Beauty is in the eye of the beholder: evidence from a common mnemonic advantage between aesthetics judgement and self-reference

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Abstract

A long-lasting and unresolved debate in the field of aesthetics is whether beauty is inherent to the object of appreciation or to the subject contemplating it. Several studies suggest that physical features (e.g., symmetry, contrast) of an artwork influence aesthetic rating. Nevertheless, this objectivist approach fails to explain the idiosyncratic nature of aesthetic experiences (AE). Recent models propose a multi-process account of AE, integrating a subjective evaluation based on self-referential processing. This proposition seems coherent with neuroimaging studies showing activation of a common neural network during AE and self-reference. Nevertheless, behavioural data supporting this hypothesis is missing. We took advantage of the self-reference effect (SRE) in memory – the mnemonic advantage for material encoded in a self-related mode - to test the hypothesis that aesthetic judgement is based on self-related processes. We predicted that if aesthetic judgement recruits self-referential processing, incidentally encoding artworks in this condition should produce a similar mnemonic advantage as the SRE. To test this hypothesis, 30 participants incidentally encoded 60 painting in three conditions: self-reference, judgement of beauty and judgement of symmetry (control condition). We found that items encoded in the aesthetic judgment condition were as well recognized as those encoded in self-reference condition when participants gave extreme judgements on the beauty scale during encoding. These findings suggest that at least intense AEs activate an individual's sense of self.

Keywords: aesthetics judgement, beauty, self, memory

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Introduction

A long-lasting and unresolved debate in the field of aesthetics is whether beauty is inherent to the object of appreciation or to the subject contemplating it. In other words: is beauty in the eyes of the beholder? In recent years, the scientific interest for the foundation of aesthetic experiences (AE) has been renewed by the emerging field of neuroaesthetics. Mirroring this philosophical and historical debate, there have been two main approaches explaining aesthetic appreciation in modern neuroaesthetic research. The dominant research endeavour in this field, that we can call the objectivist approach, has tried to determine the physical features of an artwork influencing aesthetic judgement. Another, more neglected, line of research has investigated the subjective factors modulating aesthetic judgement.

The objectivist approach has shown that various physical properties of an object are reliable predictors of AE. The symmetry of an artwork is considered a stable and robust predictor of aesthetic preference. Indeed, symmetry positively influenced aesthetic preference for geometric shapes, and this effect was additionally resistant to familiarisation (Tinio & Leder, 2009). In another study, a mild disruption in symmetry resulted in a significant decline in aesthetic preference for geometric shapes (Gartus & Leder, 2013). Complexity also appears as influencing aesthetic preference: its effect on aesthetic judgement has been found for abstract and representational artwork (Osborne & Farley, 1970; Roberts, 2007), or for geometric shapes (Tinio & Leder, 2009). In the same vein, aesthetic preference was greater for photographs with higher level of fractal dimensions (Spehar et al., 2003). Regarding visual contrast, participants' preference for abstract and representational paintings was greater when the contrast was adjusted higher than the original level, compared to a lower-than-original contrast, independently of the subjects' cultural and social status (Van Dongen & Zijlmans, 2017). Another study, providing further understanding of this effect, suggested the existence of an 'optimal level of contrast in paintings' most preferred by viewers (Dijkstra & van Dongen, 2017). Abstract paintings were most appreciated when the contrast was moderately higher than the original, but not excessively. Curvature and angularity are also properties that influence aesthetic judgement. Higher preference for curved shapes and polygons over angular ones has been reported (Bertamini et al., 2016; Silvia & Barona, 2009). Aesthetic judgement is also affected by the content of the artwork. Some studies observed a higher appreciation among the general population for representational compared to abstract art (Roberts, 2007; Sidhu et al., 2018), and more generally for real-world scenes compared to abstract images (Vessel & Rubin, 2010). Taken together, these findings show that the physical features of visual stimuli robustly modulate subjects' aesthetic judgments.

These studies are grounded in cognitive models trying to isolate single key factors determining AE (e.g., Berlyne, 1971; Reber et al., 2004), and they give precious information on the physical characteristics of an artwork influencing AE. Nevertheless, they probably fail to capture the complexity of the phenomenon, neither they explain the widespread intuition that AE is somewhat subjective. An intuition that seem confirmed by experimental studies showing that there is low inter-individual agreement on aesthetic response to visual artistic stimuli, suggesting that aesthetic experience is highly subjective (Vessel et al., 2012). To account for this subjective variability, more recent models propose a multi-process account of AE (Leder et al., 2004; Leder & Nadal, 2014). Leder and collaborators' model proposes five main processing stages leading to aesthetic judgement: perception, implicit memory integration, explicit classification, cognitive mastering, evaluation, and continuous emotion evaluation. By assessing dimensions, such as the evaluative one, pertaining to elements unrelated to the object, these models account for AE beyond the simple elaboration of physical properties. Critically for the present work, the last stages of this model, cognitive mastering and evaluation, account for the subjective component of aesthetics judgement. In particular, the authors propose that self-related cognitive information could be a gateway in understanding and evaluating an artwork. Anecdotally, they state that "[…] perceiver might be satisfied with the recognition of the train station in Monet's La Gare St Lazare, because 'he likes trains because they remind him of a journey'" (Leder et al., 2004, p.499). Thus, they explicitly link AE with self-related processing associated to autobiographical information. The link between AE and the self seems to be sustained by the fact that many people consider their artistic taste to be an important part of their identity, their sense of *who they are* (Vessel et al., 2013).

These observations echo neuroimaging findings showing that key regions of the default mode network (DMN) are activated during aesthetic judgement (Jacobsen et al., 2006; Kawabata & Zeki, 2004; Martín-Loeches et al., 2014; Vessel et al., 2012, 2019). In particular, the medial prefrontal cortex (mPFC) is of utmost relevance. Importantly, the DMN and the mPFC are known to underpin self-representation at different levels of abstraction (for a meta-analysis, see Martinelli et al., 2013). Nevertheless, it is necessary to avoid haphazardly associating two cognitive processes only on the basis of shared cortical activations. Behavioral data suggesting a possible link between the self and AE also exist. For example, a large corpus of literature demonstrates the importance of familiarity on the aesthetic judgement of proverbs, human faces, and music (Bohrn et al., 2013; Bornstein, 1989; Park et al., 2010; Schubert, 2007; Verhaeghen, 2018). Moreover, it is interesting to note that some studies reported that aesthetic judgement during incidental encoding lead to increased memory performance for representational and abstract art pictures (Nadal et al., 2006), for photographs of real-world scenes (Choe et al., 2017), and for paintings (Ishai et al., 2007). Some authors proposed that this effect could be due to the fact that aesthetic judgment may have increased self-related processing (Choe et al., 2017). Indeed, it is well known that items requiring a self-related processing gain a robust mnemonic advantage, in comparison to other types of treatment (e.g., semantic processing), an effect known as self-reference effect (SRE) in memory (Conway, 2005; Cunningham et al., 2008; Kalenzaga et al., 2015; Leshikar et al., 2015; Sui & Humphreys, 2015; Symons & Johnson, 1997). Nevertheless, no study to date directly compared the mnemonic advantage produced by aesthetic judgement and self-reference in order to investigate the potential existence of a common mechanism organizing AE and the self-representation.

To test this hypothesis, we asked participants to incidentally encode artworks in three conditions: an aesthetic judgement condition, a self-referential judgement condition, and a control condition (judgement of symmetry). Our main hypothesis was that if AE is linked to self-referential processing, we should find a comparable mnemonic advantage for the self-referential and the aesthetic judgement condition, compared to a control condition requiring judgement of low-level visual features. An exploratory and complementary hypothesis was that the mnemonic advantage for item encoded in the aesthetic judgement condition should be modulated by participants' evaluation during encoding. In particular, accordingly to a recent study showing better memory performance for the location of paintings that elicited extreme aesthetic experiences, whether positive or negative (Babo-Rebelo et al., 2020), we made the hypothesis that paintings receiving judgments at the two poles would receive the greatest mnemonic advantage.

Material and Methods

Participants

30 university students (27 women; mean age 20.7 ± 2.76 years) were recruited for this study. The participants were undergraduate students in psychology at the University of Paris. All participants had a normal or corrected vision. No participant showed expertise in art, based on the Aesthetic Fluency Scale (Silvia, 2007; Smith & Smith, 2006; mean score 11.63 ± 4.69 out of 40). All participants were informed of the academic nature of the study and accepted that their responses would be processed anonymously. After the nature of the procedure had been fully explained, all participants gave written informed consent before carrying out the study. The protocol was carried out in accordance with the local ethical standards.

Material

Visual stimuli

One hundred pieces of visual art were selected from the Wiki Art data base, across nine different artistic styles representing some of the most important styles between the 16^{th} and 20^{th} century: Nordic renaissance art, Baroque art, Rococo art, Romanticism, Realism, Symbolism, Expressionism, Impressionism, and Post-impressionism. We only selected color and representational paintings with a landscape width-height ratio. We excluded painting including easily recognizable elements (e.g., artist' signature, writings). A complete list of the painting is presented in the **Supplementary Material 1**. Among the selected 100 pieces, 60 were used as target stimuli during the encoding phase. The remaining 40 were used as distractors in the recognition phase. The distractors were visually paired with some of the target stimuli in terms of content (people, animals, landscape, style etc.) and color schemes, in order to make sure they were not dissimilar. The two groups of stimuli did not show any significant differences concerning their physical features: luminance (Targets mean = 93.28 ± 40.53; Lure mean = 101.5 ± 40.79; $t(98) = -1.00$, $p = .321$); contrast (Targets mean = 50.60 ± 11.11; Lure mean = 48.8 ± 9.90; $t(98) = 0.82$, $p = .415$).

Encoding phase

There were three within-subject experimental conditions (encoding conditions): an aesthetic judgement condition, a self-referential judgement condition, and a symmetry judgement condition (control). In the aesthetic judgement condition, the subjects were asked to judge their appreciation of the stimuli ("Judge how beautiful the image is") on a scale from 0 to 10. In the self-referential judgement condition, the subjects were asked to judge to what degree the stimuli reminded them personal memories ("Judge how much the image reminds you of your personal memories") on a scale from 0 to 10. In the symmetry judgement condition, the subjects were asked to judge the stimuli's level of symmetry ("Judge how symmetric the image is") on a scale from 0 to 10. Participants were not informed of the following memory test (incidental encoding).

Prior to the beginning of the encoding phase, a painting not employed in the experimental task (i.e., Viktor Vanetsov's "The Bard Bayan", which is about a Slavic mythological scene) has been used to instruct participants. The self-reference condition was explained to the subjects with the example painting in the following way: "Although it is improbable that you have experienced the event represented in this painting, it is possible that the painting reminds you personal memories such as a friendly hillside picnic, a museum visit where you may have seen similar paintings, a scene of a movie, or even a visual representation of a story that you have read". The beauty condition was explained to the subjects with this image by asking them to simply judge how subjectively beautiful they found the image. The symmetry condition was explained with this image by explaining that although some elements of the painting are quite symmetrical (e.g., the shape and colors of the hill and the sky), some other elements are not (e.g., the left-heavy way people are dispersed on the hill, the people's appearances, the diagonally placed central weapon, etc.), and that they could judge the global symmetry in their own way.

Each condition contained 20 target images presented in a block. The distribution of the 60 target stimuli on the encoding conditions was counterbalanced across participants, so that each item was presented in each experimental condition. The order of block was randomized across subjects. In each block, a trial started with a fixation cross for 500 ms that was followed by the presentation of a stimulus for 3 seconds. Once the stimulus presentation ended, the rating scale appeared on the screen, where the subjects had to enter their score according to the experimental condition. There was no time limit for the evaluation. Once the participants responded, the next trial started. The end of the block was signaled by the presentation of written instructions for the next block.

Recognition phase

During the recognition phase, all target stimuli were presented intermixed with 40 distractor stimuli in a random order. After the presentation of the fixation cross (500ms), each stimulus was presented for 3 seconds. Once the stimulus presentation was over, participants had to indicate if they had seen the picture before. They could choose between 3 different responses appearing on the screen: “Yes”, “Maybe” and “No”. If the answer was either “Yes” or “Maybe”, participants were asked to indicate in which encoding condition they had seen the image. There was no time limit to answer. Once the recognition response was entered, the fixation cross appeared, followed by the next trial.

Procedure

The experiment was conducted at the MC²Lab, located at the Paris University Psychology Institute. Participants were invited to an experimental room, where they were seated at approximately 40cm in front of a 14-inch computer screen (1920x1080, 60Hz). The screen was adjusted to maximum brightness for all participants. The experiment, implemented in Psychopy v3.1.1 (Peirce, 2007), was conducted in three parts for all participants in this order: the encoding phase, the retention interval, the recognition phase. The duration of the retention interval was about 30 minutes (30.32±8.13 minutes). During this phase, participants filled in four questionnaires[1], and watched an 8-minute short film (Alike, Lara & Cano Méndez, 2015). All the above listed material except for the Aesthetic Fluency Scale was used solely as a way to guarantee a sufficiently long retention interval. The results for these questionnaires were thus not analyzed.

Data analysis

The first two sets of analyses model the item (Yes responses) and source recognition (a binary variable) as a function of the condition (3 levels; Beauty, Self-reference and Symmetry) using mixed logistic models (participants and items were entered as random factors). Marginal means-based contrasts were then estimated to allow us exploring the pairwise differences between the levels. In the second part, we additionally modelled the effect of the rating during encoding (a continuous variable ranging from 0 to 10), in each condition, for item and source recognition, allowing to investigate possible non-linearity using second order polynomials.

[1] The Desire for Aesthetics Scale (Lundy et al., 2010), the Aesthetic Fluency Scale (Silvia, 2007; Smith & Smith, 2006), the Tellegen Absorption Scale (Tellegen & Atkinson, 1974), and the Autism Quotient (Auyeung et al., 2008).

Data processing was carried out with R (https://www.r-project.org/) and the *easystats* suite (Lüdecke et al., 2019; Makowski, Ben-Shachar, & Lüdecke, 2019). The whole analysis was performed under the Bayesian framework using MCMC sampling with the *rstanarm* package (Goodrich et al., 2018; http://mc-**stan**.org/). To assert effect significance, we used the Probability of Direction (effects were considered "significant" when *pd* > 97%), a Bayesian equivalent of the *p*-value (Makowski, Ben-Shachar, Chen, et al., 2019). For clarity, only the relevant effects will be described in the text, but the full reproducible analysis script (containing the full description of all models along with complementary results and figures as well complete descriptive statistics) is available in **Supplementary Materials 2**.

Results

Effect of Condition

The mixed logistic model predicting the item recognition had a total explanatory power (Bayes R2; Gelman et al., 2019) of 22%, from which 3% (marginal R2) were related to the effect of the condition alone. Within this model, the Self-reference condition led a significantly higher item recognition probability than the Beauty (difference = 0.91, 95% CI [0.61, 1.23], *pd* = 100%) and the Symmetry (difference = 1.10, 95% CI [0.80, 1.40], *pd* = 100%) conditions. The difference between the latter two was not significant (difference = 0.18, 95% CI [-0.08, 0.46], *pd* = 90.75%). See **Figure A1.**

The mixed logistic model predicting the source recognition had a total explanatory power of 10%, from which 3% was related to the effect of the condition alone. Within this model, there were no significant differences between any of the conditions (Beauty – Self-reference, difference = -0.28, 95% CI [-0.58, 0.03], *pd* = 96.35%; Beauty – Symmetry, difference = -0. 22, 95% CI [-0.50, 0.13], *pd* = 91%; Self-reference – Symmetry, difference = 0.06, 95% CI [-0.25, 0.41], *pd* = 65%). See **Figure B1.**

Effect of Rating

The mixed logistic model predicting the item recognition had a total explanatory power of 24%, from which 5% were related to the condition and the rating. Within this model, only the rating of Symmetry displayed a significant linear positive relationship with the probability of item recognition (median = 12.50, 95% CI [2.79, 23.14], *pd* = 99%). However, the rating of Beauty had a significant quadratic relationship (median = 24.29, 95% CI [14.02, 36.62], *pd* =

100%), with middle ratings leading to a lower probability of item recognition. Additionally, contrast analysis confirmed that at the rating extremities (0 and 10), the difference between the Beauty and the Self-reference was not significant (difference = 0.55, 95% CI [-0.34, 1.52], *pd* = 87.92%; difference = 0.55, 95% CI [-0.60, 1.69], *pd* = 82.85%, respectively). See **Figure A2.**

The mixed logistic model predicting the source recognition had a total explanatory power of 11%, from which 3% were related to the condition and the rating. Within this model, both the ratings of Symmetry (median = 12.41, 95% CI [1.01, 24.46], *pd* = 98.20%) and Self-reference (median = 16.44, 95% CI [6.39, 26.97], *pd* = 99.95%) displayed a significant linear positive relationship with the probability of source recognition. The rating of Beauty had a significant quadratic relationship (median = 20.04, 95% CI [8.90, 32.08], *pd* = 99.98%), with middle ratings leading to a lower probability of source recognition. See **Figure B2.**

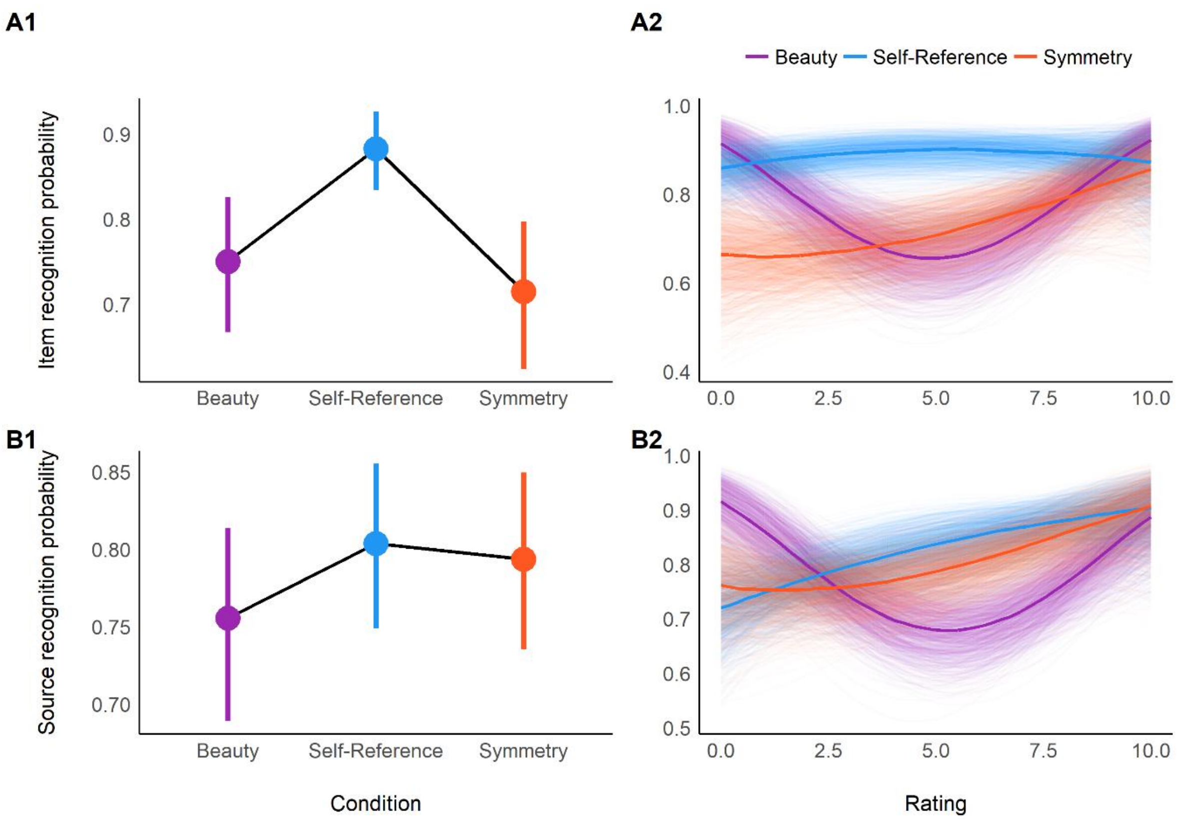

Figure 1. The estimated probability of item (A) and source (B) recognition averaged by conditions (1) and its modulation by the rating (2). The error bars represent the 95% Credible

Intervals (CI). Thin lines represent individual posterior draws (i.e., the possible effects) and the thick line shows the median effect.

Discussion

In this study, we investigated the relationship between AE and the self at the behavioral level. We tested the hypothesis that AE is grounded on self-reference by examining the common mnemonic advantage produced by incidentally encoding aesthetic visual stimuli under aesthetic judgement, self-reference and a control condition. Given that self-referential encoding produces robust mnemonic advantage (Conway, 2005; Cunningham et al., 2008; Kalenzaga et al., 2015; Leshikar et al., 2015; Sui & Humphreys, 2015; Symons & Johnson, 1997), we expected that comparable results would be observed for aesthetic encoding, owing to the potential shared mechanism. The main result, confirming our hypothesis, was that items in the aesthetic judgment condition were as well recognized as those encoded in self-reference condition when participants gave extreme judgements on the beauty scale during encoding.

First of all, we replicated the self-reference effect (SRE) in memory. Indeed, items encoded in this condition were generally better recognized than the other two conditions (aesthetics and symmetry judgement). This result confirms the effectiveness of our experimental manipulation. Our main result was that items encoded in the aesthetic judgement condition, although they were not generally better recognized, showed the same recognition probability of items encoded in the self-reference condition, when participants had given an extreme judgement (very high or very low) during encoding. Several studies reported a positive link between aesthetic evaluation and memory. For example, Nadal, Marty and Munar (2006) reported that aesthetic preference was higher for artworks that have left stronger memory traces. Similar results have been observed by Ishai, Fairhall & Pepperell (2007) reporting that the higher the appreciation of the stimuli during encoding, the more probable their recognition was. In the same vein, Choe et al. (2017) showed that rating aesthetic value during an incidental encoding task boosted memory performances, compared to an intentional encoding condition or to a search task. Finally, a recent study reported better memory performance for the location of paintings that elicited extreme aesthetic experiences, whether positive or negative (Babo-Rebelo et al., 2020). Although these results suggest that in general aesthetic judgement enhances memory performance, at first glance, this effect seems to vary between studies. Indeed, memory can be facilitated independently of the extent of the rating during encoding (Choe et al., 2017), can linearly vary with the rating (Ishai, Fairhall and Pepperell, 2007), or can be associated with extreme (positive or negative) judgements. This heterogeneity could be linked to the type of aesthetic judgement required. Indeed, Ishai and colleagues (2007) asked participants how strongly the paintings affected them. This measure can capture both positive and negative aspect of the AE. Babo-Rebelo et al. (2020) employed liking and intensity rating (the squared liking rating), the latter being a more robust predictor of subsequent memory. In this light, one hypothesis would be that the absolute intensity of AE, more than the valence, determines the subsequent memory enhancement. Our findings seem to be coherent with this hypothesis. Moreover, we showed, for the first time, that the memory enhancement for items receiving extreme aesthetic rating is comparable to that produced by self-reference. Our results directly support the proposal that the memory advantage produced by AE is linked to the recruitment of self-referential processing (Choe et al., 2017).

Interestingly, some neuroimaging studies seem to confirm that intense AE recruits brain regions involved in self-referential processing. For example, Vessel et al. (2012) asked participants to rate how strongly paintings move them while recording their brain activity with fMRI. They identified two brain networks showing different pattern of activity. The activity in the first network, composed by sensory regions, increased linearly with participants' rating. The second network, mainly encompassing region of the DMN, showed increased activity only for the most moving stimuli. This was particularly true for the medial prefrontal cortex (MPFC). Interestingly, in another study the MPFC showed a nonlinear pattern of activity when participants were asked to judge their appreciation of a human face and body stimuli. Indeed, this region showed increased activation for both ugly and beautiful stimuli, compared to neutral ones (Martín-Loeches et al., 2014). Again, these results suggest that strong AE, whatever their valence, recruit brain regions underpinning self-representation. Our behavioral data seems to corroborate the suggestion that at least strong AE can activate an individual's sense of self (Vessel et al., 2013), involving either an apprehension of the object as conveying one's deep identity (in the case of positive valence) or its very opposite (in the case of negative valence).

One alternative explanation for our results could be that the reported effect is not due to aesthetic judgement per se, but would be linked to the emotional reaction associated to highly aesthetically moving stimuli. Indeed, emotional evaluation is central to AE (Chatterjee & Vartanian, 2014), and comes into play at almost every processing level during AE (Leder et al., 2004; Leder & Nadal, 2014). In addition, emotional content is known to facilitate memory (Adelman & Estes, 2013; Leppänen et al., 2007; Meng et al., 2017; Schaefer et al., 2009; Sharot & Phelps, 2004). Further studies should explore the relation between AE and the self, disentangling the potential effects of emotional content not controlled in the present work.

We also reported that judgement of symmetry showed a linear relationship with subsequent recognition probability. This can be due to the well-known link between symmetry and aesthetic preference as mentioned in the introduction (Gartus & Leder, 2013; Tinio & Leder, 2009). Probably, stimuli judged as highly symmetric were also implicitly judged as beautiful, and produced the same mnemonic advantage. Further studies should use different control conditions not pertaining to judgement of features that are known to be associated with aesthetic evaluation. Concerning source memory, the results were less clear. Indeed, for this measure we did not report any effect of the encoding condition. The blocked presentation of conditions could have facilitated the source memory task leading to a ceiling effect as shown by the high rate of correct answers (see **Supplementary Material 2**). Thus, although the probability of source memory for items encoded in the aesthetic judgement condition followed the same u-shaped pattern than recognition probability, these data are less easily interpretable.

In conclusion, we presented here behavioral results corroborating previous neuroimaging findings suggesting that intense AEs are strictly linked to self-referential processing. These data support the idea that beauty, but also ugliness, is (at least partly) in the eye of the beholder, and give a cognitive explanation to intersubjective variability in aesthetic appreciation. Beyond the fundamental theoretical interest in the field of neuroaesthetics, our results could have some implications for clinical research. Indeed, some studies reported that patients suffering from Alzheimer's disease showed a preserved stability of aesthetic preferences, even if they not have explicit memory for the artworks (Halpern et al., 2008; Silveri et al., 2015). These findings suggest that AE could be a window to preserved portions of the self in these patients.

Author contributions

HL, AJ and MS wrote the article. HL and MS conceptualized the experiment. HL and DM did the data analyses. All the authors contributed to the final draft of the article.

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Figure 1. The estimated probability of item (A) and source (B) recognition averaged by conditions (1) and its modulation by the rating (2). The error bars represent the 95% Credible Intervals (CI). Thin lines represent individual posterior draws (i.e., the possible effects) and the thick line shows the median effect.