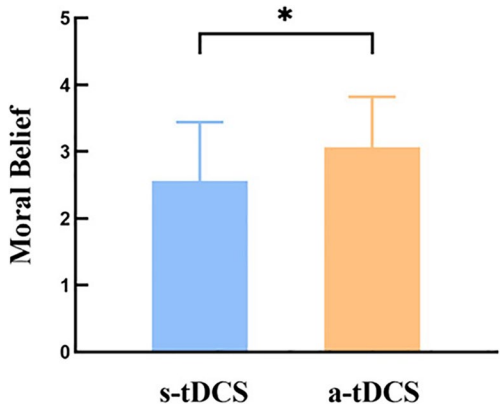

Fig. 4 Mean moral belief (+SD) of the s-tDCS and a-tDCS. $^{*}p < 0.05$

less moral belief than the a-tDCS (M_{a-tDCS} = 3.059, SD = 0.759), as shown in Fig. 4.

Purchase intention

The mixed-design repeated-measures ANOVA analysis was conducted with between-subject factor (stimulation group: a-tDCS vs. s-tDCS) and the within-subject factor (attitude function of advertisement: SAAC vs. VEAC) for purchase intentions. There is a significant main effect of the stimulation group (F (1, 56) = 5.037, $p = 0.029$, $\eta^2_p = 0.083$). Participants' purchase intentions for a-tDCS (M_{a-tDCS} = 3.584, SD = 0.599) are lower than that of s-tDCS (M_{s-tDCS} = 3.969, SD = 0.719). However, the main effect of the attitude function (F (1, 56) = 0.708, $p = 0.404$, $\eta^2_p = 0.012$) and the interaction effect is not significant (F (1, 56) = 0.070, $p = 0.792$, $\eta^2_p = 0.001$). Table 1 and Fig. 5 summarize the results.

Reaction time

The mixed-design repeated-measures ANOVA analysis was conducted with between-subject factor (stimulation group: a-tDCS vs. s-tDCS) and the within-subject factor (attitude function of advertisement: SAAC vs. VEAC) for RT. The stimulation group's main effect is insignificant (F (1, 56) = 2.561, $p = 0.115$, $\eta^2_p = 0.044$). The main effect of the attitude function (F (1, 56) = 4.829, $p = 0.032$, $\eta^2_p = 0.079$) is significant. SAAC ($M_{social-adjustive}$ = 3166.743, SD = 1338.976) has shorter RT than VEAC ($M_{value-expressive}$ = 3345.663, SD = 1393.182). The interaction effect of the stimulation group and attitude function is also significant (F (1, 56) = 7.567, $p = 0.008$, $\eta^2_p = 0.119$).

Further simple effect analyses were carried out. When exposed to the SAAC, participants show no significant effect of RT between a-tDCS and s-tDCS (t = -0.926, $p = 0.359$). In contrast, when exposed to the VEAC, participants' RT is significantly longer (t = -2.184, $p = 0.0.033$) for the a-tDCS

Table 1 Summary of purchase intention results

	F	*df*	*P*	η^2_p	Mean (S.D.) of purchase intention	
Stimulation group	5.037	56	0.029*	0.083	a-tDCS: 3.584(0.599)	s-tDCS: 3.969(0.719)
Attitude function	0.708	56	0.404	0.012	Social-adjustive: 3.792(0.692)	Value-expressive: 3.762(0.688)
Stimulation group×Attitude function	0.070	56	0.792	0.001	N/A	N/A

* $p < 0.05$

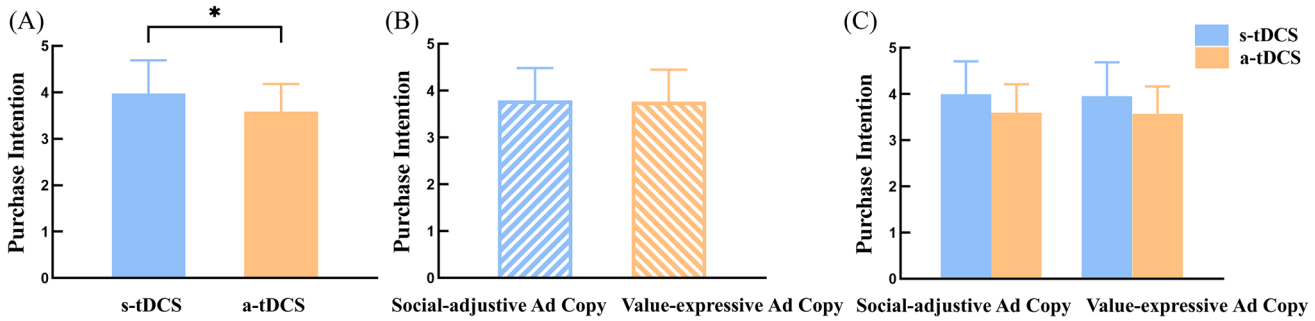

Fig. 5 Purchase intention results. **A** Mean purchase intention (+SD) of the s-tDCS and a-tDCS; **B** Mean purchase intention (+SD) of the SAAC and VEAC; **C** Mean purchase intention (+SD) of the s-tDCS and a-tDCS for SAAC and VEAC; $^{*}p < 0.05$

(M_{a-tDCS} = 3732.62, SD = 1500.20) compared with the s-tDCS (M_{s-tDCS} = 2958.70, SD = 1179.17). Table 2 and Fig. 6 summarize the results.

Discussion

This study has explored how moral beliefs affect individuals' implicit moral decision and neural underlying. We took non-deceptive counterfeit luxury consumption as an example of implicit moral decision, and attitude function of luxury brand to influence the implicit nature of moral decision. The results demonstrated that the self-report moral belief of counterfeit luxury consumption collected after the experiment was higher for the a-tDCS. This is consistent with previous studies that a-tDCS on left DLPFC can increase moral belief (Gan et al., 2022). This indicates that the manipulation check was successful, as it has elicited the anticipated differences among the experimental conditions. Furthermore, it also shows that the moral belief toward implicit moral decision is also related with the left DLPFC, consisting with previous traditional moral decision studies (Kuehne et al., 2015).

Our results also found that purchase intention for a-tDCS was lower than that of s-tDCS, suggesting that increased moral belief can reduce consumers' counterfeit luxury purchase intention, although it is an implicit moral decision. For a-tDCS, increasing moral beliefs may enable individuals to decide based on more stringent ethical standards. Thus, people are more inclined to classify counterfeit luxury consumption as unethical (Wang et al., 2019), even though the boundaries of morality are relatively blurred and the consequences of moral decisions are difficult to assess. Furthermore, it has been reported that left DLPFC is more involved in emotional aspects of moral beliefs, such as guilt and shame (Zampetakis, 2014). This suggests the involvement of moral emotions in counterfeit luxury consumption decisions. This finding aligns with previous EEG studies that have also focused on the role of emotions in luxury shopping (Pozharliev et al., 2015). Previous studies have elucidated the impact of moral beliefs on counterfeit luxury consumption through the lens of moral emotion. Notably, guilt emerges as one of the most intensely experienced emotions during non-deceptive counterfeit consumption situations (Zampetakis, 2014). However, these studies only explain it from theoretical derivation, lacking of direct evidence. Thus, the current study also provides neurophysiological evidence that illustrate the role of moral emotion in counterfeit luxury shopping.

Furthermore, we also found social-adjustive function have a shorter RT than value-expressive function. As mentioned above, RT refers to the engagement of cognitive processing

Table 2 Summary of RT results

	F	*df*	*Sig.*	η^2_p	Mean (S.D.) of reaction time	
Stimulation group	2.561	56	0.115	0.044	a-tDCS: 3531.178 (1499.779)	s-tDCS: 2981.228 (1160.555)
Attitude function	4.829	56	0.032*	0.079	Social-adjustive: 3166.743 (1338.976)	Value-expressive: 3345.663 (1393.182)
Stimulation group × Attitude function	7.567	56	0.008**	0.119	N/A	N/A

**$p < 0.01$, *$p < 0.05$

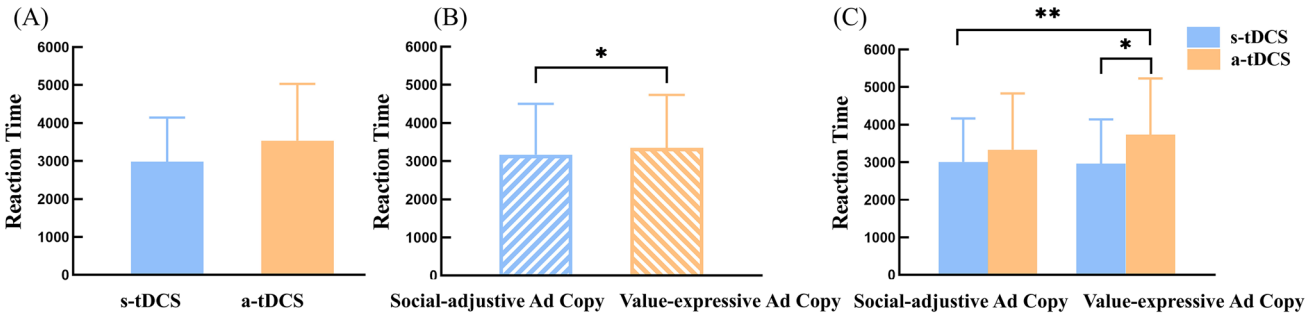

Fig. 6 RT results. **A** Mean RT (+SD) of the s-tDCS and a-tDCS. **B** Mean RT (+SD) of the SAAC and VEAC. **C** Mean RT (+SD) of the s-tDCS and a-tDCS for SAAC and VEAC. **$p < 0.01$, *$p < 0.05$

engagement (Greene & Paxton, 2009), the longer RT indicates higher cognitive engagement (Leber et al., 2008). The social-adjustive function condition has clearer moral boundary of counterfeit luxury consumption, which made it easier to make the moral decision than the value-expressive condition, reflected in shorter RT.

Further research on the interaction effect showed that RT was significantly longer for the a-tDCS than the s-tDCS when exposed to the value-expressive function; meanwhile, there was no significant RT between stimulation groups when exposed to the social-adjustive function. This conclusion is of great significance. This suggested that the increased moral beliefs for counterfeit luxury consumption only made the consumers engage more cognitive resource for the value-expressive condition, which is a more implicit moral decision. However, previous studies also suggested the increased moral belief can prolong the RT of traditional moral decision (Knoch & Fehr, 2007). These studies focused on the RT of the immoral behavior and explained it from the perspective of self-control (Fan et al., 2020). Different from previous studies, we asked participants' purchase intention, and focused on the implicit moral decision processes. As such, our current findings reveal that attitude functions can influence the relationship between moral beliefs and the processes of moral decision-making (as reflected in RT), but they do not significantly impact the relationship between moral beliefs and outcomes of moral decision-making (as reflected in purchase intentions).

There are several theoretical implications for the current study. First, moral belief plays an important role in implicit moral decision. Implicit moral decisions differ markedly from traditional moral decisions. (a) The consequences of moral decisions are difficult to assess in implicit moral decisions. Although counterfeit luxury consumption harms legitimate producers, buyers usually cannot directly witness the harm and easy to rationalize their behaviors (Sharma et al., 2022). That is, purchasing counterfeit luxury products causes indirect harm (Jiang et al., 2019). (b) The boundaries of morality are relatively blurred in implicit moral decisions, and it is easier for individuals to rationally explain unethical behaviors and avoid possible moral and psychological burdens. However, regarding the behavioral results of the current study, the increase of moral beliefs will still reduce the likelihood that an individual will engage in unethical behavior. Traditional moral cognition regards harm as a central reference point for moral judgments, which is called centrally immoral (Buchtel et al., 2015). But this study shows that, in addition to consequences considerations, people's moral decisions are heavily influenced by their inner discipline and beliefs.

Second, attitude function, which will influence the implicit degree of counterfeit luxury consumption, impact the relationship between moral belief and counterfeit luxury decision. Still, this effect is reflected in the impact on the decision process (reflected in RT) rather than the decision outcome (reflected in purchase intention). Counterfeit luxury consumption is the subset of high-order cognitive capacities that sustains implicit moral considerations and complex adaptive goal-directed behavior, especially the non-deceptive counterfeit luxury consumption, which is more complicated than the traditional moral decision. This suggested that even no differences were found between implicit and explicit moral decision from the decisions result, implicit moral decision occupies more cognitive resources and involves more complex cognitive processing from a procedural perspective. It reflects the process of individual hesitation and trade-off under the influence of different attitude functions. Future research should focus not only on the moral behavior but also on the decision process.

The findings have several critical practical implications for solving the above problems. Implicit moral decisions are common in real life, such as purchasing counterfeit luxury goods, imitating art work and so on. However, research on moral decision has not specifically focused on the internal mechanisms of implicit moral decision, with the fact of the significant differences between implicit moral decisions and traditional moral decisions. This paper focused on the neural mechanisms of implicit moral decisions and the role of moral belief, which can better guide implicit moral decisions related decisions and reduce social problems.

It should be noted that although this study has employed a rigorous experimental procedure, several challenges still require additional effort. The generalizability of the findings is limited because data were collected only from China. Future research should consider the effects of cultural, ethnic, and institutional differences. Another potential limitation to consider is the widely recognized low spatial resolution of tDCS (Bennabi & Haffen, 2018). Even though the current experiment induced a larger amount of current due to the small distance between the two electrodes, computational current flow models have demonstrated that tDCS typically results in a dispersion of electric fields, occurring both beneath the stimulating electrodes and in the regions between them. Thus, we cannot rule out the possibility that the stimulation affected other areas within the DLPFC. Further research utilizing more focused techniques can shed light on our findings. High-definition transcranial direct current stimulation (HD-tDCS), for instance, represents an enhanced version of tDCS, offering the advantage of delivering current with greater precision to the target site, resulting

in increased focus and longer-lasting effects (Parlikar et al., 2021). Additionally, the use of transcranial magnetic stimulation (TMS) techniques, which are often regarded as a relatively focal approach (Lindenberg et al., 2010), could also be explored.

Conclusion

The current work tries to clarify the moral decision mechanism of implicit moral decision. It is found that moral beliefs can change the individual's moral decision results in the context of implicit moral decisions, even though the boundaries of morality are relatively blurred and the consequences of moral decision are difficult to assess. This is also related with left DLPFC. Second, the attitude functions will affect the relationship between moral belief and purchase intention. Still, this effect is reflected in the decision process (RT), not the decision result (purchase intention). In summary, the findings of the current study can also help to solve the social problems caused by implicit moral decisions.

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Author contributions Jia Jin : Conceptualization, Methodology, Investigation, Data curation, Writing - original raft, Writing - review & editing. Lu Dai : Conceptualization, Writing - original draft, Visualization. Taihao Li : Writing - review & editing. Ting Xu : Software, Data curation. Baojun Ma : Writing - review & editing. Guanxiong Pei : Formal analysis, Writing - review & editing, Supervision.

Data & code availability The datasets generated and analyzed during the current study are not publicly available due to privacy protection for the participants but are available from the corresponding author on reasonable request.

Declarations

Ethical approval This study has received approval from the Ethics Committee (Approval Number: 2022BC030) and adhered to the principles outlined in the Declaration of Helsinki.

Conflict of interest There are no conflicts of interest.

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