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A Theoretical Model from Hedonic Perspective of Processing Fluency

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Effects of Mindfulness and Emotion Regulation on Aesthetics: A Theoretical Model from Hedonic Perspective of Processing Fluency

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Abstract

Research has shown that processing fluency positively impacts perceived aesthetics, with pleasure mediating the relationship. Considering the important role of pleasure, we propose studying the role of emotion regulation in moderating the mediated relationship from processing fluency to perceived aesthetics. Based on our hypotheses, individuals' emotion regulation strategies are expected to have moderating effects on the relationship between processing fluency and perceived aesthetics such that cognitive reappraisal positively moderates the relationship from processing fluency to pleasure, and expressive suppression negatively moderates the relationship from pleasure to perceived aesthetics. Trait mindfulness is also expected to influence perceived aesthetics through emotion regulation by increasing cognitive reappraisal and reducing expressive suppression. Overall, we propose a theoretical model that focuses on affective processes through the hedonic perspective to understand how users perceive aesthetics from IT artifacts and AI-generated art that have different levels of processing fluency.

Keywords: Processing fluency, Pleasure, Aesthetics, Emotion regulation, Trait mindfulness

1. Introduction

The importance of visual aesthetics has been well-documented in the human-computer interaction (HCI) literature (Lima & Von Wangenheim, 2022; Ye et al., 2020). Past studies have shown that *processing fluency* is an important antecedent to *perceived aesthetics* (Preßler et al., 2023). Processing fluency refers to "*the ease or difficulty with which information can be processed, or the ease or difficulty with which content can be brought to mind*" (Graf et al., 2018, p. 393). In other words, perceived aesthetics is largely dependent on its processing fluency by users.

In the context of IT, users often encounter artifacts of low processing fluency. Despite the efforts made by IT providers to release IT artifacts with high aesthetics, many well-known IT products available on the market contain aesthetic defects, such as the apps of Google, Facebook, and Canva (Bessghaier et al., 2022). These aesthetic defects often have low processing fluency, such as imbalance or a lack of simplicity (Bessghaier et al., 2022; Reber et al., 2004). Although the development of AI-generated art has advanced and flourished (Nah et al., 2023), it often deviates from human expectations or norms, as in the case of the "AI-generated fingers problem" in which AI frequently generates an unexpected number of human fingers (Hughes, 2023). When AI generates unexpected outputs such as a human with six fingers (an example is shown in Figure 1), it reduces a viewer's processing fluency because it does not fit the schema in the viewer's brain. Nevertheless, individuals may still perceive aesthetics when the processing fluency is low. For example, the world's first AI-generated magazine cover also has the "AI-generated fingers problem," but artists were able to perceive aesthetics from it (Liu, 2022). Besides, in the non-IT context, many people perceive high aesthetic value from "Wabi-Sabi" artwork that usually contains some defects in appearance (Tsaknaki & Fernaeus, 2016). In short, despite findings from the literature indicating that processing fluency has a positive relationship with perceived aesthetics, individuals could perceive aesthetics even when processing fluency is lacking.

To explore the reason for such a phenomenon, it is important to explore the reasons for human affective processes in aesthetic contexts from the hedonic perspective because *pleasure* plays a mediating role between processing fluency and perceived aesthetics, and its full mediation effect has been empirically supported (Graf & Landwehr, 2017; Orth & Wirtz, 2014). The definition of perceived aesthetics is "*the degree to which a person believes that the overall design is aesthetically pleasing to the eye*" (Lin, 2013, p. 1113). Many studies have shown that people evaluate aesthetics based on the level of pleasure they experience (Pearce et al., 2016; Chatterjee &

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Vartanian, 2014; Bhandari et al., 2019). In other words, people typically experience beauty when they observe a pleasurable product (Bhandari et al., 2019).

Figure 1. An example of the "AI-generated fingers problem" in which AI generated a human with six fingers on one hand. (Image source: self-generated by authors using Midjourney)

Given the importance of pleasure in perceived aesthetics, we propose studying the effects of *emotion regulation* on the relationship between processing fluency, pleasure, and perceived aesthetics. Past studies have shown that people often use emotion regulation strategies to control their emotions and emotional responses (Gross, 2015). Individuals are able to regulate their emotions through *cognitive reappraisal*, such as creating and focusing on the positive aspects of stimuli (Goldin et al., 2008; Gross & John, 2003). After performing cognitive reappraisal, a person could perceive pleasure from stimuli of low fluency to perceive aesthetics. The "Wabi-Sabi" concept mentioned earlier could echo cognitive reappraisal by appreciating and accepting that "nothing is perfect" in assessing aesthetics (Tsaknaki & Fernaeus, 2016). Although cognitive reappraisal is a strategy of emotion regulation that might increase the pleasure experienced from IT-related products, *expressive suppression* is another strategy of emotion regulation that might weaken the positive effect of pleasure on perceived aesthetics. Expressive suppression is related to exercising self-control after emotions have arisen. People who are good at expressive suppression can restrain emotional behaviors (Goldin et al., 2008; Gross & John, 2003). Perceived aesthetics can be seen as an emotional expression of an object's visual value (Augustin et al., 2012). In other words, even if a person feels pleasure from a fluent IT-related product, his/her perceived aesthetics might be reduced by using the expressive suppression strategy. Such a double-edged influence has not been explored in past studies in IT and aesthetic contexts.

Besides, *trait mindfulness* refers to an individual's dispositional tendency to focus on the present moment, heighten awareness, and exhibit acceptance (Feldman et al., 2007). Exploring the influence of trait mindfulness on perceived aesthetics is important because mindful individuals tend to be aware of their own feelings (Feldman et al., 2007), which could drive emotion regulation. Some studies have found that trait mindfulness could increase cognitive reappraisal and decrease expressive suppression (Feldman et al., 2007; Iani et al., 2019). In other words, mindful individuals are better equipped to evaluate IT-related products based on their positive aspects (Garland et al., 2015). They also tend to describe their perception by accepting their feelings (Feldman et al., 2007). Interestingly, studies have found that mindful individuals experience more frequent aesthetic experiences in everyday life (Harrison & Clark, 2016, 2020); however, the reasons for such an influence have yet to be fully understood. Given this research gap, we propose that trait mindfulness has a positive effect on perceived aesthetics that is achieved through emotion regulation by increasing cognitive reappraisal and decreasing expressive suppression.

In summary, pleasure plays an important role in the relationship between processing fluency and perceived aesthetics (Graf & Landwehr, 2017; Orth & Wirtz, 2014). Exploring the role of emotion regulation and trait mindfulness in the context of aesthetics is important because emotion regulation could change the level of pleasure and its consequences, while trait mindfulness could influence emotion regulation (Carpenter et al., 2019; Feldman et al., 2007; Iani et al., 2019). In this paper, we propose a theoretical model and study design to address the following research questions:

RQ1. How does emotion regulation influence the relationship between processing fluency and perceived aesthetics?

RQ2. Are the effects of trait mindfulness on perceived aesthetics mediated by the moderating effects of cognitive reappraisal and expressive suppression?

This research is expected to provide answers on why and how users perceive aesthetics from IT-related products that have low processing fluency such as the "AI-generated fingers problem" and IT artifacts with aesthetic defects (Hughes, 2023; Bessghaier et al., 2022).

2. Literature review

2.1. Aesthetics, pleasure, and fluency

Recent studies in neuroaesthetics have indicated that the brain circuits involved in aesthetic valuation are similar to those involved in hedonic valuation (Pearce et al., 2016; Skov, 2019). In other words,

aesthetic valuation appears to evaluate the level of pleasure in a manner similar to hedonic valuation (Skov, 2019; Pearce et al., 2016; Feng et al., 2022). Pleasure is "*the hedonic valence (pleasant or unpleasant) of the affective response to a stimulus*" (Loureiro & Roschk, 2014, p. 213), while some marketing studies define pleasure as "*the degree to which a person feels good, joyful, happy, or satisfied in a situation*" (Menon & Kahn, 2002, p. 32). Many aesthetic studies have suggested that pleasure acts as a reward that drives aesthetic value (Pearce et al., 2016; Skov & Nadal, 2021). The importance of pleasure for perceived aesthetics has also been demonstrated in IT research (Bhandari et al., 2019).

The Processing Fluency Theory of Aesthetic Pleasure states that pleasure in aesthetic situations arises from processing fluency (Reber et al., 2004). Processing fluency is the ease with which information can be processed or brought to mind (Graf et al., 2018). Such fluency comprises perceptual and conceptual levels (Graf et al., 2018). The former is influenced by the appearance of an object (e.g., balance, symmetry, and contrast), while the latter is associated with the user's familiarity (Reber et al., 2004). However, Graf et al.'s (2018) research suggested that perceptual and conceptual fluency can be aggregated into a single concept termed processing fluency. According to the Hedonic Fluency Model and the Theory of Hedonic Marking (Musch & Klauer, 2003; Winkielman & Cacioppo, 2001), processing fluency (1) can trigger familiarity, (2) enhances successful recognition and interpretation, and (3) indicates a sense of grasping the current situation (Landwehr & Eckmann, 2020; Musch & Klauer, 2003). Therefore, processing fluency is typically associated with positive aspects that bring pleasure. Research by Graf and Landwehr (2017) as well as Orth and Wirtz (2014) further demonstrated a causal relationship in fluency-pleasure-attractiveness where the terms "attractiveness" and "aesthetics" have been used interchangeably in past studies (Hu et al., 2022; Neben et al., 2015; Thielsch et al., 2019). We use the term "aesthetics" in this paper, which refers to a response (Graf & Landwehr, 2017) that involves a positive expressible emotional evaluation of an object's visual value (Augustin et al., 2012).

Processing fluency is expected to have a positive impact on perceived aesthetics. However, as we mentioned in the introduction, certain phenomena indicate that a negative relationship sometimes exists. Given the importance of the mediating role played by pleasure, we use the hedonic perspective to examine emotion regulation to understand why and how people could perceive aesthetics from a stimulus of low processing fluency.

2.2. Emotion regulation

Despite the vital role that emotions play in human survival (Lang & Bradley, 2010), the hedonic-motivation perspective posits that people rely on emotions to make decisions, such as avoiding something that brings displeasure (Berridge & Kringelbach, 2015). However, emotions also impact people's sense of well-being (Kemp & Kopp, 2011; Kobylińska & Kusev, 2019). Therefore, in situations that do not endanger survival, people aspire to maximize positive emotions and minimize negative emotions; in other words, people might view "feeling better" or feeling good as a goal (Kemp & Kopp, 2011).

Emotions can be actively controlled in addition to being passively experienced. Emotion regulation is a strategy that influences emotions and it refers to "*the ability to modulate the intensity, frequency, and duration of positive and/or negative emotions*" (Boemo et al., 2022, p. 1), and "*a process by which individuals influence what emotions they have, when they have them, and how they experience and express them*" (Kobylińska & Kusev, 2019, p. 2). Emotion regulation as a coping strategy can help individuals adapt to negative stimuli and promote "feeling better." Emotion regulation strategies can be divided into *cognitive reappraisal* and *expressive suppression* (Gross & John, 2003), both of which are not mutually exclusive. Cognitive reappraisal is defined as "*a form of cognitive change that involves construing a potentially emotion-eliciting situation in a way that changes its emotional impact*" (Gross & John, 2003, p. 349), and it focuses on adjusting emotion before emotion is established. When a person performs cognitive reappraisal, his/her negative emotions are typically decreased (John & Gross, 2004). Cognitive reappraisal is an adaptive process that usually occurs in negative situations (Gross, 2015). Wang and Yin (2023) proposed that the mechanism of cognitive reappraisal is related to a reconstruction of meaning, which is similar to extinction learning which involves elimination of the original negative association. Cognitive reappraisal is one of the best emotion regulation strategies and usually results in reduced activation of emotion-related brain regions, such as the amygdala (Gross, 2015).

Another strategy is expressive suppression, which is defined as "*a form of response modulation that involves inhibiting ongoing emotion-expressive behavior*" (Gross & John, 2003, p. 349), and it focuses on self-control after emotions arise. Performing expressive suppression will lead to the inhibition of emotional behaviors. Expressive suppression has been associated with regions of cognitive control in the

human brain (Sikka et al., 2022) as well as areas related to self-control and inhibition of action (e.g., dorsomedial prefrontal cortex) (Kühn et al., 2011). Although past research on expressive suppression has mainly focused on physiological reactions as the experiment target (Mohammed et al., 2021), it has also been negatively associated with various behaviors, such as emotional disclosure, electronic word of mouth, distress disclosure, and sharing (Richards, 2004; Kahn et al., 2012; Pauw et al., 2022; Liu et al., 2021). Expressive suppression enables individuals to "keep calm and carry on" (Kühn et al., 2011).

2.3. Trait mindfulness

Mindfulness is an important concept in the context of this research. Mindfulness has been defined slightly differently from various perspectives (Choi et al., 2021; Daniel et al., 2022), though it mainly emphasizes the awareness of the present moment (Keng et al., 2011). Mindfulness can manifest as either a short-term state or a long-term trait, with the latter often being associated with *trait mindfulness* (Baer, 2019). Trait mindfulness is a personality tendency to maintain a state of mindfulness in daily life, such as a preference for paying attention to and being aware of present-moment experiences (Baer, 2019; Daniel et al., 2022).

In accordance with Choi et al.'s (2021) recommendation to "take the context seriously" in mindfulness-related research, we adopt the definition of trait mindfulness from Feldman et al. (2007) in which they have validated the relationship between trait mindfulness and emotion regulation. From this perspective, trait mindfulness is defined as "*the awareness that emerges through paying attention on purpose, in the present moment, and non-judgmentally to the unfolding of experience moment to moment*" (Feldman et al., 2007, p. 177), and encompasses four sub-concepts: (1) *Attention:* the tendency to adjust attention towards something or an experience and to avoid distractions, (2) *Present-focus:* the tendency to focus on the present experience, (3) *Awareness:* the tendency to enhance awareness on inner thoughts, inner feelings, and information of outer something, and (4) *Acceptance:* the tendency to have a non-judgmental attitude toward experience, such as "*I can accept things I cannot change*" (Feldman et al., 2007). Individuals with high trait mindfulness are better equipped to attend to multiple aspects of the present moment and reconstruct their cognitive processing and working memory in a positive way (Garland et al., 2015). Past studies have found that mindful individuals are associated with better self-regulation and adaptation, as mindful individuals report less anxiety and depression, and display fewer negative cognitive responses to stress (Keng et al., 2011).

In addition, it should be noted that although IT-related research has conceptualized "IT mindfulness" as a type of mindfulness in the IT-specific context (Thatcher et al., 2018), IT mindfulness is not equivalent to trait mindfulness (Ioannou et al., 2022). Considering the impact of mindfulness on perceived aesthetics could be cross-contextual, we focus on trait mindfulness in this research.

3. Hypothesis development

3.1. Fluency-pleasure-aesthetics

The impact of processing fluency on perceived aesthetics has been verified in the fields of IT and HCI (Preßler et al., 2023). Additionally, Graf and Landwehr (2017) as well as Orth and Wirtz (2014) have found that pleasure plays a mediating role in the fluency-pleasure-aesthetics relationship. We integrate this relationship into the Stimulus-Organism-Response (SOR) model (Chang et al., 2011) and examine moderators as an extension of this research. The SOR model refers to the environmental stimulus (S) that leads to emotional states (O), thus promoting behavioral responses (R).

Past studies in aesthetics have suggested the visual attributes of objects in the environment (such as symmetry, balance, and contrast) automatically trigger brain processing (Chatterjee & Vartanian, 2016), with the ease of processing being termed processing fluency. Therefore, processing fluency is an indicator of how the brain constantly interprets environmental stimuli (Graf et al., 2018). The Processing Fluency Theory of Aesthetic Pleasure and the Theory of Hedonic Marking both point out processing fluency as cues of positive signals in contexts involving aesthetics, such as those involving cues of familiarity and prototypicality, leading to positive affective states (Reber et al., 2004; Winkielman et al., 2003). Based on the functionalist perspective of emotion (Salerno et al., 2014), the reasons for experiencing emotions can be linked to an evolutionary perspective, where external perceptions are transformed into internal forms as affective states (Phaf & Rotteveel, 2012). To adapt to the environment, the brain tends to process external signals with minimal resources (Chaiken & Trope, 1999). Familiarity and prototypicality are positive aspects the brain can efficiently process through constructed schemas (Winkielman et al., 2003). These positive aspects are presented in an internal form as pleasure. Hence, we propose the following hypothesis.

H1. Processing fluency positively influences pleasure.

Research on neuroaesthetics suggested that the brain circuits underlying aesthetic valuation exhibit many overlaps with those involved in hedonic valuation (Pearce et al., 2016; Feng et al., 2022; Skov, 2019). Researchers in neuroaesthetics have proposed that aesthetic valuation and hedonic valuation are similar or identical, which suggests that aesthetic valuation depends on the degree of pleasure (Skov, 2019; Pearce et al., 2016; Skov & Nadal, 2021). In other words, pleasure could affect aesthetic value (Bhandari et al., 2019). According to Graf and Landwehr's (2017) research, perceived aesthetics is a response to an object's visual value. According to theories of aesthetics, perceived aesthetics could be viewed as an expressible outcome of an emotional evaluation (Augustin et al., 2012; Leder et al., 2004). Past research has found that aesthetic processing activates Brodmann's area 44 (BA44) (Brown et al., 2011), a brain region usually involved in expressive tasks (Bernal et al., 2015). Hence, we propose the following hypothesis.

H2. Pleasure positively influences perceived aesthetics.

3.2. The impact of emotion regulation

The visual characteristics of objects can drive automatic processing in mind (Chatterjee & Vartanian, 2016). Therefore, processing fluency can increase positive emotions based on the Hedonic Fluency Model (Landwehr & Eckmann, 2020). However, people cannot only passively experience emotions but also actively engage in emotion regulation.

Emotion regulation comprises two well-known strategies (Gross & John, 2003). The first strategy, cognitive reappraisal, is a type of antecedent-focused strategies performed before the establishment of emotions (Gross & John, 2003). The main goal of cognitive reappraisal is to change emotions through reconsidering, reconceptualizing, or obtaining new perspectives on the emotional meaning (Gross, 2015). Cognitive reappraisal has a positive effect on emotions, in accordance with Hedonic Emotion Regulation (Kobylińska & Kusev, 2019), in which individuals regulate emotions to maximize pleasure. Many studies have demonstrated the positive impact of cognitive reappraisal on reducing self-reported negative emotions (John & Gross, 2004). Therefore, when an IT-related product is not fluent in processing, users or viewers might experience less pleasure based on the Processing Fluency Theory of Aesthetic Pleasure (Reber et al., 2004). However, individuals could perform cognitive reappraisal, such as considering other uses of the product, to attempt to experience pleasure, which might regulate the relationship between processing fluency and pleasure. Thus, we propose the following hypothesis.

H3. Cognitive reappraisal positively moderates the effect of processing fluency on pleasure.

Another emotion regulation strategy is expressive suppression, classified as a response modulation (Gross & John, 2003). Expressive suppression is a strategy used after emotions have been established, primarily aimed at decreasing the expression of emotions (Gross & John, 2003; Kobylińska & Kusev, 2019). Therefore, it does not affect the emotion itself but rather its outcome. For example, despite feeling angry, a person can use the strategy of expressive suppression to reduce the emotional reaction caused by anger, such as frowning, in order to achieve their goal (e.g., maintaining interpersonal relationships). Expressive suppression is related to self-control (Sikka et al., 2022; Kühn et al., 2011). In sociality, expressive suppression can lead to a decrease in emotional disclosure. With regard to the perceived aesthetics of an object, people can usually express their thoughts to others, such as "this product is beautiful," or "this design is attractive" (Augustin et al., 2012). Since perceived aesthetics involves the emotional expression of an object's visual value, people who tend to inhibit their emotional disclosure through expressive suppression might inhibit or conceal the expression of their perceived aesthetics. Therefore, we propose the following hypothesis.

H4. Expressive suppression negatively moderates the effect of pleasure on perceived aesthetics.

3.3. The impact of trait mindfulness

Harrison and Clark's (2016, 2020) studies have found that individuals with higher trait mindfulness experience higher levels and higher frequencies of aesthetic experiences in daily life. Harrison and Clark (2016, 2020) suggested that these positive effects might be caused by mindful individuals' higher degree of attention and awareness of the present moment. However, they also acknowledged that further explanations are needed. We propose an explanation that the positive effect of trait mindfulness on perceived aesthetics is due to the intervening role of emotion regulation.

Past research has indicated that trait mindfulness, as a personality trait, is an antecedent of emotion regulation (Iani et al., 2019; Chen & Cheung, 2021) and validated the positive relationship between trait mindfulness and cognitive reappraisal (Feldman et al., 2007; Chen & Cheung, 2021; Iani et al., 2019; Zhou et al., 2023). Mindful individuals are usually able to

focus on the present moment, avoid distractions, and adjust their attention (Ford et al., 2021; Feldman et al., 2007). Mindful individuals also tend to be aware of their own feelings (Feldman et al., 2007). Greater attention and awareness towards the present moment are likely to contribute to cognitive reappraisal. Hence, mindful individuals are more likely to perceive their emotional states and notice the positive aspects of things around them, and doing so might facilitate the regulation of emotions in a positive direction. This viewpoint echoes Wang and Yin's (2023) theories, where successful cognitive reappraisal relies on exploring positive cues in the present situation to activate the schema. Besides, the positive relationship between trait mindfulness and cognitive reappraisal could be explained by *metacognitive beliefs* which are "*beliefs about how the mind works. Such beliefs can alter people's motivation to allocate their cognitive resources into self-regulation and shape what they envision effective self-regulation to look like*" (Reina & Kudesia, 2020, p. 80). In other words, when mindful individuals experience negative stimuli, they know that their emotions can be adjusted by perceiving it from the positive aspect, which enables them to achieve greater awareness and attention. Overall, mindful individuals' greater awareness and attention should promote self-regulation. We propose the following hypothesis.

H5. Trait mindfulness positively influences cognitive reappraisal.

On the other hand, given the relationship between mindfulness and emotion regulation, past studies have also investigated the impact of mindfulness on expressive suppression (Iani et al., 2019; Chen & Cheung, 2021; Zhou et al., 2023). From a theoretical perspective, some studies hypothesized a negative relationship between trait mindfulness and expressive suppression (Chen & Cheung, 2021; Pepping et al., 2016). First, mindful individuals tend to accept their emotional state as "*learning to accept, rather than reflexively act on thoughts and emotions*" (Chambers et al., 2009, p. 566). Second, mindful individuals tend to describe their thoughts and feelings in greater detail (Feldman et al., 2007). As Reina and Kudesia (2020, p. 79) noted "*mindfulness entails that people monitor their thoughts and feelings about these ongoing events from a more detached perspective, in which they 'step back' mentally, rather than getting involved in their thoughts and feelings.*" Some past studies have found a negative relationship between trait mindfulness and expressive suppression (Pepping et al., 2016; Iani et al., 2019). However, others have found no relationship between them (Chen & Cheung, 2021; Iani et al., 2019; Zhou et al., 2023). Considering that the divergence of evidence could be caused by contexts (Zhou et al., 2023), in the context of aesthetics, we take a step back to follow the theory from past studies which suggested trait mindfulness has a negative effect on expressive suppression. Therefore, we propose the following hypothesis. Our research model is shown in Figure 2.

H6. Trait mindfulness negatively influences expressive suppression.

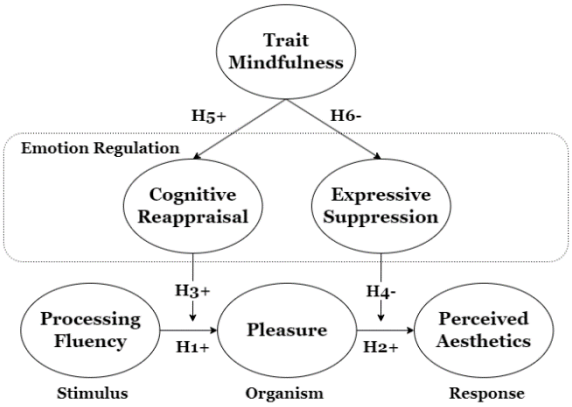


Figure 2. Research model.

4. Methodology

We will conduct two experiments to test our hypotheses. In experiment 1, we will use the stimuli of art-style pictures which are typical stimuli for aesthetic research (Graf & Landwehr, 2017). Using art-style pictures is important for testing our hypotheses in the context of AI-generated art due to its popularity of usage, such as on a magazine cover (Liu, 2022). In experiment 2, we aim to examine the generalizability of our hypotheses in the context of IT-specific artifacts, such as websites (Preßler et al., 2023), which could provide useful information for IT and applied aesthetic communities. Overall, the various stimuli and contexts aim to provide empirical findings for our hypotheses.

4.1. Pre-study

The pre-study aims to detect and validate fluent and disfluent stimuli for the experiments. We plan to collect and select three types of stimuli. A panel of three experts will select the stimuli. For the first type, we follow Graf and Landwehr (2017) by having experts select 20 abstract art pictures, 10 of them of low processing fluency and the other 10 of high processing fluency. For the second type, we will create realistic art pictures that aim to represent humans and their hands through generative AI, and experts will select 20 pictures, with half of them containing the "AI-generated fingers problem" (Hughes, 2023). The

pictures that have the problem are expected to negatively influence processing fluency. For the third type, we will follow Preßler et al.'s (2023) research to create 20 screenshots of websites that include disfluent and fluent ones. The content on each website will be the same. As a manipulation check, 50 students will rate the fluency of all 60 stimuli. These stimuli and ratings will be used in the experiments.

4.2. Experiments

We will select representative stimuli based on the results from the pre-study. In experiment 1, we will select two of the most disfluent abstract art pictures and two of the most realistic art pictures that contain the "AI-generated fingers problem" (Hughes, 2023) as four of the most disfluent art pictures. Then, we will follow the same logic to select four fluent art pictures based on the two most fluent stimuli from abstract art and realistic art, respectively. In experiment 2, we will select four of the most disfluent and four of the most fluent website screenshots. The summary and examples are shown in Table 1.

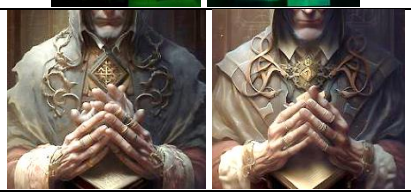
Both experiments will follow the same procedure: we will recruit 300 participants for each experiment. Four of the most disfluent stimuli and four of the most fluent stimuli will be assigned to each participant in a random sequence. Each assigned stimulus has two stages. In the first stage, we aim to test automatic affective processes of fluency and pleasure from participants' first impressions. Each participant will be asked to view each stimulus for 500 milliseconds (Lindgaard et al., 2006), and then they will assess processing fluency and pleasure using Graf et al.'s (2018) as well as Graf and Landwehr's (2017) scales. In the second stage, we aim to test cognitive processes. Participants will continue to view this stimulus until they are satisfied, and then we will assess their pleasure and the following concepts. The concepts of perceived aesthetics will be adapted from Preßler et al.'s (2023) items. For emotion regulation, we plan to adopt Gross and John's (2003) and Balaji et al.'s (2017) scales of two-factor emotion regulation, which include cognitive reappraisal and expressive suppression. After participants finish assessing all eight stimuli, we will measure their trait mindfulness. The scale of trait mindfulness will be adopted from Feldman et al.'s (2007) Cognitive and Affective Mindfulness Scale-Revised (CAMS-R). Finally, each participant's self-report for each assigned stimulus will be treated as a sample for analysis with regression-based path models.

In summary, experiment 1 aims to examine the typical context of aesthetics using AI-generated art. Experiment 2 aims to examine the generalizability of our hypotheses in an IT-specific context. Our design of the experiments will provide findings for the aesthetics of IT and non-IT artifacts.

5. Expected results and contributions

Pleasure fully mediates the positive relationship between processing fluency and perceived aesthetics (Graf & Landwehr, 2017). Therefore, it is important to explore this relationship based on the hedonic perspective of emotional theories, especially since people frequently regulate their emotions to maximize pleasure or inhibit emotional outcomes. This study considers the impact of emotion regulation that is commonly used in people's daily lives (Gross & John, 2003). Through cognitive reappraisal, individuals might adjust their thinking and evaluation process to

Table 1. A summary of the experiments and examples of stimuli. (Image source: Art pictures were generated by authors using Midjourney; Website screenshots were adapted from a page on Amazon)

Exp.	Context	IT-related	Stimuli	Disfluency (left) vs.Fluency (right)
1	Art pictures (non-IT-specific context)		Abstract art pictures (inspired by Graf & Landwehr, 2017)	
		✓	Realistic art pictures involving "AI-generated fingers problem"	
2	IT artifacts (IT-specific context)	✓	Website screenshots (inspired by Preßler et al., 2023)	

experience both fluent and disfluent objects with positive emotions, which could positively contribute to perceived aesthetics. On the other hand, expressive suppression might have negative effects on perceived aesthetics, even if users perceive pleasure from it. Moreover, we hypothesized that trait mindfulness could have a positive impact on perceived aesthetics by increasing cognitive reappraisal and decreasing expressive suppression, both of which are expected to moderate the relationship between processing fluency and perceived aesthetics, with pleasure as a mediator of the relationship.

In summary, this study proposes a theoretical model that focuses on human affective processes to test an explanation for the relationship between processing fluency and perceived aesthetics (Graf & Landwehr, 2017; Hekkert et al., 2003). It also help to explain why mindful individuals have a higher frequency of aesthetic experiences in daily life (Harrison & Clark, 2016, 2020). Given that users can perceive aesthetics from IT-related products with low processing fluency, such as artworks with "AI-generated fingers problem" and IT artifacts with aesthetic defects (Hughes, 2023; Bessghaier et al., 2022), it is important to test a plausible theoretical explanation for the phenomenon.

This study has several potential contributions. From an academic research perspective, this study not only fills a research gap but also expands the boundaries of aesthetics. First, we associate trait mindfulness with emotion regulation in the context of aesthetics, which could provide a theory-based explanation for the positive influence of trait mindfulness on perceived aesthetics. Second, we address a research gap by examining the double-edged influence of emotion regulation by breaking it down into cognitive reappraisal and expressive suppression. Third, we draw upon findings from other domains to expand research boundaries in IT aesthetics. Fourth, our theoretical model could contribute to communities of aesthetics by incorporating IT perspectives. From the perspective of practice and application, this study suggests that users might adjust their emotions and emotional responses to influence their perceptions of aesthetics. Therefore, IT practitioners should not simply use fluency to predict users' perceived aesthetics because any IT environment might trigger users' emotion regulation to influence their perceived aesthetics. Conversely, users' characteristics, such as trait tendencies and cognitive strategies for managing emotions, could be considered when evaluating or predicting users' perceived aesthetics of products. Besides, we provide an explanation to AI practitioners on how users evaluate AI-created art with the "AI-generated fingers problem."

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