Scent of Poetry: Influence of Olfactory Imagery during Haiku Appreciation on Aesthetic Evaluation

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Abstract

In cognitive science, research about mental imagery is often limited to visual, often overlooking olfactory imagery. In this study, we examined the relationship between beauty and olfactory imagery evoked by haiku. We used an odor priming commonly used in cognitive science to measure olfaction so that we could examine the effects of environmental aromas on the aesthetic experience. 44 participants were asked to evaluate 30 haikus. Half of them were exposed to a cypress aroma while the other half had no aroma exposure. The results showed that olfactory imagery during haiku appreciation positively influenced the beauty of haiku, and higher olfactory imagery ability led to a deeper immersion in the haiku. Odor priming did not affect evaluations, but it did affect gaze bias as measured by eye tracking. This is the first time to demonstrate the influence of olfactory imagery on aesthetic evaluation in the psychology of aesthetics.

Keywords: Haiku Poetry; Aesthetic Experience; Olfactory Imagery; Odor priming; Multisensory Imagery

Introduction

Haiku Poetry and Olfactory Imagery

Haiku is the world's shortest form of poetry, originating in Japan (Iida, 2008). The main characteristic of haiku is its reliance on one or two core images due to the is constraint caused by the small number of words (Blasko & Merski, 1998). For example:

Plum flower temple:
Voices rise
From the foothills
(梅の寺 麓の人語 聞こゆなり)

This haiku depicts two images (“plum flower temple” and “voices raising from the foothills”) in the haiku. Prior studies have focused on this feature and found that the vividness of the imagery explains aesthetic appeal (Belfi et al., 2018; Hitsuwari & Nomura, 2021). They also showed that individual traits are explanatory factors in haiku ratings using the Vividness of Visual Imagery Questionnaire (Marks, 1973), which measures individual differences in visual imagery ability. Although these studies have shown a link between imagery vividness and aesthetic evaluation of haikus, prior studies have focused either explicitly or implicitly exclusively on "visual" imagery. However, is mental imagery only visual? Shaw (2008) succinctly defines mental imagery as "an internal representation of stimuli that are not physically present" and has multimodal characteristics that are not limited to vision. Indeed, while visual imagery has been the most intensively studied, it has been reported that imagery can occur in any sensory modality (Andrade et al., 2014). Among those multisensory mental images, the present study focuses on olfactory imagery in particular.

In recent years, olfaction has been the focus of much attention in cognitive science and psychology (Olofsson & Pierzchajlo, 2021). The sense of smell has often been a neglected sense, but recent olfactory abnormalities caused by COVID-19 has reminded us of the importance of smell for health and well-being (Olofsson & Pierzchajlo, 2021). The psychology of aesthetics and art is also increasingly focusing on the sense of smell. A recent study applied a measure of aesthetic emotions known as AESTHEMOS (Schindler et al., 2017) to odor stimuli such as perfume and found that participants finding beauty in relation to the sense of smell (Diessner et al., 2021). In other words, aesthetic evaluation can be composed not only of audiovisual stimuli, but also of olfactory stimuli. Based on these findings, this study examines the relationship between olfactory imagery and beauty during haiku appreciation. In addition to asking how much olfactory imagery was evoked during haiku appreciation, the Plymouth Sensory Imagery Questionnaire (Psi-Q; Andrade et al., 2014), which measures multisensory mental imagery ability, was also examined from an individual trait.

Odor priming

Odor priming is a major element in cognitive science and psychological research related to the sense of smell (De Luca & Botelho, 2020; Li et al., 2007; Morrin & Ratneshwar, 2003; Wisman & Shrira, 2015). Priming is a phenomenon in which a stimulus influences higher-order cognition or behavior without conscious awareness (Bargh et al., 2010) In odor priming, an odor stimulus is used. According to Smeets & Dijksterhuis (2014), one of the conditions for successful priming is that the participant is unaware that you are being primed exposed to . Because of this, odor priming, also known as implicit sensation, is suitable for priming tasks. Among the various types of priming, affective and semantic priming are especially likely to occur in odor priming. For example, Morrin and Ratneshwar (2003) showed that pleasant ambient scents enhanced participants' attention to brand stimuli, regardless of whether the scent matched or mismatched with the product category. In other words, the positive valence of an odor prime stimuli may have

In M. Goldwater, F. K. Anggoro, B. K. Hayes, & D. C. Ong (Eds.), *Proceedings of the 45th Annual Conference of the Cognitive Science Society.*

influenced behavior (affective priming[1]). Although there have been no studies applying odor priming to the arts, it has often been shown in other contexts, such as marketing and social psychology, that positive odors have a positive influence on later evaluations (Ardelet et al., 2022; Feng & Lei, 2022; Fraune et al. al., 2022; Ortegón et al., 2022). This implies that it is quite possible that positive odors during haiku appreciation may also influence evaluation.

Wisman & Shrira (2015), on the other hand, conducted an experiment on semantic priming using putrescine, one of the odor chemicals released from dead bodies. In Wisman & Shrira (2015), putrescine associated with dead bodies was considered semantically consistent with the fight-or-flight response, but ammonia, used as a control odor stimulus, was considered to be negatively affective, as was putrescine, but semantically inconsistent with the fight-or-flight response. The results showed that putrescine (negative valence and semantically congruent) evoked stronger fight-or-flight responses than ammonia (negative valence but semantically incongruent), which evokes the same disgust. Here, the semantic link between death and the fight-or-flight response may have facilitated the priming effect (via semantic priming). In this study, haiku appreciation and evaluation were conducted during odor priming. Given that priming effects are greater when the target is a verbal stimulus rather than a visual stimulus (De Luca, 2018), haiku is an appropriate target for odor priming.

Odor and Memory

Finally, we exploratorily examined the effects of smell on memory. Phenomena connecting smell and memory, such as the Proust phenomenon where a smell brings back memories and emotions from the time the smell was first experienced, has been established in literature. A recent meta-analysis supported the Proust phenomenon, showing that odor-induced memories are stronger than other evoked memories (Hackländer et al., 2019). For example, Morrin and Ratneshwar (2003) are known for their study showing that odor priming promotes memory performance. They conducted a two-day experiment demonstrating that odor priming during encoding, but not retrieval, had a positive effect on memory performance. As a mechanism for this, the odor environment is believed to have stimulated attention to the product since the stimulus viewing time was longer in the with-odor group. To verify these findings in this study as well, eye gaze measurement was used to measure the time spent looking at haiku during evaluation. There are methods for improving haiku creation abilities through repeated readings (Nakaoka, 2003) as it is a form of literature that encourages memorization. Therefore, haiku is an excellent subject for the memory task used in this study.

Aims and Hypotheses

In summary, this study examines how olfactory imagery and odor priming affect aesthetic experience with haiku as the subject. The first aim is to examine the relationship between olfactory imagery vividness and aesthetic evaluation of haikus. The hypotheses are as follows:

H1.1 The higher the vividness of olfactory imagery, the higher the aesthetic evaluation of haiku.

H1.2 Individuals with higher olfactory imagery ability will have higher aesthetic evaluation of haiku.

The second aim is to examine how odor priming changes haiku appreciation. The hypotheses are as follows:

H2.1 Aromatic odor priming will result in a higher aesthetic evaluation of haiku.

H2.2 The effect of odor priming is greater for haiku that are semantically consistent with the aroma odor (semantic priming), independent of the type of haiku (affective priming).

The third aim is to examine the effect of odor on memory. The hypotheses are as follows:

H3.1 Memory for haiku will improve in with-aroma group.

H3.2 The with-aroma group will spend more time looking at the haiku (considering that increased attention is the mechanism by which odors improve memory performance).

Method

All plans for this study were approved by the Ethics Committee of the Graduate School of Education, Kyoto University (CPE-540).

Participants

Forty-four participants (Mage = 21.93, SD = 4.07, 23 male, 20 female, 1 other) were recruited via the Kyoto University electronic bulletin board and participated in the laboratory experiment. The sample size was designed assuming an analysis of variance with an experimental design of 2-level odor priming (with / without aroma; between participants) and 3-level haiku type (haiku evoking odor imagery consistent with aroma / haiku evoking odor imagery inconsistent with aroma / haiku not evoking odor imagery). Assuming a moderate effect size (f = .25) for the experimental manipulation, we calculated 44 subjects using G Power (Faul et al., 2007), aiming for a power of .95.

Materials

Haiku Poetry A total of sixty haikus were employed in this study: 20 odor-matching haiku, 20 odor-mismatching haiku, and 20 odorless haiku. The experiment consisted of two lists

[1] De Luca and Botelho (2020) refer to the facilitation of a response when the valence of the prime matches the valence of the target as affective priming.

of 30 haikus: 10 odor-matching haiku, 10 odor-mismatching haiku, and 10 odorless haiku The participants were asked to evaluate one of two lists.[2] First, we collected 4,679 seasonal haiku from the 19,950 haiku database of the Haiku Poets' Association (https://www.haijinkyokai.jp/system/saijiki/) that were submitted to the National Haiku Competition and 928 nonseasonal haiku from the Modern Haiku Association (https://haiku-data.jp/index.php) for a total of 5,607 haikus. Second, seven authors (authors 1 to 7) determined whether odor imagery could be evoked from the haiku and whether the haiku were semantically consistent with aroma, resulting in 105 odor-matching haikus, 803 odor-mismatching haikus, and 4699 odorless haikus. Third, a preliminary survey was conducted on a Japanese crowdsourcing platform called CrowdWorks, in which 201 people were asked to rate based on smell imagery and 225 people were asked to rate based on beauty. Using the scores, we selected the haiku with higher olfactory imagery for odor-matching and odor-mismatching haikus, and haikus with lower odor imagery for odorless haikus. Finally, to avoid differences in beauty scores, we categorized the haikus and created two haiku lists. An ANOVA was then conducted with two levels of lists and three levels of haiku types showing no significant difference in beauty scores of these haiku lists (Table 1; main effect of lists, $F(36, 1) = .001$, $p = .98$, $\eta^2 = .00$; main effect of haiku types, $F(36, 2) = .02$, $p = .98$, $\eta^2 = .00$). Similarly, there were no significant differences in odor imagery scores between odor-matching and odor-mismatching haiku lists (main effect of list, $F(18, 1) = .001$, $p = .98$, $\eta^2 = .00$; main effect of haiku type, $F(18, 1) = .03$, $p = .87$, $\eta^2 = .001$).

Table 1. Olfactory imagery ability and beauty scores for each haiku type in the preliminary study

Haiku Type	Example	List	Olfactory Imagery	Beauty
Odor-matching	Sometimes picking Young leaves Foot of Ogura Mountain	1	60.52	4.53
		2	60.77	4.53
Odor-mismatching	The smell of Grilled conger eel Festival comes to island	1	61.97	4.54
		2	60.20	4.53
Odorless	Giving a bow to the station staff Then graduating	1	0.00	4.54
		2	0.00	4.55

Aroma Based on several previous studies of odor priming (Errajaa et al., 2018; Morrin & Ratneshwar, 2003), we used an aroma diffuser (RYOHIN KEIKAKU Co., Ltd; MJ-UAD1). The odor was chosen to be woody, as is typical of Japan. Among five candidates, the essential oil of Japanese cypress (Nakagawa Masashichi Shoten Co., Ltd.; 1208-0303-202-00) was used, which all seven authors (authors 1 to 7) indicated could evoke a positive mood. The diffuser was placed next to the participants in a 6 m2 room and was turned on 5 minutes before the start of the experiment. Seven authors confirmed that the room was filled with a sufficiently perceptible odor.

Questionnaires A short version of the Psi-Q (Andrade et al., 2014; Hitsuwari & Nomura, 2023 for the Japanese version) was used to measure individual differences in multisensory mental imagery ability and the PANAS (Watson et al., 1988; Sato & Yasuda, 2001 for the Japanese version) questionnaire was used to see if subjective mood states were affected by odor priming. The Japanese version of the shortened Psi-Q is an 18-item scale with 3 items for each modality that can measure mental imagery ability in 6 sensory modalities: vision, sound, smell, taste, touch, and body. For example, one item for olfactory imagery is a word such as "freshly cut grass," to which respondents are asked to indicate the degree to an olfactory image is evoked using a 7-point scale ranging from 1 "I can't imagine it at all" to 7 "It is as vivid as if it were right in front of my eyes". The Japanese version of PANAS is a 16-item scale consisting of 8 positive affect items and 8 negative affect items. For example, for the negative affect of "nervous," respondents are asked to respond using a 6-point scale ranging from 1 "not at all applicable" to 6 "very applicable."

Procedure

Of the 44 participants, the first 22 were assigned to the odorless condition, and the latter 22 were exposed to the smell of the cypress in a between-subjects design (Figure 1). First, the subjects were asked to sign a consent form and answer the PANAS as a pre-questionnaire. Next, the gaze measurement was calibrated. A monitor-mounted Tobii Pro Fusion (Tobii Technology Inc.), was recorded at a sampling frequency of 120 Hz to measure eye movement. The participants were instructed to look at the computer at a distance of 60 cm from the computer screen and to keep their heads as still as possible. In the subsequent haiku evaluation, a haiku was presented for 7 seconds, after which three evaluation items appeared: beauty, olfactory imagery, and immersion. Participants responded to these three aspects on a Visual Analogue Scale (VAS) ranging from 0 to 100. After a 3-second interval, the next haiku was presented. A total of 30 haikus were presented, all randomly. The participants then responded to a post-questionnaire that included PANAS, a haiku re-recognition task, Psi-Q, familiarity and experience with haiku, creative experience, and demographic information. in the haiku recognition task, participants were asked to select only the haikus that they had appreciated from

[2] Due to a human error in the experimental program, participants who rated the haiku in List 1 rated 10 odor-matching haiku and 20 odor-mismatching haiku, not odorless haiku. This resulted in a slight difference in the number of evaluations for each haiku type. In addition, the lists presented in the recognition task were no longer consistent, so the results of the recognition task were analyzed by half of the 22 participants who evaluated List 2.

a total of 45 haikus, 30 of which they had read during the previous task and 15 of which they had not seen.

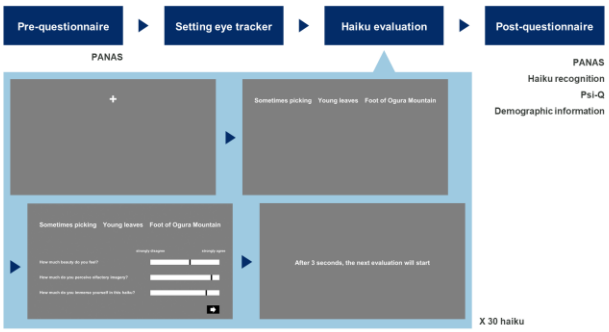

Figure 1. Procedure of the experiment

Data Analysis

First, for the relationship between olfactory imagery and the beauty of haiku, we applied a linear mixed model with olfactory imagery as the fixed effect, participants and haiku as the random effects, and beauty as the dependent variable. Second, for odor priming, 3 ANOVAs were performed with 2 levels of odor priming (with / without aroma) and 3 levels of haiku type (odor-matching / odor-mismatching / odorless haiku) as independent variables and beauty, olfactory imagery, and immersion as dependent. Third, to examine the effect of conditions on performance for the recognition task, we used a generalized linear mixed model with the experimental condition as the fixed effect, participant and haiku as the random effects, and correct and incorrect responses as dependent variables. The eye measurement data introduced to examine the effect of attention were used after deblinking and smoothing preprocessing. All analyses were performed in R (ver. 4.2.2; R Core Team, 2022), using lmerTest package (Kuznetsova et al., 2017) for general linear mixed models and generalized linear mixed models, anovakun package (Iseki, 2021) for ANOVA, and gazeR package (Geller et al., 2020) for gaze preprocessing.

Results

The means and standard deviations for beauty, olfactory imagery, and immersion for each experimental condition and haiku type are shown in Table 2. Regardless of odor-matching or mismatching, haiku with odor were rated higher than those without odor. The means and standard deviations of the PANAS, Psi-Q, and demographic data for each experimental condition are shown in Table 3. There were no significant differences in PANAS scores between conditions (pre negaitive: t = -.66, p = .51; pre positive: t = 1.22, p = .23; post negative: t = -1.22, p = .23; post positive: t = 1.67, p = .10), suggesting that odor priming did not improve subjective mood.

Table 2. Descriptive statistics for beauty, olfactory imagery, and immersion for each experimental condition and haiku type

		Without Aroma		With Aroma	
Item	Haiku Type	Mean	SD	Mean	SD
Beauty	Odor-matching	57.38	(26.23)	57.12	(20.90)
	Odor-mismatching	62.20	(25.10)	60.35	(20.35)
	Odorless	54.96	(24.34)	49.89	(23.35)
Smell	Odor-matching	54.01	(30.38)	55.89	(25.89)
	Odor-mismatching	60.88	(28.89)	58.19	(28.70)
	Odorless	20.17	(22.34)	21.90	(18.81)
Immersion	Odor-matching	56.63	(27.23)	58.67	(21.78)
	Odor-mismatching	59.15	(27.93)	63.08	(20.77)
	Odorless	48.71	(27.30)	49.89	(25.36)

Table 3. Descriptive statistics of participants' mood states and individual traits for each experimental condition

	Without Aroma		With Aroma	
	Mean	SD	Mean	SD
Pre PANAS				
Negative Affect	2.08	.75	2.23	.72
Positive Affect	3.12	.89	2.84	.60
Post PANAS				
Negative Affect	1.70	.60	1.96	.81
Positive Affect	3.13	.95	2.68	.84
Psi-Q				
Vision	6.08	.82	6.27	.66
Sound	6.39	.70	6.30	.61
Smell	4.55	1.15	4.55	1.52
Taste	5.41	1.06	5.89	.88
Touch	6.12	.73	6.05	1.09
Body	5.98	.97	5.94	.93
Emotion	5.58	.93	5.44	1.25
Demographic info				
Age	21.86	2.87	22.00	5.07
Haiku Familiarity	1.14	.35	1.00	.00
Haiku Experience	1.09	.43	1.14	.35
Creative Experience	1.18	.39	1.36	.58

Relationship between olfactory imagery and aesthetic evaluation of haiku

To examine the first hypothesis, we examined a linear mixed model with olfactory imagery from the VAS as the independent variable and haiku beauty as the dependent variable. Results revealed that olfactory imagery explained haiku beauty (b = .23, SE = .05, df = 34.98, t = 4.26, p < .001; Figure 2). Olfactory imagery ability as an individual trait did

not correlate with beauty (r = .10, p = .52; Figure 3A), but it was moderately correlated with immersion (r = .32, p = .03; Figure 3B).

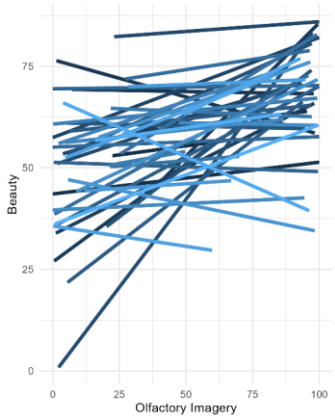

Figure 2. The relationship between olfactory imagery and beauty during haiku appreciation

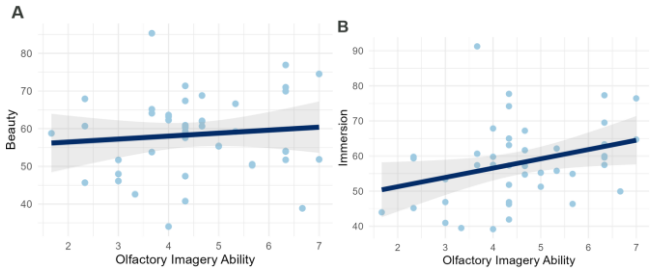

Figure 3. Scatterplots and correlations between olfactory imagery ability and (A) beauty and (B) immersion

Effect of odor priming on aesthetic evaluation of haiku

Next, we examined the effect of odor priming with aromas and found that the main effect of haiku type was significant in the analysis of variance for beauty (F(40, 2) = 4.69, p = .01, η^2 = .07), but odor priming (F(40, 1) = 1.45, p = .24, η^2 = .04) and the interaction with haiku type (F(40, 2) = .03, p = .97, η^2 = .00) were non-significant (Figure 4A). Multiple comparisons showed that odor-matching haiku were more beautiful than odor-matching and odorless haiku. There was no significant difference between odor-matching and odor-neutral haiku. Similarly, for olfactory imagery, only the main effect of haiku type was significant (F(40, 2) = 110.45, p = .00, η^2 = .62), with odor-matching haiku evoking stronger olfactory imagery than odor-matching and odorless haiku (Figure 4B). For immersion, only the main effect of haiku type was significant (F(40, 2) = 9.30, p < .001, η^2 = .14), indicating that odor-mismatching haikus were more immersive than odor-matching and odorless haikus, and odor-matching haikus were more immersive than odorless haikus (Figure 4C).

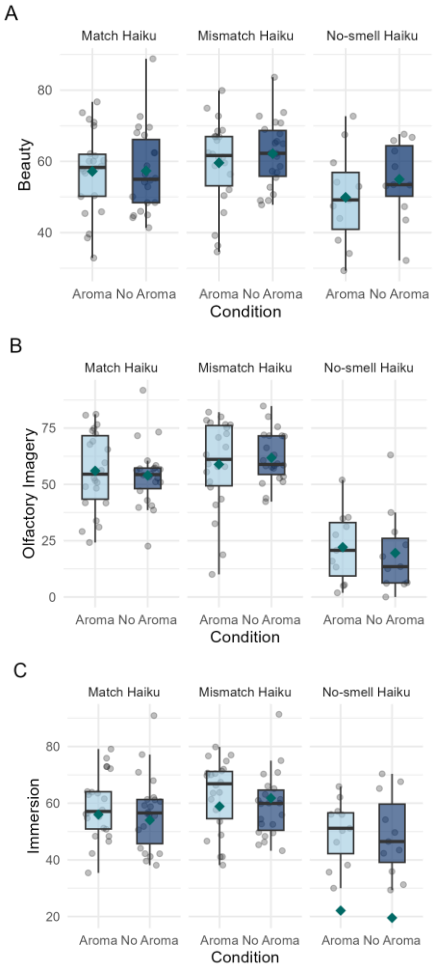

Figure 4. Plots of (A) beauty, (B) olfactory imagery, and (C) immersion for each experimental condition and haiku type

Effects of odor priming on memory performance

Finally, we examined the effect of odor priming on memory while reading haikus. The correct response rates for the conditions with and without odor priming were 98.6% and 96.4%, respectively. In both groups, participants remembered the haikus almost completely, suggesting that a ceiling effect occurred. Examination of a generalized linear mixed model explaining correct and incorrect responses revealed a non-significant effect of condition (b = .92, SE = .79, z = 1.17, p = .24). No effect of odor priming on memory was found, but differences in viewing time of the haikus, as measured by eye gaze, were examined. Of the 7 seconds of haiku-only viewing time and the evaluation time that could be applied arbitrarily, the mean time spent looking at the haiku shown at the top was 12.21 seconds (SD = 4.92) in the with aroma condition and 11.62 seconds (SD = 4.75) in the without aroma condition, with a significant t-test difference (t = -2.09, df = 1164.5, p = .04; Figure 5). It is suggested that odor priming may have increased attention to the haikus.

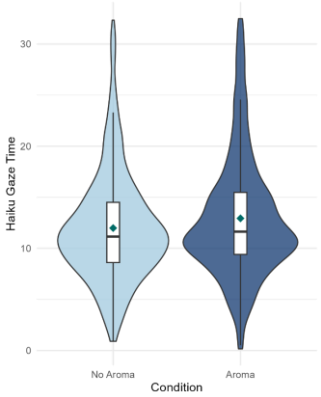

Figure 5. Plots of haiku gazing time for each experimental condition

Discussion

In this study, we focused on the sense of smell and examined the appreciation and evaluation of haiku in terms of olfactory imagery and odor priming.

First, it was found that higher olfactory imagery in a haiku led to an increase in its perceived beauty. This result was consistent with previous studies (Belfi et al., 2018; Hitsuwari & Nomura, 2021) that showed a positive relationship between visual imagery vividness and the aesthetic appeal of haikus. Haiku has been described as a literature dependent on mental imagery (Blasko & Merski, 1998), revealing the importance of olfactory imagery as well as visual imagery. This positive influence of mental imagery on aesthetic evaluation has been explained in previous studies through the mediation of emotional evocation (Hitsuwari & Nomura, 2021). That is, the more vivid the image, the stronger the emotion evoked (mainly positive emotion valence in the context of previous studies) (Holmes & Mathews, 2005), and consequently, the higher the aesthetic evaluation. Again, it is possible that the vivid olfactory imagery evoked stronger emotions. Another explanation might be suggested by the fluency theory of aesthetic experience (Reber et al., 2004). That is, the more vivid the olfactory imagery, the better the haiku was processed, which might have resulted in a higher evaluation. We also found a positive correlation between olfactory imagery ability as an individual trait and immersion. Prior research has found that odor enhances immersion in a particular place (Errajaa et al., 2018), which is consistent with the result showing olfactory imagery's ability to enhance immersion. However, in addition to the lack of correlation between olfactory imagery ability and beauty, the Psi-Q, which measures multisensory imagery ability, did not show the correlation with visual imagery ability shown in previous studies. This suggests that the different scales used may have influenced the results. The short version of the Psi-Q is a three-item measure of imagery ability for each sensory organ. To make each imagery ability measure more reliable, some previous studies have employed single-factor, more-item scales such as the VVIQ (Talamini et al., 2022).

In addition, the effects of odor priming and haiku type on haiku beauty were examined, revealing no effect of odor priming, only the effect of haiku type. Since positive smells have been shown to positively influence later evaluations in marketing, social psychology, and even human-robot interaction (Ardelet et al., 2022; Feng & Lei, 2022; Fraune et al, 2022), the results were inconsistent with those findings. It is possible that the odor may have been influenced by habituation (Pellegrino et al., 2017) meaning that during the 15 minutes of the haiku appreciation task the participants may have become habituated to the odor. In some past experimental paradigms, participants were given a renewed time to experience the odor or smelled the odor on each constant trial before moving on to the presentation of the stimulus (De Luca & Botelho, 2020; Morrin & Ratneshwar, 2003). In the current study, haiku types were also classified a priori, and odor-matching haiku were prepared for the aroma, but no interaction between haiku type and odor priming was observed. The haiku set prepared as odor-matching haiku included some haikus that were slightly distant from the odor of cypress, such as cherry blossoms and grass from rice paddies. Note that the beauty scores for the haiku containing cypress, such as the haiku "Scattered scent of cypresses in making Noh mask. The end of March," were 51.3 for the with-aroma group and 38.5 for the without-aroma group. Although statistically non-significant (t = -1.32, p = .21) due to the small sample size, the results suggest there is a need to improve the level of congruency for the congruent haikus.

On the other hand, attention to a haiku, as measured by eye gaze, was shown to increase with odor priming. The increase of attention by odor priming is consistent with previous studies (Carrieri et al., 2023; Morrin & Ratneshwar, 2003). It is quite possible that positive effects on memory may occur when odors increase attention (Morrin & Ratneshwar, 2003), although this could not be examined in the present study because of a ceiling effect on scores in the recognition task. In summary, this study provides a new perspective on the psychology and cognitive science of aesthetics by revealing for the first time the relationship between olfactory imagery and aesthetic evaluation. The results also showed that odor priming did not affect subjective evaluation, but did affect the attention obtained by eye gaze measurement. This study focused on olfactory imagery and reported new findings, but such studies are highly novel and this preliminary work could be additionally developed. For example, an experimental design could be prepared that would reduce habituation to the odor as described above, or the participants could be unconsciously presented with odor stimuli, where the effects of olfactory priming can be more effective. In addition, mental imagery such as auditory and tactile may also be important in haiku appreciation and should be considered addressed. Although previous studies on art appreciation have focused exclusively on audiovisual perception, these results show that it is necessary to take the influence of smell into account. This research is not limited to the field of aesthetics but also addresses the need for olfactory research in cognitive science in general including attention, emotion, and decision making.

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