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,

70   2010). Taken together, these findings show that the physical features of visual stimuli robustly

71   modulate subjects' aesthetic judgments.

72   These studies are grounded in cognitive models trying to isolate single key factors determining

73   AE (e.g., Berlyne, 1971; Reber et al., 2004), and they give precious information on the physical

74   characteristics of an artwork influencing AE. Nevertheless, they probably fail to capture the

75   complexity of the phenomenon, neither they explain the widespread intuition that AE is

76   somewhat subjective. An intuition that seem confirmed by experimental studies showing that

77   there is low inter-individual agreement on aesthetic response to visual artistic stimuli,

78   suggesting that aesthetic experience is highly subjective (Vessel et al., 2012). To account for

79   this subjective variability, more recent models propose a multi-process account of AE (Leder

80   et al., 2004; Leder & Nadal, 2014). Leder and collaborators' model proposes five main

81   processing stages leading to aesthetic judgement: perception, implicit memory integration,

82   explicit classification, cognitive mastering, evaluation, and continuous emotion evaluation. By

83   assessing dimensions, such as the evaluative one, pertaining to elements unrelated to the object,

84   these models account for AE beyond the simple elaboration of physical properties. Critically

85   for the present work, the last stages of this model, cognitive mastering and evaluation, account

86   for the subjective component of aesthetics judgement. In particular, the authors propose that

87   self-related cognitive information could be a gateway in understanding and evaluating an

88   artwork. Anecdotally, they state that "[…] perceiver might be satisfied with the recognition of

89   the train station in Monet's La Gare St Lazare, because 'he likes trains because they remind

90   him of a journey'" (Leder et al., 2004, p.499). Thus, they explicitly link AE with self-related

91   processing associated to autobiographical information. The link between AE and the self seems

92   to be sustained by the fact that many people consider their artistic taste to be an important part

93   of their identity, their sense of *who they are* (Vessel et al., 2013).

94   These observations echo neuroimaging findings showing that key regions of the default mode

95   network (DMN) are activated during aesthetic judgement (Jacobsen et al., 2006; Kawabata &

96   Zeki, 2004; Martín-Loeches et al., 2014; Vessel et al., 2012, 2019). In particular, the medial

97   prefrontal cortex (mPFC) is of utmost relevance. Importantly, the DMN and the mPFC are

98   known to underpin self-representation at different levels of abstraction (for a meta-analysis,

99   see Martinelli et al., 2013). Nevertheless, it is necessary to avoid haphazardly associating two

100 cognitive processes only on the basis of shared cortical activations. Behavioral data suggesting

101 a possible link between the self and AE also exist. For example, a large corpus of literature

102   demonstrates the importance of familiarity on the aesthetic judgement of proverbs, human faces,

103   and music (Bohrn et al., 2013; Bornstein, 1989; Park et al., 2010; Schubert, 2007; Verhaeghen,

104   2018). Moreover, it is interesting to note that some studies reported that aesthetic judgement

105   during incidental encoding lead to increased memory performance for representational and

106   abstract art pictures (Nadal et al., 2006), for photographs of real-world scenes (Choe et al.,

107   2017), and for paintings (Ishai et al., 2007). Some authors proposed that this effect could be

108   due to the fact that aesthetic judgment may have increased self-related processing (Choe et al.,

109   2017). Indeed, it is well known that items requiring a self-related processing gain a robust

110   mnemonic advantage, in comparison to other types of treatment (e.g., semantic processing), an

111   effect known as self-reference effect (SRE) in memory (Conway, 2005; Cunningham et al.,

112   2008; Kalenzaga et al., 2015; Leshikar et al., 2015; Sui & Humphreys, 2015; Symons &

113   Johnson, 1997). Nevertheless, no study to date directly compared the mnemonic advantage

114   produced by aesthetic judgement and self-reference in order to investigate the potential

115   existence of a common mechanism organizing AE and the self-representation.

116   To test this hypothesis, we asked participants to incidentally encode artworks in three

117   conditions: an aesthetic judgement condition, a self-referential judgement condition, and a

118   control condition (judgement of symmetry). Our main hypothesis was that if AE is linked to

119   self-referential processing, we should find a comparable mnemonic advantage for the self-

120   referential and the aesthetic judgement condition, compared to a control condition requiring

121   judgement of low-level visual features. An exploratory and complementary hypothesis was that

122   the mnemonic advantage for item encoded in the aesthetic judgement condition should be

123   modulated by participants' evaluation during encoding. In particular, accordingly to a recent

124   study showing better memory performance for the location of paintings that elicited extreme

125   aesthetic experiences, whether positive or negative (Babo-Rebelo et al., 2020), we made the

126   hypothesis that paintings receiving judgments at the two poles would receive the greatest

127   mnemonic advantage.

Material and Methods

Participants

130   30 university students (27 women; mean age 20.7 ± 2.76 years) were recruited for this study.

131   The participants were undergraduate students in psychology at the University of Paris. All

132   participants had a normal or corrected vision. No participant showed expertise in art, based on

133   the Aesthetic Fluency Scale (Silvia, 2007; Smith & Smith, 2006; mean score 11.63 ± 4.69 out

134   of 40). All participants were informed of the academic nature of the study and accepted that

135   their responses would be processed anonymously. After the nature of the procedure had been

136   fully explained, all participants gave written informed consent before carrying out the study.

137   The protocol was carried out in accordance with the local ethical standards.

138   **Material**

139   **Visual stimuli**

140   One hundred pieces of visual art were selected from the Wiki Art data base, across nine

141   different artistic styles representing some of the most important styles between the 16th and 20th

142   century: Nordic renaissance art, Baroque art, Rococo art, Romanticism, Realism, Symbolism,

143   Expressionism, Impressionism, and Post-impressionism. We only selected color and

144   representational paintings with a landscape width-height ratio. We excluded painting including

145   easily recognizable elements (e.g., artist' signature, writings). A complete list of the painting

146   is presented in the **Supplementary Material 1**. Among the selected 100 pieces, 60 were used

147   as target stimuli during the encoding phase. The remaining 40 were used as distractors in the

148   recognition phase. The distractors were visually paired with some of the target stimuli in terms

149   of content (people, animals, landscape, style etc.) and color schemes, in order to make sure

150   they were not dissimilar. The two groups of stimuli did not show any significant differences

151   concerning their physical features: luminance (Targets mean $= 93.28 \pm 40.53$; Lure mean $=$

152   101.5 ± 40.79; $t(98) = -1.00$, $p = .321$); contrast (Targets mean $= 50.60 \pm 11.11$; Lure mean $=$

153   48.8 ± 9.90; $t(98) = 0.82$, $p = .415$).

154   **Encoding phase**

155   There were three within-subject experimental conditions (encoding conditions): an aesthetic

156   judgement condition, a self-referential judgement condition, and a symmetry judgement

157   condition (control). In the aesthetic judgement condition, the subjects were asked to judge their

158   appreciation of the stimuli ("Judge how beautiful the image is") on a scale from 0 to 10. In the

159   self-referential judgement condition, the subjects were asked to judge to what degree the

160   stimuli reminded them personal memories ("Judge how much the image reminds you of your

161   personal memories") on a scale from 0 to 10. In the symmetry judgement condition, the subjects

162   were asked to judge the stimuli's level of symmetry ("Judge how symmetric the image is") on

163 a scale from 0 to 10. Participants were not informed of the following memory test (incidental

164 encoding).

165 Prior to the beginning of the encoding phase, a painting not employed in the experimental task

166 (i.e., Viktor Vanetsov's "The Bard Bayan", which is about a Slavic mythological scene) has

167 been used to instruct participants. The self-reference condition was explained to the subjects

168 with the example painting in the following way: "Although it is improbable that you have

169 experienced the event represented in this painting, it is possible that the painting reminds you

170 personal memories such as a friendly hillside picnic, a museum visit where you may have seen

171 similar paintings, a scene of a movie, or even a visual representation of a story that you have

172 read". The beauty condition was explained to the subjects with this image by asking them to

173 simply judge how subjectively beautiful they found the image. The symmetry condition was

174 explained with this image by explaining that although some elements of the painting are quite

175 symmetrical (e.g., the shape and colors of the hill and the sky), some other elements are not

176 (e.g., the left-heavy way people are dispersed on the hill, the people's appearances, the

177 diagonally placed central weapon, etc.), and that they could judge the global symmetry in their

178 own way.

179 Each condition contained 20 target images presented in a block. The distribution of the 60

180 target stimuli on the encoding conditions was counterbalanced across participants, so that each

181 item was presented in each experimental condition. The order of block was randomized across

182 subjects. In each block, a trial started with a fixation cross for 500 ms that was followed by the

183 presentation of a stimulus for 3 seconds. Once the stimulus presentation ended, the rating scale

184 appeared on the screen, where the subjects had to enter their score according to the

185 experimental condition. There was no time limit for the evaluation. Once the participants

186 responded, the next trial started. The end of the block was signaled by the presentation of

187 written instructions for the next block.

188 **Recognition phase**

189 During the recognition phase, all target stimuli were presented intermixed with 40 distractor

190 stimuli in a random order. After the presentation of the fixation cross (500ms), each stimulus

191 was presented for 3 seconds. Once the stimulus presentation was over, participants had to

192 indicate if they had seen the picture before. They could choose between 3 different responses

193 appearing on the screen: "Yes", "Maybe" and "No". If the answer was either "Yes" or "Maybe",

194 participants were asked to indicate in which encoding condition they had seen the image. There
195 was no time limit to answer. Once the recognition response was entered, the fixation cross
196 appeared, followed by the next trial.

Procedure

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

Data analysis

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

217 Data processing was carried out with R (https://www.r-project.org/) and the *easystats* suite
218 (Lüdecke et al., 2019; Makowski, Ben-Shachar, & Lüdecke, 2019). The whole analysis was
219 performed under the Bayesian framework using MCMC sampling with the *rstanarm* package
220 (Goodrich et al., 2018; http://mc-**stan**.org/). To assert effect significance, we used the
221 Probability of Direction (effects were considered "significant" when $pd > 97\%$), a Bayesian

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[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).

222   equivalent of the *p*-value (Makowski, Ben-Shachar, Chen, et al., 2019). For clarity, only the

223   relevant effects will be described in the text, but the full reproducible analysis script (containing

224   the full description of all models along with complementary results and figures as well

225   complete descriptive statistics) is available in **Supplementary Materials 2**.

<div align="center">

Results

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226

Effect of Condition

227

228   The mixed logistic model predicting the item recognition had a total explanatory power (Bayes

229   R2; Gelman et al., 2019) of 22%, from which 3% (marginal R2) were related to the effect of

230   the condition alone. Within this model, the Self-reference condition led a significantly higher

231   item recognition probability than the Beauty (difference = 0.91, 95% CI [0.61, 1.23], *pd* =

232   100%) and the Symmetry (difference = 1.10, 95% CI [0.80, 1.40], *pd* = 100%) conditions. The

233   difference between the latter two was not significant (difference = 0.18, 95% CI [-0.08, 0.46],

234   *pd* = 90.75%). See **Figure A1.**

235   The mixed logistic model predicting the source recognition had a total explanatory power of

236   10%, from which 3% was related to the effect of the condition alone. Within this model, there

237   were no significant differences between any of the conditions (Beauty – Self-reference,

238   difference = -0.28, 95% CI [-0.58, 0.03], *pd* = 96.35%; Beauty – Symmetry, difference = -0.

239   22, 95% CI [-0.50, 0.13], *pd* = 91%; Self-reference – Symmetry, difference = 0.06, 95% CI [-

240   0.25, 0.41], *pd* = 65%). See **Figure B1.**

Effect of Rating

241

242   The mixed logistic model predicting the item recognition had a total explanatory power of 24%,

243   from which 5% were related to the condition and the rating. Within this model, only the rating

244   of Symmetry displayed a significant linear positive relationship with the probability of item

245   recognition (median = 12.50, 95% CI [2.79, 23.14], *pd* = 99%). However, the rating of Beauty

246   had a significant quadratic relationship (median = 24.29, 95% CI [14.02, 36.62], *pd* = 100%),

247   with middle ratings leading to a lower probability of item recognition. Additionally, contrast

248   analysis confirmed that at the rating extremities (0 and 10), the difference between the Beauty

249   and the Self-reference was not significant (difference = 0.55, 95% CI [-0.34, 1.52], *pd* =

250   87.92%; difference = 0.55, 95% CI [-0.60, 1.69], *pd* = 82.85%, respectively). See **Figure A2.**

251   The mixed logistic model predicting the source recognition had a total explanatory power of

252   11%, from which 3% were related to the condition and the rating. Within this model, both the

253   ratings of Symmetry (median = 12.41, 95% CI [1.01, 24.46], pd = 98.20%) and Self-reference

254   (median = 16.44, 95% CI [6.39, 26.97], pd = 99.95%) displayed a significant linear positive

255   relationship with the probability of source recognition. The rating of Beauty had a significant

256   quadratic relationship (median = 20.04, 95% CI [8.90, 32.08], pd = 99.98%), with middle

257   ratings leading to a lower probability of source recognition. See **Figure B2.**
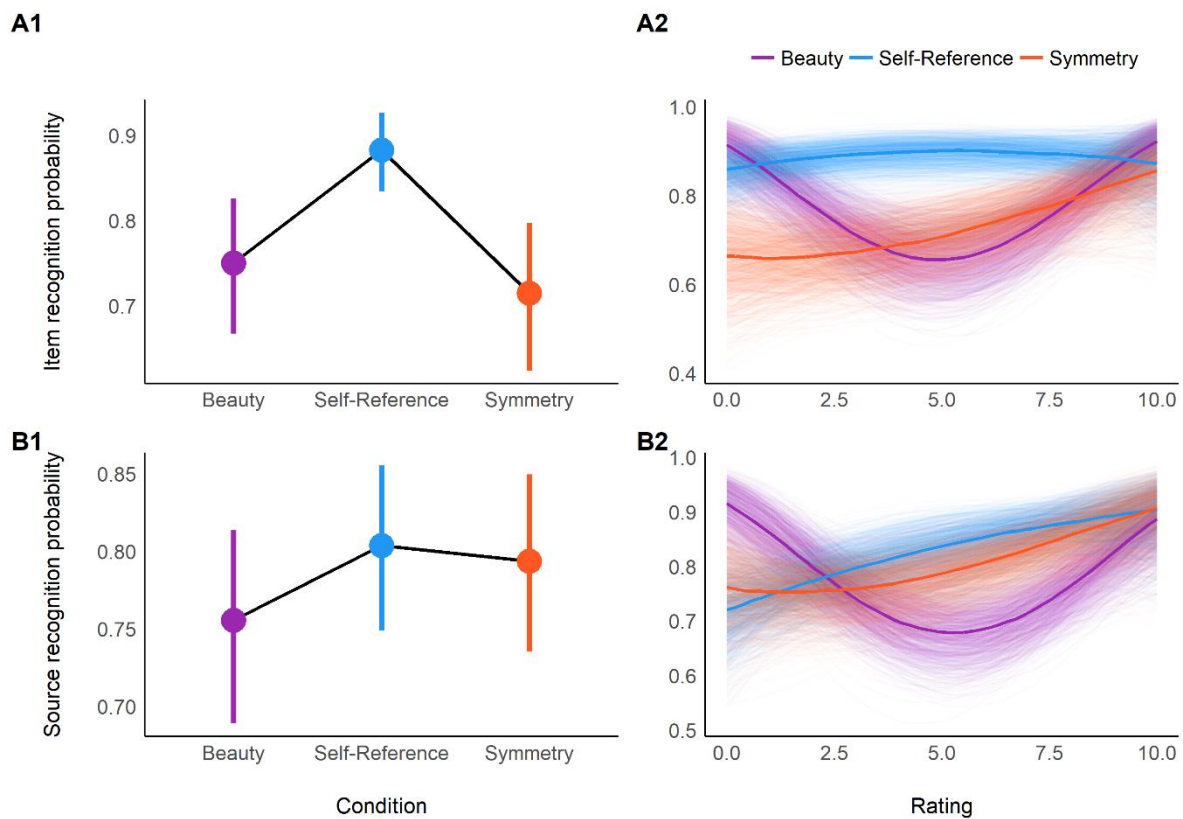
258

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

265   In this study, we investigated the relationship between AE and the self at the behavioral level.

266   We tested the hypothesis that AE is grounded on self-reference by examining the common

267 mnemonic advantage produced by incidentally encoding aesthetic visual stimuli under
268 aesthetic judgement, self-reference and a control condition. Given that self-referential encoding
269 produces robust mnemonic advantage (Conway, 2005; Cunningham et al., 2008; Kalenzaga et
270 al., 2015; Leshikar et al., 2015; Sui & Humphreys, 2015; Symons & Johnson, 1997), we
271 expected that comparable results would be observed for aesthetic encoding, owing to the
272 potential shared mechanism. The main result, confirming our hypothesis, was that items in the
273 aesthetic judgment condition were as well recognized as those encoded in self-reference
274 condition when participants gave extreme judgements on the beauty scale during encoding.

275 First of all, we replicated the self-reference effect (SRE) in memory. Indeed, items encoded in
276 this condition were generally better recognized than the other two conditions (aesthetics and
277 symmetry judgement). This result confirms the effectiveness of our experimental manipulation.
278 Our main result was that items encoded in the aesthetic judgement condition, although they
279 were not generally better recognized, showed the same recognition probability of items
280 encoded in the self-reference condition, when participants had given an extreme judgement
281 (very high or very low) during encoding. Several studies reported a positive link between
282 aesthetic evaluation and memory. For example, Nadal, Marty and Munar (2006) reported that
283 aesthetic preference was higher for artworks that have left stronger memory traces. Similar
284 results have been observed by Ishai, Fairhall & Pepperell (2007) reporting that the higher the
285 appreciation of the stimuli during encoding, the more probable their recognition was. In the
286 same vein, Choe et al. (2017) showed that rating aesthetic value during an incidental encoding
287 task boosted memory performances, compared to an intentional encoding condition or to a
288 search task. Finally, a recent study reported better memory performance for the location of
289 paintings that elicited extreme aesthetic experiences, whether positive or negative (Babo-
290 Rebelo et al., 2020). Although these results suggest that in general aesthetic judgement
291 enhances memory performance, at first glance, this effect seems to vary between studies.
292 Indeed, memory can be facilitated independently of the extent of the rating during encoding
293 (Choe et al., 2017), can linearly vary with the rating (Ishai, Fairhall and Pepperell, 2007), or
294 can be associated with extreme (positive or negative) judgements. This heterogeneity could be
295 linked to the type of aesthetic judgement required. Indeed, Ishai and colleagues (2007) asked
296 participants how strongly the paintings affected them. This measure can capture both positive
297 and negative aspect of the AE. Babo-Rebelo et al. (2020) employed liking and intensity rating
298 (the squared liking rating), the latter being a more robust predictor of subsequent memory. In

299   this light, one hypothesis would be that the absolute intensity of AE, more than the valence,

300   determines the subsequent memory enhancement. Our findings seem to be coherent with this

301   hypothesis. Moreover, we showed, for the first time, that the memory enhancement for items

302   receiving extreme aesthetic rating is comparable to that produced by self-reference. Our results

303   directly support the proposal that the memory advantage produced by AE is linked to the

304   recruitment of self-referential processing (Choe et al., 2017).

305   Interestingly, some neuroimaging studies seem to confirm that intense AE recruits brain

306   regions involved in self-referential processing. For example, Vessel et al. (2012) asked

307   participants to rate how strongly paintings move them while recording their brain activity with

308   fMRI. They identified two brain networks showing different pattern of activity. The activity in

309   the first network, composed by sensory regions, increased linearly with participants' rating.

310   The second network, mainly encompassing region of the DMN, showed increased activity only

311   for the most moving stimuli. This was particularly true for the medial prefrontal cortex (MPFC).

312   Interestingly, in another study the MPFC showed a nonlinear pattern of activity when

313   participants were asked to judge their appreciation of a human face and body stimuli. Indeed,

314   this region showed increased activation for both ugly and beautiful stimuli, compared to neutral

315   ones (Martín-Loeches et al., 2014). Again, these results suggest that strong AE, whatever their

316   valence, recruit brain regions underpinning self-representation. Our behavioral data seems to

317   corroborate the suggestion that at least strong AE can activate an individual's sense of self

318   (Vessel et al., 2013), involving either an apprehension of the object as conveying one's deep

319   identity (in the case of positive valence) or its very opposite (in the case of negative valence).

320   One alternative explanation for our results could be that the reported effect is not due to

321   aesthetic judgement per se, but would be linked to the emotional reaction associated to highly

322   aesthetically moving stimuli. Indeed, emotional evaluation is central to AE (Chatterjee &

323   Vartanian, 2014), and comes into play at almost every processing level during AE (Leder et al.,

324   2004; Leder & Nadal, 2014). In addition, emotional content is known to facilitate memory

325   (Adelman & Estes, 2013; Leppänen et al., 2007; Meng et al., 2017; Schaefer et al., 2009; Sharot

326   & Phelps, 2004). Further studies should explore the relation between AE and the self,

327   disentangling the potential effects of emotional content not controlled in the present work.

328   We also reported that judgement of symmetry showed a linear relationship with subsequent

329   recognition probability. This can be due to the well-known link between symmetry and

330 aesthetic preference as mentioned in the introduction (Gartus & Leder, 2013; Tinio & Leder,
331 2009). Probably, stimuli judged as highly symmetric were also implicitly judged as beautiful,
332 and produced the same mnemonic advantage. Further studies should use different control
333 conditions not pertaining to judgement of features that are known to be associated with
334 aesthetic evaluation. Concerning source memory, the results were less clear. Indeed, for this
335 measure we did not report any effect of the encoding condition. The blocked presentation of
336 conditions could have facilitated the source memory task leading to a ceiling effect as shown
337 by the high rate of correct answers (see **Supplementary Material 2**). Thus, although the
338 probability of source memory for items encoded in the aesthetic judgement condition followed
339 the same u-shaped pattern than recognition probability, these data are less easily interpretable.

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

349 **Author contributions**

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

352 **Acknowledgement**

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522

523   **Figure 1.** The estimated probability of item (A) and source (B) recognition averaged by

524   conditions (1) and its modulation by the rating (2). The error bars represent the 95% Credible

525   Intervals (CI). Thin lines represent individual posterior draws (i.e., the possible effects) and the

526   thick line shows the median effect.