Individual Depression Tendencies Impede Emotional Sensitivity to Comic Poetry

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Individual Depression Tendencies Impede Emotional Sensitivity to Comic Poetry

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A recent pupillary investigation provided evidence that Japanese lay people experience emotions when listening to senryu as comic poetry and haiku as aesthetic poetry, as compared to non-poetic prose (Niikuni et al., 2022). In this study, we analyzed Niikuni et al.'s (2022) data on pupillary responses to poetic languages in combination with participants' scores for depressive tendencies to examine how pupils in participants with diverse depressive tendencies react during the process of emotional arousal while listening to comic and aesthetic poetry. The findings demonstrated individual depressive differences in pupil responses to comic poetry but not to aesthetic poetry. Participants with higher depressive tendencies had less pupil dilation in response to comic poetry than non-poetry. This suggests that people with a higher depression severity may be less sensitive to the comical properties of poetic language.

Key words: pupillometry, emotional arousal, comic poetic, individual depressive tendencies

Introduction

Poetry is language art in which poets effectively express various emotions using sophisticated words and rhetorical techniques. In particular, fixed verses, the formulas in which poetry is composed, have evolved in various languages throughout the world and reflect cultural characteristics. Japanese haiku and senryu are the world's shortest fixed verses, with a five-seven-five-syllabic rhythm pattern. Haiku represents a type of aesthetic poetry (AP) that utilizes aspects of nature's beauty, wherein human affairs are implicated, as shown in (1).

(1)	spring ocean	*haru-no umi*
	swaying gently	*hinemosu notari*
	all day long	*notari kana*

By contrast, senryu represents a type of comic poetry (CP) that emphasizes humor to make readers laugh (Ueda, 1999), as shown in (2).

(2)	to lose weight,	*genryō no*
	I always make up my mind	*ketsui wa itsumo*
	when I am full	*manpuku ji*

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Most native Japanese speakers are familiar with famous haiku pieces as they are taught in elementary schools and with senryu at an annual popular senryu competition (e.g., Salaryman Senryu Poetry Contest held by Dai-ichi Life Insurance Co.).

Recent neurophysiological investigations have demonstrated that readers' emotional states change while appreciating poetry. A functional magnetic resonance imaging study (Wassiliwizky et al., 2017) demonstrated that neural connectivity in the reward network, including the nucleus accumbens, played a principal role in participants experiencing chills while appreciating German poetry. Regarding pupil dilation as an index of emotional arousal (e.g., Schwarz & Luo, 2015), Niikuni et al. (2022) provided evidence that Japanese lay people experienced pleasant emotions while listening to senryu as CP and haiku as AP, in comparison with non-poetry control stimuli (NP) comprising slogans with the same rhythm patterns. In the earlier time window at the beginning, their pupils dilated in response to CP and then later in response to AP, which was to a similar degree as CP. This suggests that the comical aspect of poetry arouses lay people's emotions more rapidly than the aesthetic aspects.

It has been reported that pupillary responses, driven by the sympathetic nervous system as part of the autonomic nervous system, are small in people with depression (Jones et al., 2015). Patients with major depressive disorder (MDD) are biased when decoding emotions from verbal and nonverbal stimuli. They tend to overreact to negative emotional stimuli and decode negative emotions from neutral stimuli while paying little attention to positive emotional stimuli (Beck, 2008). Decreased cortical activity in the prefrontal area and limbic system may underlie the insensitivity of patients with MDD to positive emotional stimuli, and the hyperactivity in the inferior parietal lobule may evoke an overreaction to negative emotional stimuli (Canli et al., 2004).

In addition, individual differences have been reported even among typically developed adults, such that the ability to recognize emotional language depends on personality traits related to depression and social cognition. For example, Xie et al. (2018) examined the effect of emotional valence (i.e., positive, neutral, and negative) on neural responses to language stimuli using event-related potentials (ERP) obtained from electroencephalograms. They revealed that participants with severe depressive tendencies elicited a greater ERP positive component 200 ms after stimulus onset (i.e., P2) of negative emotional words than those with lower depressive tendencies. This leads to the prediction that poetic language, which involves expressing human emotions, induces different emotional reactions among readers according to their depressive tendencies.

This study investigated individual differences in pupillary responses to poetic language among typically developed adults with various degrees of depressive tendencies. We analyzed Niikuni et al.'s (2022) data on pupillary responses to poetic languages in combination with the participants' scores for depressive tendencies to examine whether pupils in participants with severe depressive tendencies are less likely to dilate in response to CP and AP.

Method

Participants

We used the data published by Niikuni et al. (2022), in which the pupillary changes of 39 participants (22 men, mean age = 20.64 ± 1.98 years) were examined in response to AP and CP in comparison with NP. The participants were native Japanese speakers with no literary training at the time of the experiment, normal hearing, and normal or corrected-to-normal vision. Written informed consent was obtained from all participants before the experiment, which was conducted in accordance with the Declaration of Helsinki. The participants received monetary compensation for their participation. This study was approved by the Institutional Review Board of Tohoku University at Kawauchi-Minami Campus, Japan.

Stimuli

The stimuli were identical to those used in Niikuni et al. (2022), which included three Poetry Types: 40 AP (Japanese haiku), 40 CP (Japanese senryu), and 40 slogans as non-poetic (NP) proses as a control condition. They all had the same five-seven-five syllable rhythm patterns. Table 1 shows examples of AP, CP, and NP. These pieces were recited by a native female Japanese poet. The details are described by Niikuni et al. (2022).

Table 1.
Example Stimuli of Three Poetry Types

Poetry type	Original Japanese	English literal translation
Fixed verse: AP (haiku)	yamazakura	wild cherry blossoms!
	kumo ippen o	a particle of clouds,
	washizukamu	I grab
Fixed verse: CP (senryu)	rimokon o	turn a remote controller
	kigen ga warui	to grandfather
	jiji ni muke	in a bad mood
Control: NP (slogan)	sasaeau	help each other,
	shakai o kizuku	to establish a society
	shohi-zei	by consumption tax

Note. Each piece comprises a five–seven–five morae (i.e., Japanese syllabic units) structure. AP = aesthetic poetry; CP = comic poetry; NP = non-poetry.

Measurements

Pupil diameters. We used pupil diameter data published by Niikuni et al. (2022), which were measured using the EyeLink 1000 Plus eye tracker (Desktop Mount; SR Research, Canada). The data were down sampled to 250 Hz before analysis.

Self-Rating Depression Scale. Participants' depressive tendencies were evaluated using the Japanese version (Fukuda & Kobayashi, 1973) of the Self-Rating Depression Scale (SDS; Zung, 1965), including 20 items. The total SDS score ranges from 20 to 80. Higher scores indicate more severe conditions. Participants' scores ranged from 34 to 54 (M = 44.9, SD = 5.1).

Procedure

Participants listened to and rated the artistic qualities of the recited stimuli while their pupil diameters were measured in a quiet and dimly lit room. One second after the fixation cross appeared, a recorded stimulus of AP, CP, or NP was auditorily presented twice, each lasting four seconds. Niikuni et al. (2022) then presented three horizontal fixation crosses and asked the participants to rate the artistic quality of the presented stimulus on a four-point scale (1 = not artistic to 4 = highly artistic). The detailed procedure for pupil diameter measurement was performed following Niikuni et al. (2022). Auditory stimuli were presented through headphones (QuietComfort 25, BOSE, USA) at approximately 65 dB, and visual stimuli (fixation crosses) were presented on a 19-in liquid crystal display (FlexScan L797, EIZO, Japan) placed approximately 80 cm from the participants' eyes. The luminance of the display was 7.8 cd/m^2. The authors controlled the experiment using a computer (Latitude E5530, DELL, USA) and the Python programming language (ver. 2.7.3). The PsychoPy (Peirce, 2007) and PyGaze (Dalmaijer et al., 2014) Python packages were used for stimulus presentation, collection of responses, and controlling the eye tracker.

After the completion of the pupil data collection, the participants answered questions about their depressive tendencies using the SDS.

Analysis

To examine the effect of individual depressive tendencies on pupillary responses to poetic language, we utilized the dependent variables from Niikuni et al.'s (2022) pupil size data of participants' right eyes recorded when stimuli were auditorily presented to the participants twice with a stimulus onset asynchrony of 4 s, leading to a total of 8 s per trial. Among the data that were preprocessed, transformed into z-scores, and baseline-corrected by subtracting the median pupil value during –0.5–0 s from each value for the 0–8 s duration, we particularly focused on the pupil diameters during the time windows of 3–4 s, 4–5 s, and 5–6 s, which indicated significant differences among the Poetry Types (Niikuni et al., 2022).

We first checked the correlations between SDS and pupillary dilations for each time window for each Poetry Type (i.e., CP, AP, and NP). We then conducted linear mixed effects (LME) modeling (Baayen, 2008) to further analyze the effect of SDS on pupil diameter differences between CP and AP compared to NP by examining the interactions between SDS and Poetry Type. For each time window, we constructed LME models, each of which included a categorical fixed variable of Poetry Type, a continuous fixed variable of SDS and their interaction, as well as two random variables of participants and items. The Poetry Types (AP/CP/NP) were treatment-coded, with NP as the reference level. Model estimation was

performed using the lme4 (Bates et al., 2014) and lmerTest (Kuznetsova et al., 2014) packages in R version 4.1.2. The alpha level was set at $p = .05$.

Results

We found no significant single correlations between SDS and pupillary responses to CP, AP, and NP for any of the time windows of 3–6 s (the correlation between SDS and CP: $r = -.17$ during 3–4 s; $r = -.16$ during 4–5 s; $r = -.07$ during 5–6 s; the correlation between SDS and AP: $r = -.23$ during 3–4 s; $r = -.21$ during 4–5 s; $r = -.16$ during 5–6 s; the correlation between SDS and NP: $r = -.29$ during 3–4 s; $r = -.29$ during 4–5 s; $r = -.23$ during 5–6 s, all ps $> .05$).

Figure 1 shows the mean baseline-corrected pupil values for each Poetry Type for time windows of 3–4 s, 4–5 s, and 5–6 s after the first stimulus onset. The results of the LME modeling (Table 2) revealed that in comparison with NP, CP evoked a significantly larger pupil dilation for all time windows of 3–6 s ($\beta = .096$, $t = 2.414$, $p = .019$ for 3–4 s; $\beta = .106$, $t = 2.768$, $p = .008$ for 4–5 s; $\beta = .113$, $t = 3.319$, $p = .001$ for 5–6 s), and AP evoked a larger dilation only for the time window of 5–6 s ($\beta = .101$, $t = 2.881$, $p = .005$).

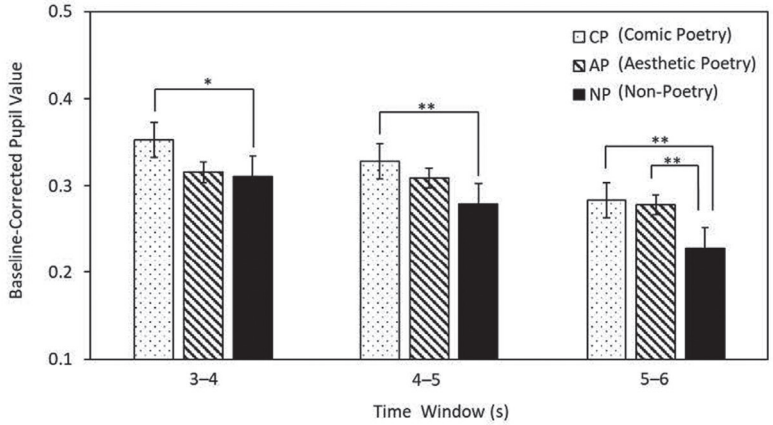
Moreover, as shown in Table 2, the main effects of SDS for time windows of 3–5 s ($\beta = -.152$, $t = -2.083$, $p = .044$ for 3–4 s; $\beta = -.146$, $t = -2.092$, $p = .043$ for 4–5 s) and the CP of the Poetry Type × SDS interactions were significant for time windows of 4–6 s ($\beta = .084$, $t = 2.343$, $p = .023$ for 4–5 s; $\beta = .079$, $t = 2.300$, $p = .023$ for 5–6 s). As shown in Figure 2, this result indicated that participants with higher SDS scores had lower pupil dilation in CP than in NP in time windows of 4–6 s ($r = -.37$, $p = .021$ during 4–5 s; $r = -.36$, $p = .023$ during 5–6 s). In contrast, the AP of the Poetry-Type × SDS interactions was not significant for all time windows (all ps $> .05$).

Discussion

In this study, we investigated how participants' individual depressive tendencies influence the affective cognition of native Japanese speakers during the process of emotional arousal while listening to poetry. Overall, the results revealed a negative correlation between participants' SDS scores and pupil dilation, consistent with previous evidence that pupil responses tended to be smaller in those with more severe depression (Jones et al., 2015). Particularly for the relationships of the depression tendencies on the pupil responses relevant to the Poetry Type (i.e., CP and AP), we observed a significant negative correlation with pupil dilation for CP during the 4–6 s period after stimulus onset. Participants with higher depressive tendencies showed less pupil dilation in response to CP than those with NP. However, the effects of individual depressive tendencies on pupil responses were not significant in AP as compared with NP.

As demonstrated by Niikuni et al. (2022), since the pupils were more dilated by aesthetic and comical aspects of poetry than by non-poetic language, pupillary responses reflect emotional arousal for both poetic types. In particular, CP induced pupil dilation earlier than

Figure 1.
Mean Pupil Values During Stimulus Presentation in Time Windows of 3–6 s



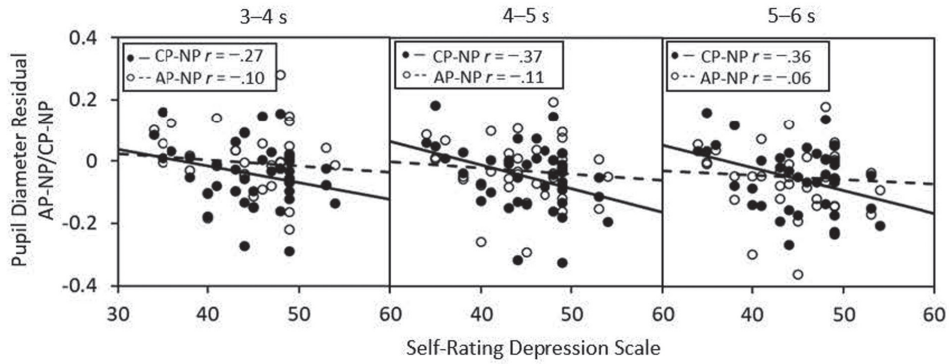
Note. Baseline corrections were applied to *z*-transformed pupil diameters (Right Eye). Error bars show the standard error of the mean of the participants.
$^{*}p < .05$, $^{**}p < .01$.

Table 2.
Fixed Effects of LME Modeling on Pupil Diameter Changes According to Poetry Type

Contrast	β	95% CI [LL, UL]	*t*	*df*	*p*
Time Window of 3–4 s					
(Intercept)	−.044	[−.187, .099]	−0.601	41.4	.551
Poetry Type CP[a]	.096	[.018, .173]	2.414	52.4	.019
Poetry Type AP[a]	.012	[−.067, .091]	0.302	46.9	.764
SDS	−.152	[−.294, −.009]	−2.083	38.9	.044
Poetry Type CP[a] × SDS	.064	[−.004, .133]	1.840	47.4	.072
Poetry Type AP[a] × SDS	.024	[−.046, .094]	0.678	39.8	.502
Time Window of 4–5 s					
(Intercept)	−.065	[−.202, .071]	−0.937	40.6	.354
Poetry Type CP[a]	.106	[.031, .182]	2.768	50.6	.008
Poetry Type AP[a]	.064	[−.006, −.134]	1.792	113.8	.076
SDS	−.146	[−.283, −.001]	−2.092	39.0	.043
Poetry Type CP[a] × SDS	.084	[.014, .155]	2.343	52.8	.023
Poetry Type AP[a] × SDS	.023	[−.042, .088]	0.704	492.7	.482
Time Window of 5–6 s					
(Intercept)	−.080	[−.210, .050]	−1.202	39.2	.237
Poetry Type CP[a]	.113	[.046, .180]	3.319	181.6	.001
Poetry Type AP[a]	.101	[.032, .170]	2.881	79.0	.005
SDS	−.115	[−.2647, .017]	−1.712	39.1	.095
Poetry Type CP[a] × SDS	.079	[.012, .146]	2.300	124.4	.023
Poetry Type AP[a] × SDS	.015	[−.054, .084]	0.431	66.7	.668

Note. LME = linear mixed effects; CI = confidence interval; LL = lower limit; UL = upper limit; AP = aesthetic poetry (haiku); CP = comic poetry (senryu); SDS = Self-Rating Depression Scale.
[a] The effects of conditions of Poetry Type were examined with reference to the non-poetry condition.

Figure 2.
Partial Regression Plots Between the Self-Rating Depression Scale and the Pupil Diameter Changes According to Poetry Type in Time Windows of 3–6 s



Note. Pupil diameter differences between comic poetry (CP) and aesthetic poetry (AP) compared to non-poetry (NP) are denoted by black dots, solid lines, white dots, and dashed lines, respectively.

AP did, which showed that CP, rather than AP, acts as more salient emotional verbal material. This is presumably because CP represents humorous human affairs, whereas AP primarily concerns nature, with a partial focus on human affairs. This finding is consistent with the idea that comical verbal materials that induce laughter, a social emotion, can act as an essential social signal (Fogarty & Kandler, 2020).

This study added to the new finding that the effect of pupillary response to comical poetic language was reduced in individuals with more severe depressive tendencies. Some neuroimaging studies have reported that individuals with depression are generally less responsive to positive stimuli than healthy individuals (Bylsma et al., 2008; Canli et al., 2004; Vanderlind et al., 2020). Accordingly, the result of smaller pupillary responses to CP in individuals with severe depressive tendencies supports the idea that depression hinders reactivity to positive emotional stimuli, especially to a language stimulus serving as a social signal.

However, the same effect of individual depressive tendencies on pupil changes was not significant when the participants listened to the AP. According to Niikuni et al. (2022; Figure 3), the pupils in response to AP were less dilated in comparison with CP during the earlier time windows of 0–5 s, but later dilated to the same extent as CP after 5 s. The authors noted that the aesthetic properties of words can elicit slower but intense emotional arousal, even in listeners with no literary training. Nevertheless, our findings reveal that pupillary responses to AP are inconsistent across different degrees of depression severity. Lay persons' inconsistent pupillary responses to AP may be because the stimuli of AP utilizing Japanese haiku include classical poetic words that they may be unfamiliar with. Presumably, some participants incurred extra processing costs for the poetic vocabulary of haiku, while they were supposedly able to easily process words used in senryu as CP. Familiarity with poetic vocabulary may

confound the severity of depression tendencies when examining lay peoples' pupil dilations in response to classical poetic language. We expect that poets proficient in poetic language may suffer the severity of depression to a greater degree for appreciating classical poetic language, which should be confirmed as the next step in research

This study has several limitations that require further examination. First, given that we examined the effect of depressive tendencies on interfering with the emotional evocation of poetry in healthy individuals, further replication studies should be conducted on patients with various severities of depressive tendencies. Second, their SDS assessment should be subdivided into cognitive, emotional, and somatic symptoms (Sakamoto et al., 1998) to investigate the influence of cognitive and emotional traits on pupillary responses elicited by poetic language. In addition, future research should investigate the impact of individual depressive tendencies on the cognitive processing of emotional arousal in response to AP with various emotional valences (e.g., happy and sad). Several previous studies have revealed that emotional reactions of individuals with depression depend on the emotional valence of the stimulus material (e.g., Joormann & Gotlib, 2010; Klumpp & Deldin, 2010; LeMoult & Gotlib, 2019).

To conclude, we found individual differences in the pupils' response to CP: pupils in participants with severe depressive tendencies were less dilated in response to CP than to NP. Despite the acknowledged limitations, this study suggests that people with higher depression severity may be less sensitive to the comical properties of poetic language.

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Notes: Niikuni et al. (2022) found that pupil dilation reflects emotional arousal via poetical language in younger lay people. This study reanalyzed Niikuni et al.'s (2022) data to shed light on the individual differences in pupillary changes in terms of depression severity.

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