Brain activity associated with preferences for artworks depending on the context of Human or AI creators

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Introduction

Previously, it has been shown that aesthetic judgments of an artwork depend on contexts, such as the authenticity [1], or the display place [2]. In the present study, we aimed at examining whether the contextual information of the creator – i.e., the human or the artificial intelligence (AI) – influences the viewers' preference judgments of an artwork. Also, we examined whether individual differences in art experience influence the preference judgments.

Research Questions

- For a visual artwork created by AI, is a viewer's preference influenced by the contextual information of its creator? If so, is the aesthetic preference moderated by the viewer's experience of art?
- What are the brain mechanisms underlying the context and the stimulus aspects of the aesthetic preference?
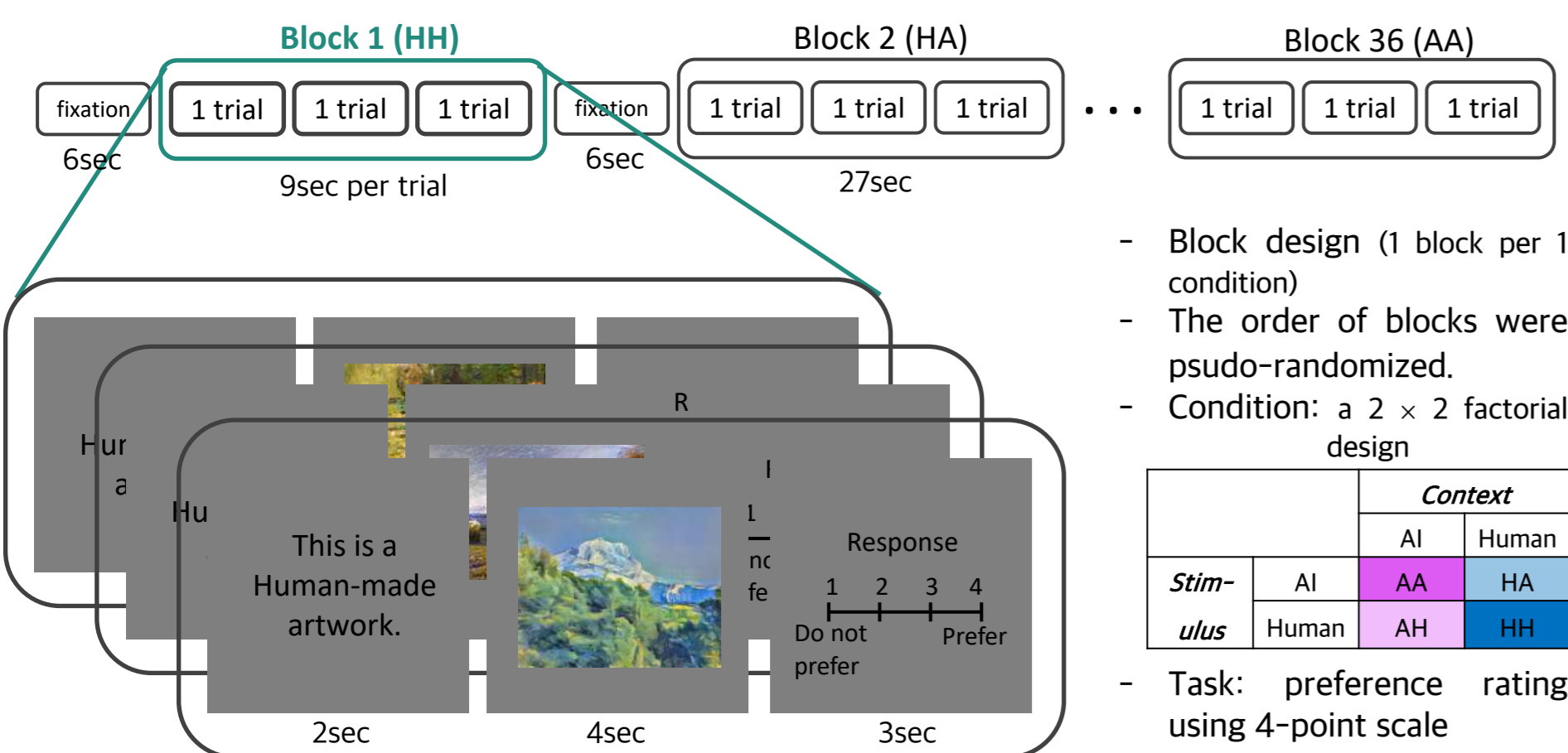
Method

· Stimuli

- 120 artworks made by six Impressionist artists were selected from Wiki Art
- 120 artworks were generated by Google Deep Dream Generator; Deep Style

Original *Human stimulus*	Input *(Photo from Google image search)*	Deep Style *AI stimulus*
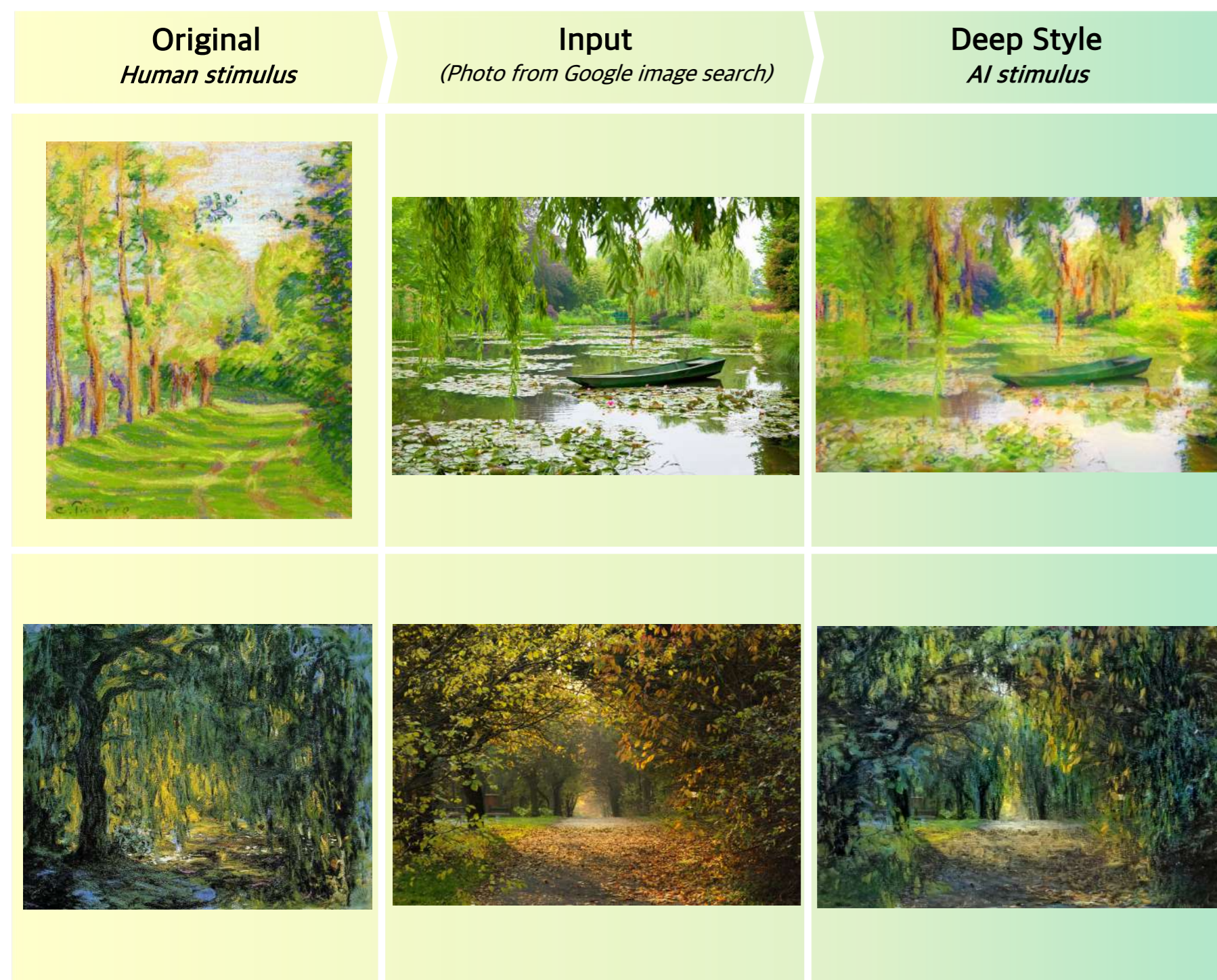
- Of the 240 artworks, 108 artworks which were difficult to determine whether they were made by Human or AI were selected through the preliminary survey.
- Each of the 108 artwork images was scaled to subtend 20° × 15° and presented against light gray background at the center of the screen.

· fMRI Procedures

- Block design (1 block per 1 condition)
- The order of blocks were psudo-randomized.
- Condition: a 2 × 2 factorial design

		Context	
		AI	Human
Stim-ulus	AI	AA	HA
	Human	AH	HH

- Task: preference rating using 4-point scale

Scan parameters: TR = 2000ms, TE = 30ms, slice thickness = 3.4mm, in-plane resolution = 3mm × 3mm
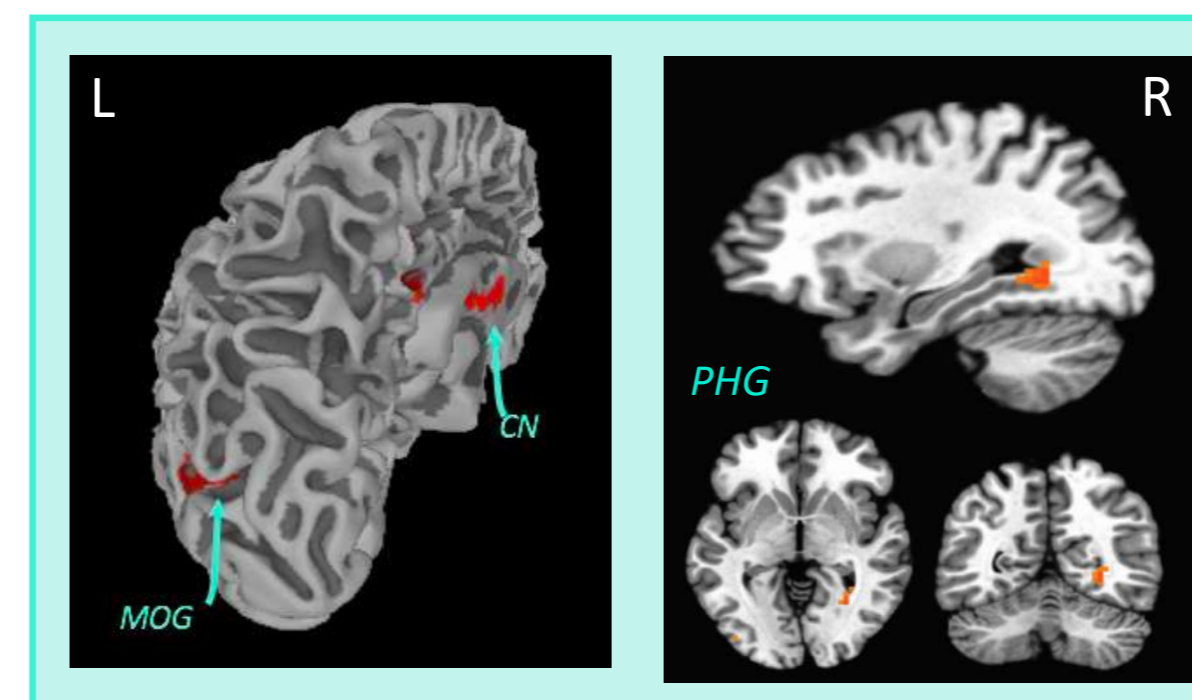
· Participants

36 participants who have not majored in art (20-29 years of age, 17 females, 19 males)

· Post-scan questionnaire

- Art Experience Questionnaire (AEQ) was given to the participants. AEQ included the subscales on the extent and duration of art education, the number of gallery visits, and the duration of art activity.

Behavioral Results

· Art experience correlates negatively with the preference for artworks in the 'Human' Context
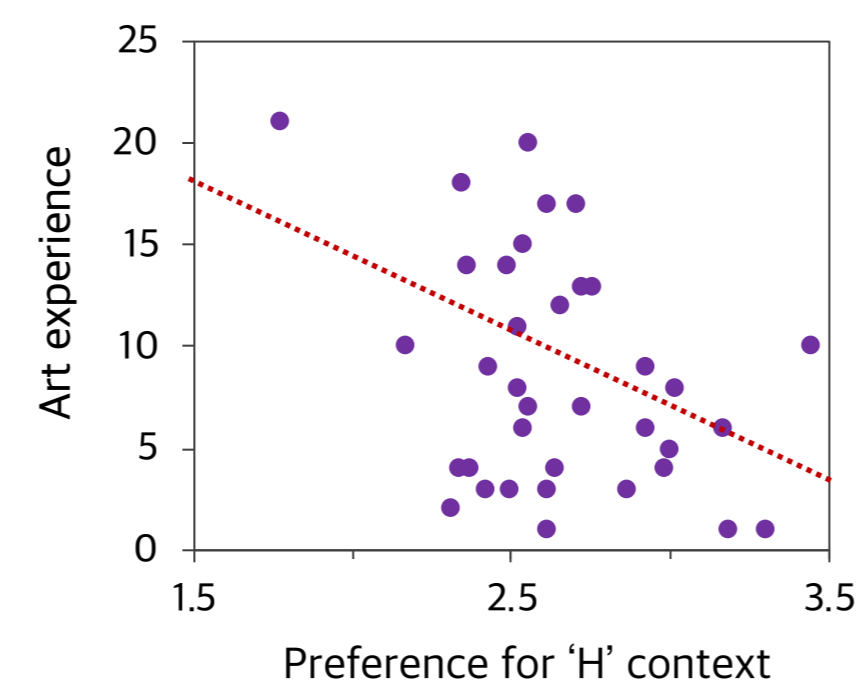
- Individual AEQ score and mean preference for the artworks with 'Human' context were negatively correlated (r = -0.362, p =0.03).
- Among three subscales of the AEQ, art activity duration showed a significant negative correlation with the mean preference for the artworks with Human label (r = -0.460, p = 0.005).

· Preference ratings

		Label	
		AI	Human
Stimulus	AI	2.77±0.08	2.81±0.08
	Human	2.42±0.06	2.49±0.06 (SEM)

- Setting the AEQ score as a covariate in a two-way ANCOVA analysis, there was a marginally significant main effect of context (F(1) = 3.974, p = 0.054). A main effect of stimulus was observed (F(1) = 28.458, p < 0.001), but there was no interaction effect between the two factors.

fMRI Results

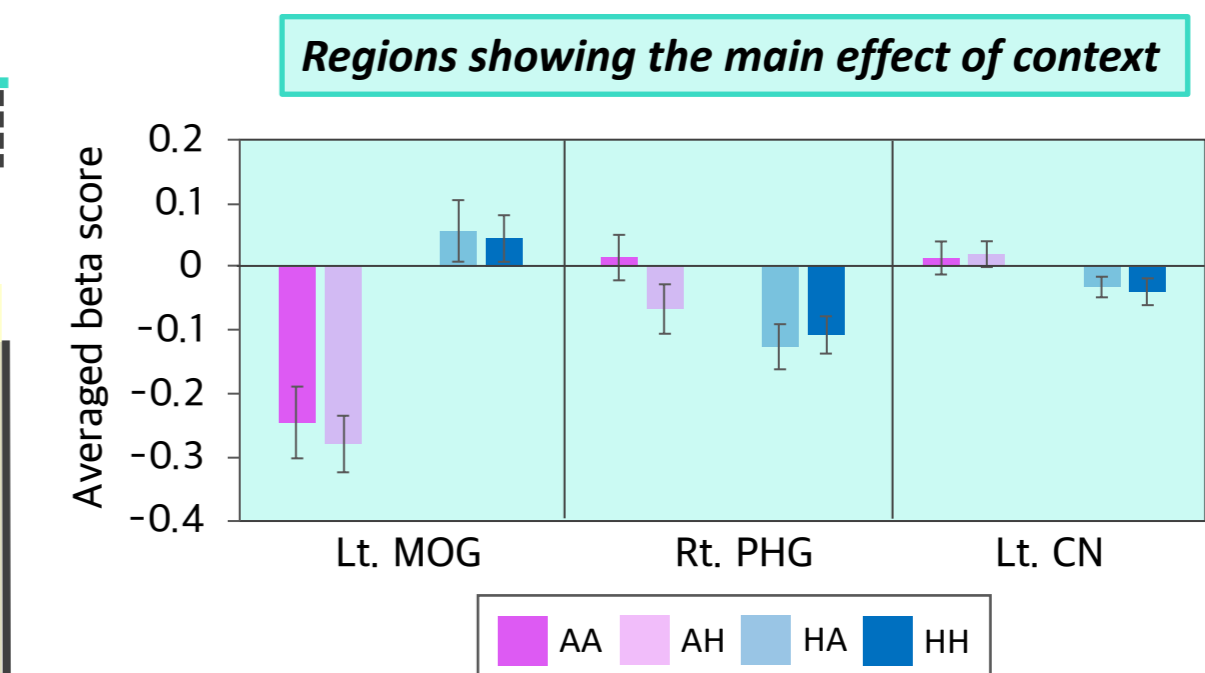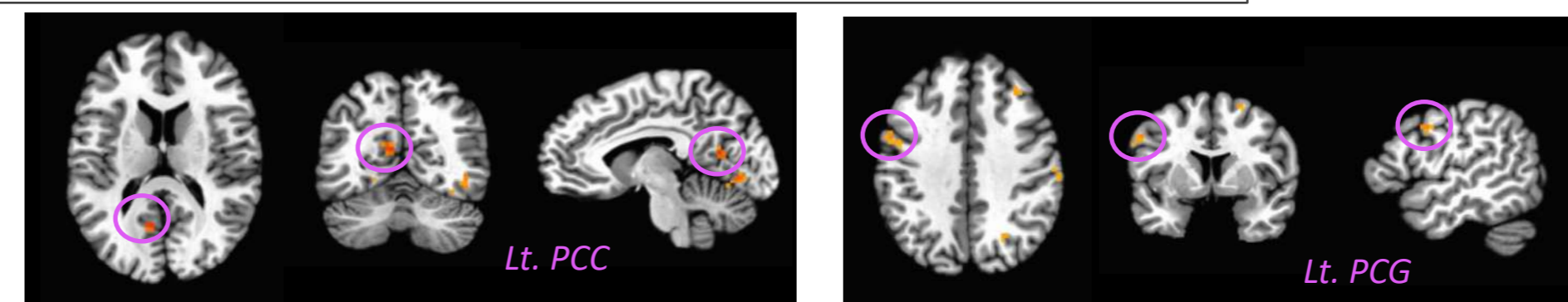### · Brain areas involved in the context and the stimulus aspects of the aesthetic preference

- A whole-brain group analysis identified the clusters showing the statistically significant main effect of context and the two-way interaction effect between label and stimulus. No statistically significant clusters were identified showing the main effect of stimulus.

| **Main effect of context**	**Main effect of stimulus**
Human > AI Lt. Middle Occipital Gyrus [-37 -79 2 TAL]	N/A
AI > Human Rt. Parrahippocampul Gyrus [28 -55 0 TAL]	**Interaction effect**
Lt. Caudate Nucleus [-1 4 14 TAL]	Lt. Cerebellum [-19 -67 -19 TAL]
Lt. Cingulate Gyrus [-16 -22 38 TAL]	Rt. Fusiform Gyrus [25 -58 -9 TAL]
Rt. Thalamus [1 -13 20 TAL]	Lt. Middle Occipital Gyrus [-40 -79 8 TAL]

- Controlling the AEQ score as a covariate, the two-way ANCOVA analysis revealed total four significant clusters showing the main effect of context and interaction effect (context × stimulus).
- The right PHG showed the main effect of context, regardless of the individual difference in the individual art experience (AEQ score).
- The left Cerebellum, MOG and the right FG showed the interaction between context and stimulus, controlling the AEQ score.


Regions showing the main effect of context

- Of the five regions showing the main effect of context, only the left MOG revealed different activation pattern by the ROI analysis; activation was greater for the 'Human' context than for the 'AI' context.

Regions showing the interaction effect (context × stimulus)
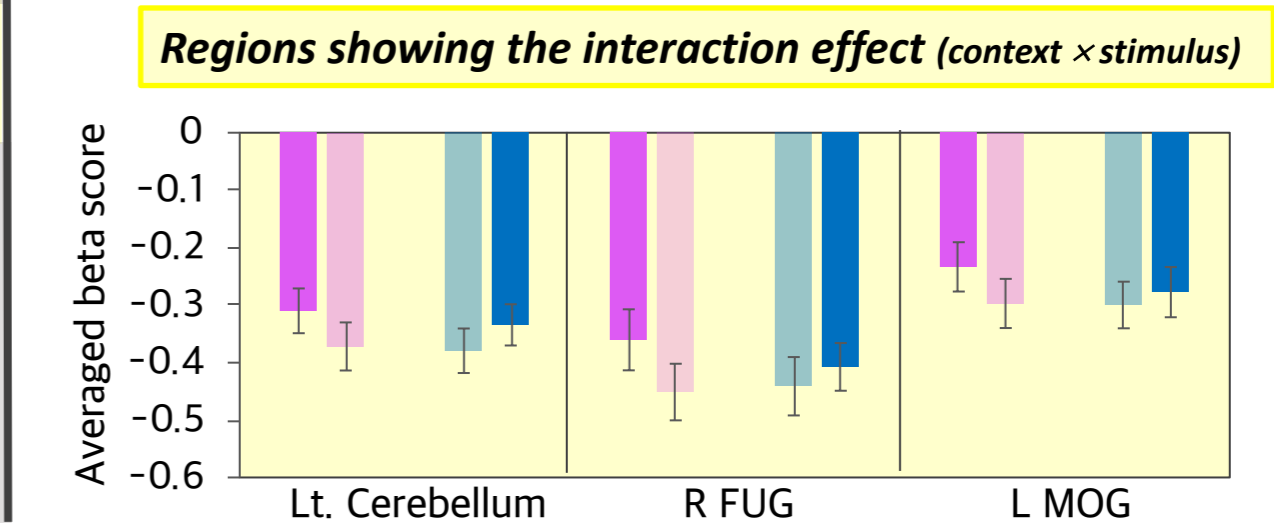
- In all three areas showing the two-way interaction, more deactivation pattern was observed when context and stimulus were incongruent (HA and AH), than when context and stimulus were congruent (HH and AA).

Voxel-wise threshold at p < 0.005
Corrected at cluster-level p < 0.05
(cluster extent > 9 voxels)

T scores -17 0 17

- PPI analyses identified a number of brain regions showing functional connectivity in the 'AI' context > 'H' context and 'H' context > 'AI' context contrasts from the three 'context'-related seed regions shown on the left.
- MOG in the left hemisphere showed a functional connection with the left PCC, a part of the DMN closely related to the subjective aesthetic experience [3].
- Precentral gyrus in the left hemisphere – known to be involved in aesthetic judgements [4], showed a functional connection with the right PHG and the left CN.

Functional connectivity with the MOG, Cd and PHG based on PPI analyses

Lt. PCC   *Lt. PCG*
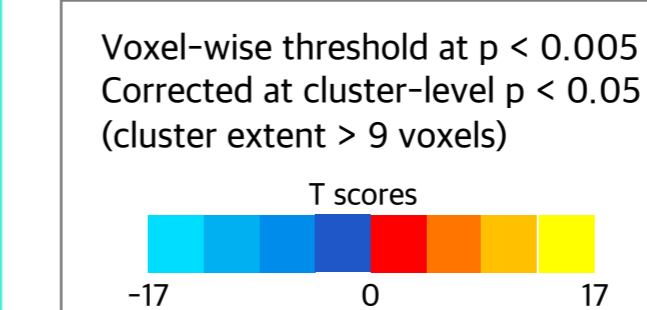
Brain-Behavior Correlation in the left Caudate Nucleus
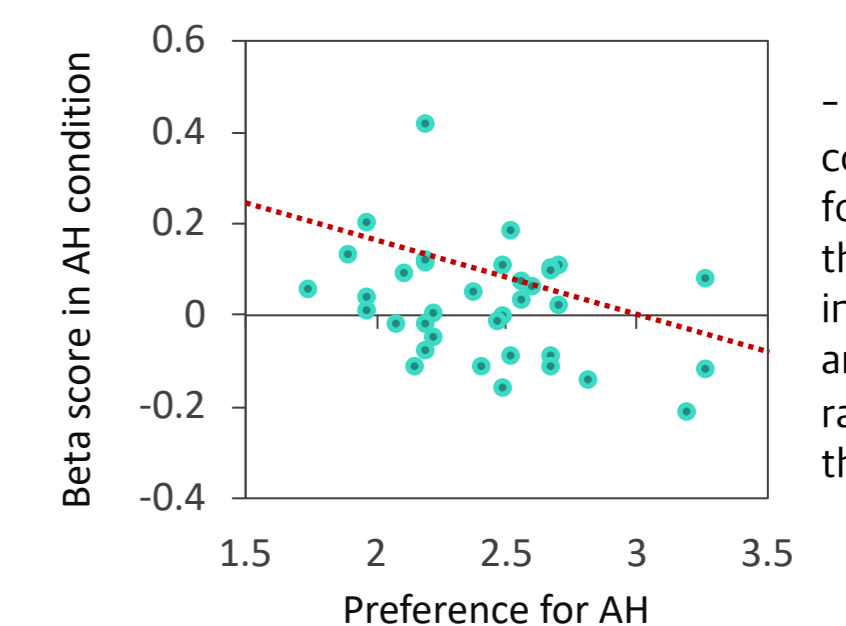
- A negative correlation was found between the BOLD signal in the left CN and preference rating score in the AH condition.

Conclusion

Preference of a visual artwork is influenced by the contextual information and moderated by degrees of art experience of the viewers.

The contextual information is associated with modulation of BOLD signal in the areas of the posterior visual perceptual system and the reward system. Those areas showed functional connectivity with the areas commonly related to aesthetic judgment.

References & Acknowledgement

[1] Newman et al. (2012). *Journal of Experimental Psychology: General,* 141(3)
[2] Kirk et al. (2009). *NeuroImage: 44,* 1125–1132.
[3] Jacobsen et al. (2006). *NeuroImage:29,* 276-285.
[4] Vessel et al. (2013). *Frontiers in Neuroscience, Volume 7, Article 258.*