

Beauty, the feeling

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Abstract

17 Many philosophers and psychologists have made claims about the feelings in an
18 experience of beauty. Here, we test how well these claims match the feelings that people report
19 while looking at an image or listening to music that is beautiful to them, or recalling a personal
20 experience of beauty. We conducted ten experiments (total $n = 851$) spanning three nations (US,
21 UK, and India). Across nations and modalities, we find that top-rated beauty experiences are
22 strongly characterized by six dimensions: intense pleasure, an impression of universality, the
23 wish to continue the experience, perceived harmony in variety, exceeding expectation, and
24 meaningfulness. Other frequently proposed beauty characteristics — like surprise, desire to
25 understand, and mind wandering — are uncorrelated with feeling beauty. When explicitly asked,
26 participants in all countries report that beauty is closely related to pleasure, found in nature rather
27 than art, influenced by mood, and a form of communication. A remembered beautiful experience
28 was typically active and social, like a family holiday, quite unlike the passive solitary appraisal
29 of art emphasized in aesthetics. Our data align well with Kant ($r = 0.74$) and psychological
30 theories that emphasize pleasure, and reject theories that emphasize information seeking. These
31 six dimensions characterizing how individuals feel beauty emerge from the reports of hundreds
32 of people seeing, hearing, or remembering something beautiful to them.

33

34

Introduction

35 Beauty has fascinated humankind for millennia. Most of the great philosophers tried to
36 define it, including Plato (428–348 BCE; Denham, 2012), Aristotle (384–322 BCE; Halliwell,
37 1986), Kant (1724-1804; Nuzzo, 2005), and Hegel (1770-1831; Nuzzo, 2006). The pioneer of
38 modern psychology, Gustav Fechner (1801—1887), took great interest in empirically testing
39 what beauty is (Fechner, 1876). Yet, in contemporary models of aesthetic experience, beauty has
40 mostly remained as one undefined aesthetic response among many others (e.g., Leder & Nadal,
41 2014; Pelowski, Markey, Forster, Gerger, & Leder, 2017).

42 The philosophical theories of beauty specify the contributions of many experiential
43 dimensions to the *experience* of beauty. Many of these dimensions, including pleasure and
44 surprise, appear in all the philosophical theories, so we can systematically score how well each
45 theory matches contemporary feelings of beauty. In contrast, among contemporary psychological
46 theories of beauty, each theory typically considers only the few dimensions that it supposes to be
47 essential to experiencing beauty. These brief theories are parsimonious in order to predict beauty
48 with just a few predictors that are not strongly correlated with each other. In contrast, the long
49 philosophical theories aim to paint a complete picture of all the variables associated with intense
50 beauty experiences. We here present data that speak to both approaches. To predict beauty
51 ratings, for each participant we collect many ratings of images and music that vary in beauty. To
52 discover correlates of beauty, we collect ratings of individual, remembered, intense beauty
53 experiences. Together, these results reveal six experiential dimensions that characterize intense
54 beauty.

55 Fechner (1876) defined beauty as an experience of pleasure. Berlyne (1971) claimed that
56 beauty pleasure results from intermediate levels of subjective complexity or arousal. Leder and
57 colleagues (2004) place the meaningfulness of an experience at the heart of beauty, while Vessel
58 and colleagues (2013) identify the state of being moved as equivalent to what others call
59 “beauty”. Diessner and colleagues (2018) equate beauty with unity in variety, i.e., a feeling that
60 the various elements of an object are harmoniously combined into a coherent whole. (This is
61 similar to Wittgenstein’s (1934) description of “clicking or fitting” or “harmony” in aesthetic
62 judgement.) A growing new perspective in music science posits that passages of music are most
63 liked, or beautiful, when the pleasure they elicit exceeds the listener’s expectation. (Salimpoor et
64 al., 2015). While these models focus on the relation between beauty and the perceiver’s

65 subjective feelings, others emphasize the relation between beauty and information-seeking,
66 broadly construed as learning, interest, or wanting to understand the experience (see also
67 Biederman & Vessel, 2006). Armstrong and Detweiler-Bedell (2008) proposed that beauty is not
68 only pleasurable but crucially contains an element of learning. Reber and colleagues (2004)
69 suggested that beauty lies in the ease of processing during the experience, i.e., a feeling that the
70 stimulus is understood. Finally, within the realm of music, Kivy (1990) claims that a piece of
71 music needs to be interesting in order to be beautiful. It is, perhaps, due to the variety of
72 proposed dimensions that the contemporary field of empirical aesthetics has yet to test which of
73 these dimensions, alone or in combination, are general characteristics of beauty experiences
74 across various kinds of object. To date, we lack a data-driven definition of what it means to
75 experience beauty.

76 Therefore, we conducted ten studies in which we asked more than 800 participants to rate
77 several dimensions, including beauty, of various experiences. To cast our net widely, we first
78 assessed eleven of the dimensions that have been considered by prominent philosophers of
79 aesthetics: 1) pleasure, 2) wishing to continue the experience, 3) feeling alive, 4) feeling that the
80 experience is beautiful to everyone, 5) number of felt connections to the experience, 6) longing,
81 7) feeling free of desire, 8) mind wandering, 9) surprise, 10) wanting to understand the
82 experience more, 11) feeling that the experience tells a story. Each of the seven included
83 philosophers made statements about each of these dimensions, so we could assess whose
84 definition fit the empirical data best. Second, we also measured people's responses to 8
85 additional dimensions brought forward by psychologists: 1) complexity, 2) arousal or
86 excitement, 3) learning from the experience, 4) wanting to understand, 5) harmony in variety, 6)
87 meaningfulness, 7) exceeding one's expectation, and 8) interest. (Our **Supplementary Material**
88 specifies the exact wording of each question and cites the authorities who inspired it.) In
89 addition, we also asked our participants about their explicit beliefs about beauty at the end of
90 each experiment to probe their endorsement of seven more beauty dimensions.

91 While seeing, hearing, or remembering beauty, our participants rated the beauty and
92 many other dimensions inspired by either philosophy or psychology. In this way, we identify the
93 general characteristics of intense beauty experience across modalities. We here focus on a
94 descriptive approach that allows us to identify experiential dimensions associated with intense

95 beauty. By uncovering which dimensions are consistently correlated with intense beauty, we
96 provide the first data-driven definition of beauty experience.
97

98 **Results**

99 *Variables associated with beauty ratings of images and music.* In our stimulus
 100 experiments, we analyzed responses by 192 participants in the USA. All together, the
 101 participants rated a total of 20 different stimuli: Experiment 1a. 5 beautiful stock-images; 5
 102 beautiful art images; 5 neutral stock-images; Experiment 1b. 5 beautiful stock-images from
 103 Experiment 1a; the top 5 billboard musical hits of all time (details in **Methods**). We used mixed-
 104 effects linear models (Bates, et al., 2015) to assess which aspects of the experience are associated
 105 with the beauty rating. The best model was selected based on the Bayesian Information Criterion
 106 (BIC) calculated on the overall fit as well as average BIC after 10-fold cross-validation. (See
 107 **Supplementary Material** for detailed model comparisons in **Tables S23-26**, and results of all
 108 tested models in **Tables S27-29**.)

109 Beauty increased primarily with: perceived universality (0.23 points per point), pleasure
 110 (0.21 points per point), and a reported wish to continue the experience (0.20 points per point).
 111 Beauty was not related to surprise or the degree to which the participant felt that the stimulus
 112 told a story. Of note, the type of stimulus (music, image, or specific image kind) did not
 113 modulate these effects. Overall, this model explains 72% of the variance. **Table 1** presents the
 114 statistics of the fit. For illustration, **Figure 1A** contrasts the rating profile for stimuli rated
 115 highest (7) in beauty vs. that for those rated lower (< 7).

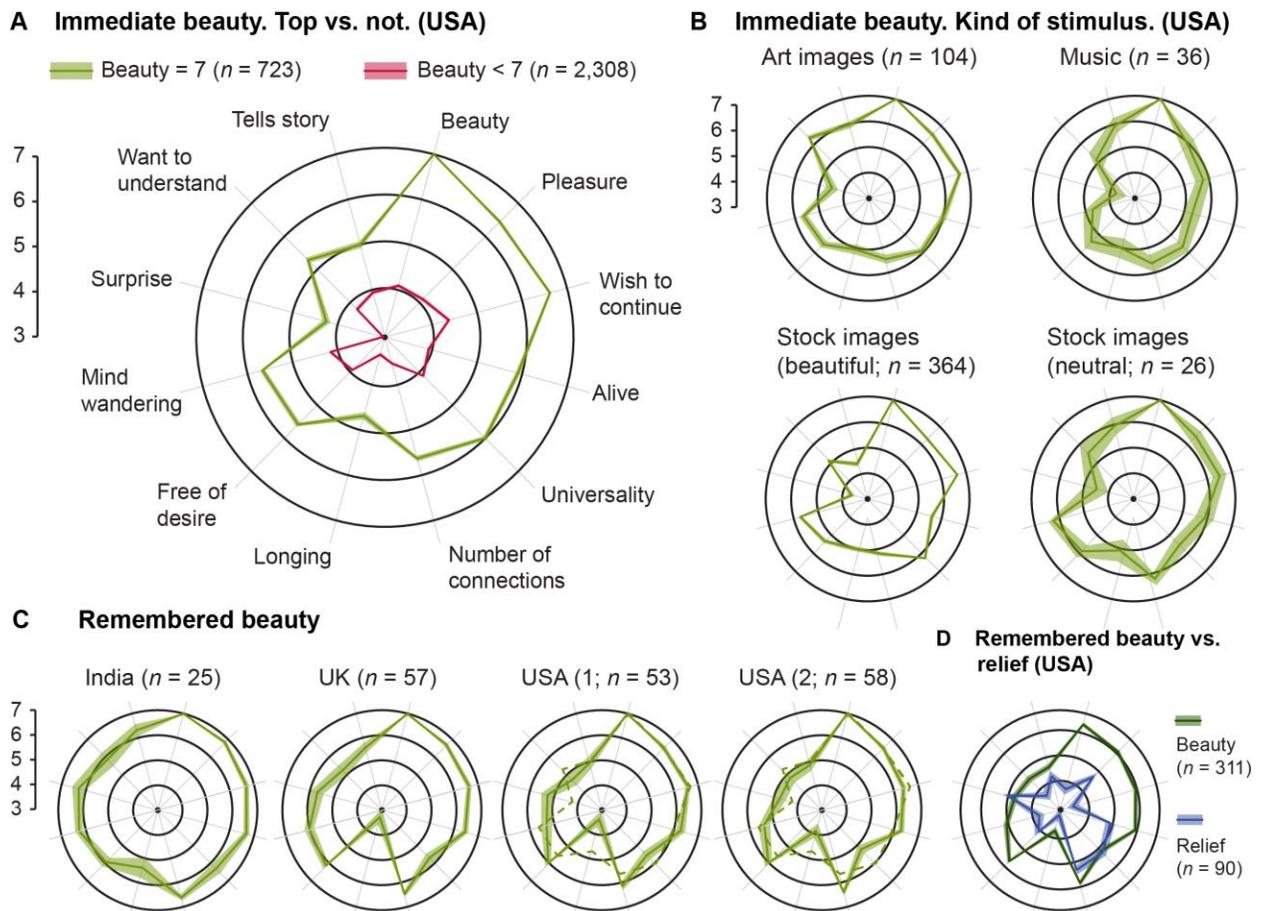
116
 117 **Table 1. The mixed-effects model that best explains rated beauty of images and music.**

RANDOM EFFECTS					
	Variance	SD			
Participant	0.07	0.26			
Stimulus	0.13	0.37			
FIXED EFFECTS					
	Estimate	SE	df	t	p
Intercept	0.34	0.12	65	2.93	0.005
1. Universality	0.23	0.02	2212	12.23	<0.001
2. Pleasure	0.21	0.02	2584	11.04	<0.001
3. Wish to continue	0.20	0.02	2622	11.27	<0.001
4. Feeling alive	0.08	0.02	2645	4.30	<0.001
5. Feeling free of desire	0.07	0.02	2444	4.25	<0.001
6. Number of felt connections	0.06	0.02	2393	3.81	<0.001
7. Mind wandering	0.05	0.02	2440	3.42	0.001
8. Wanting to understand more¹	0.04	0.02	2567	2.76	0.006
9. Longing¹	0.04	0.02	2134	2.38	0.017
10. Telling a story	-0.01	0.01	2393	-0.73	0.466
11. Surprise	-0.02	0.01	1882	-1.13	0.260

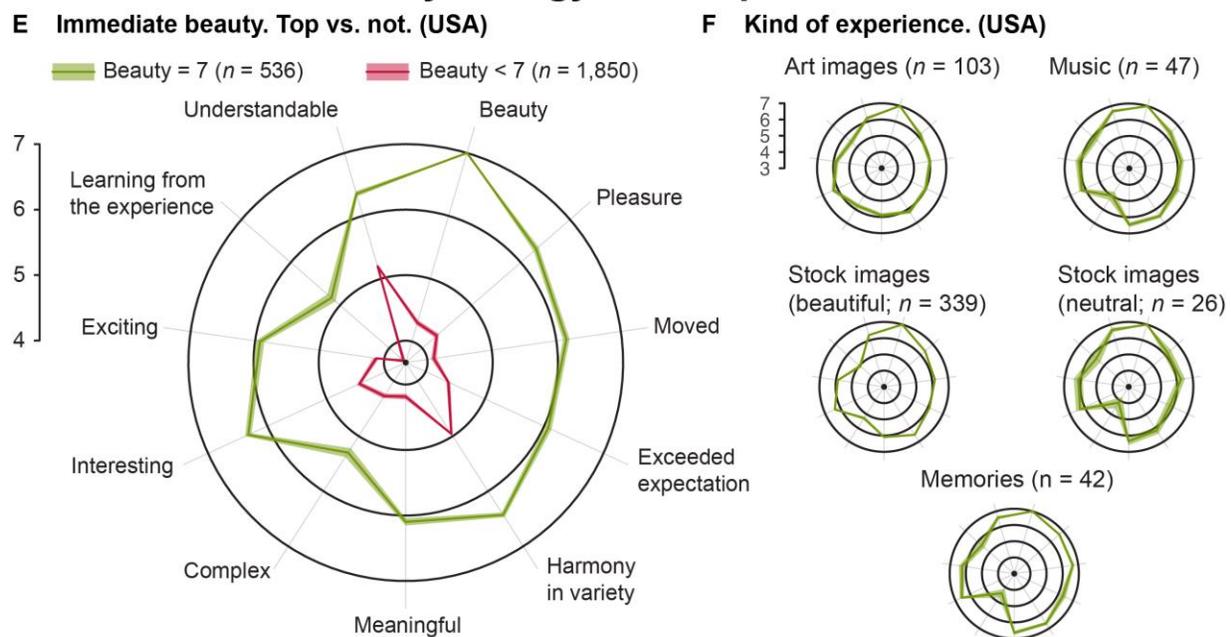
118 *Notes.* Significant fixed effects are highlighted in bold. The model explains 72% of the variance
 119 in beauty ratings (on a scale of 1 to 7) with an RMSE of 0.96. ¹The marked dimensions did not

120 receive consistently high ratings for remembered beauty, which is evidence against universality
 121 of their contribution to experienced beauty.
 122

Philosophy-based questions



Psychology-based questions



123
 124 *Figure 1.* Average ratings for beauty experiences for all experiments. A) In USA, polar plot of
 125 average ratings on 12 philosophy-derived dimensions (12D) across all top-rated (green) vs. less-
 126 than-top-rated (red) *immediate*-beauty trials (i.e. they consider their immediate experience). B) In
 127 USA, average 12D ratings for top-rated *immediate*-beauty trials, separately for each stimulus type.
 128 C) Average 12D ratings on top-rated *remembered*-beauty trials (i.e. they consider their own
 129 remembered experience), separately for each independent population sample: India, UK, and two
 130 in USA. For reference, the dashed green lines represent the averages for the top-beauty-rated trials,
 131 copied from panel A. D) In USA, average ratings for all *remembered-beauty* (dark green) vs.
 132 *remembered-relief* (blue) trials. Not pictured: ratings on the two dimensions perfection and
 133 peacefulness that were not included in all studies; both peacefulness and perfection ratings were
 134 higher for beauty compared to relief ratings. E) In USA, polar plot of average ratings on 11
 135 psychology-derived dimensions (11D) across all top-rated (green) vs. less-than-top-rated (red)

136 *immediate*-beauty trials. F) Average 11D ratings on top-rated immediate and remembered (bottom-
 137 most) trials. Shaded areas in all polar plots indicate $\pm SEM$ (not visible due to small *SEM* in some
 138 panels).

139
 140 *Variables correlated with remembered beauty.* One might wonder whether a beauty
 141 experience produced in an online-test session by a previously high-rated image or popular music
 142 is likely to be strong enough to be comparable with the intense beauty experiences that
 143 philosophers wrote about. We imagine that a philosopher describing the feeling of beauty would
 144 naturally emphasize his recollection of his own most intense beauty experience. In that spirit, we
 145 asked participants in our second set of studies (Experiment 2a $n = 92$; replication Experiment 2b
 146 $n = 89$; both US American) to describe and rate a remembered intense beauty experience from
 147 their own lives. Since we intentionally collected data only for memories of intense beauty, we
 148 did not use linear models to explain beauty ratings as in Experiment 1, which would be
 149 underpowered due to the small variability in beauty ratings. Instead, we compared the ratings
 150 based on top-rated remembered- vs. immediate-beauty trials ($n = 111$ vs. 530). We here report
 151 comparisons of the five dimensions correlated with beauty in Experiment 1. Comparisons
 152 between ratings on the dimensions not correlated with intense beauty can be found in the
 153 **Supplementary Material.**

154 According to Kolmogorov-Smirnov tests, ratings of pleasure, wishing to continue the
 155 experience, and mind wandering were not differently distributed for immediate- vs. remembered-
 156 beauty trials, both $p \geq 0.448$. Yet, participants rated remembered-beauty higher in terms of
 157 feeling alive, feeling free of desire, and the number of felt connections, all $0.41 \leq d \leq 0.63$. In
 158 contrast, they rated remembered beautiful experiences as less universally beautiful, wanted to
 159 understand them more to a lesser extent, and reported less longing compared to immediate
 160 beauty experiences, all $0.32 \leq d \leq 0.68$. Nonetheless, ratings on all seven of the nine dimensions
 161 correlated with beauty ratings in Experiments 1a and 1b were also high for remembered beauty,
 162 all means ≥ 5.43 on a 1-7 scale. The exceptions were ratings of wanting to understand the
 163 experience more and feeling alive, both means $\leq .76$, rendering these dimensions less likely to be
 164 essential constituents of beauty experiences. This is unsurprising given the weak association with
 165 beauty revealed by the general linear model.

166 **Figures 1A vs. C** illustrate the similarity of average ratings in Experiments 1 vs. 2:
 167 immediate vs. remembered beauty. (To facilitate this comparison, the top-beauty data from
 168 **Fig. 1A** appear as dashed lines in the USA panels of **Fig. 1C**.)

169 *Conservation across cultures.* In our third set of studies, we asked how well our previous
 170 findings generalize across countries and cultures. We therefore compared the beauty memory
 171 ratings from our initial US samples to those from the UK ($n = 78$) and India ($n = 52$). (Our
 172 questionnaire is in English, so we confined ourselves to English-speaking countries.) There were
 173 differences in the average rating pattern between countries, $F(2,304) = 3.50, p < 0.001$. Because
 174 average beauty ratings differed, too, we restricted the comparison between countries to top-rated
 175 remembered-beauty trials ($n = 25$ for India; $n = 56$ for UK; $n = 111$ for USA). Of the seven
 176 dimensions consistently associated with high beauty ratings, only two differed across countries.
 177 The impression of universality was higher in India, $M = 6.36$, than in the USA, $M = 5.43$,
 178 $p = 0.018, d = 0.62$, and reported mind wandering was lower in the USA, $M = 5.37$, than the UK,
 179 $M = 6.05$, and India, $M = 6.32$, both $p \leq 0.024$, both $d \geq 0.41$. Notably, longing ratings were
 180 much higher in India, $M = 5.44$, than any other country, both $M \leq 3.67$, both $p \leq 0.001$,
 181 potentially suggesting a greater import of this dimension in India than other English-speaking
 182 countries. In sum, the general pattern of ratings correlated with beauty was nearly identical
 183 across cultures.

184 *Uniqueness of the beauty-rating profile: a comparison to relief.* So far, we have
 185 described the characteristics of a beauty experience, but we have not addressed which of these
 186 characteristics might distinguish beauty from other positive experiences. To do so, we asked an
 187 independent sample of US Americans ($n = 90$) to recall and then describe and rate a personal
 188 experience of intense relief. We compare beauty to relief, here, because it is a strongly positive
 189 emotion, the memory of which is not usually also deemed beautiful (in contrast to, e.g., joy, see
 190 **Supplementary Material**). The ratings for remembered relief are very different from those for
 191 remembered beauty (see **Figure 1D**), $F(1,395) = 0.53, p < 0.001$. Follow-up t-tests indicate that
 192 the two concepts do not differ in perceived universality, $p = 0.381$, or surprise, $p = 0.471$.
 193 However, remembered relief received lower ratings on all 12 remaining dimensions, all
 194 $p \leq 0.001$, all $d \geq 0.39$. Thus, among the dimensions correlated with intense beauty, all but one
 195 — universality — are *uniquely* correlated with beauty, not just any positive memory.

196 *Comparison between responses and philosophers' theories.* Of the seven philosophers
 197 considered here, Kant has the most matches to the data: 10 out of 11 assessed dimensions. (See
 198 **Supplementary Table S30** for correlations between data and all 7 included philosophers.)
 199 Kant's theory also states our participants' belief that beauty is found in nature rather than art and

200 that both the object as well as its story contribute to beauty. Yet, contrary to Kant's theory,
201 higher surprise is not associated with more intense beauty. However, as we will show below,
202 there is a kind of surprise, i.e., the surprise of something exceeding one's expectation, that is
203 indeed linked to beauty.

204 *Comparison between responses and psychological theories.* Our first series of studies
205 focused on questions based on philosophical theories of beauty because they all make statements
206 regarding a wide range of characteristics. However, we also wanted to assess how well modern
207 psychological theories of beauty reflect people's beauty experiences. We therefore ran modified
208 versions of Experiments 1a, 1b, and 2b with questions gleaned from psychological theories about
209 beauty (see **Table 2** for a complete list).

210 We again assessed which of the 11 tested dimensions were associated with beauty ratings
211 using mixed-effects linear models for data of those participants who rated images and/or music
212 (total $N = 186$). As in Experiment 1, we tested several models. Again, we created two sets of
213 models: In one set, complexity and excitement were added as linear terms, like the other
214 dimensions. In the other set – based on Berlyne's claims (1971) – they were added as squared
215 terms. According to the average BIC based on 10-fold cross-validation, a model that includes an
216 interaction with stimulus modality explains beauty ratings best, explaining 70% of the variance
217 (see **Supplementary Tables S31-32** for detailed model comparisons). For all stimuli, beauty
218 increases with pleasure (0.28 points per pleasure point for images, 0.07 for music), feeling
219 moved (0.18 beauty points per point), perceived harmony among variety (0.11 beauty-points per
220 point), feeling that the experience exceeded expectation (0.11 points), and meaningfulness (0.08
221 points for images, 0.21 points for music). In addition, beauty ratings were inversely correlated
222 with squared complexity ratings. Of note, interest was correlated with beauty ratings for images,
223 but not for music. The detailed parameters of the model are listed in **Table 2**.

224 Next, we again compared ratings on all dimensions for immediate experiences to those
225 for the remembered beauty experiences of an independent sample ($N = 72$). Ratings of pleasure,
226 feeling that the experience exceeded expectation, and harmony in variety did not differ between
227 stimulus- and memory-related beauty experiences with top (7) ratings, all $p \geq 0.265$. Memories
228 were, however, rated slightly more moving, meaningful, and relatively less complex, all
229 $p \leq 0.040$. Of note, all these differences were small, all $|d| \leq 0.45$, and all means were in the
230 range expected based on the linear model (see **Table 2**). Thus, as was the case for the dimensions

231 collected from philosophical theories, the psychology-theory related characteristics of beautiful
 232 experiences did not differ much between modalities.

233
 234 **Table 2. The mixed-effects model that best explains rated beauty of images and music based**
 235 **on questions from psychological theories.**

RANDOM EFFECTS					
	Variance	SD			
Participant	0.06	0.25			
Stimulus	0.05	0.21			
FIXED EFFECTS					
	Estimate	SE	df	t	p
(Intercept)	0.55	0.13	287	4.09	<0.001
Music	-0.49	0.27	312	-1.86	0.063
Pleasure	0.28	0.02	2221	12.00	<0.001
Moved	0.18	0.02	2229	8.09	<0.001
Exceeded expectation	0.11	0.02	2148	5.05	<0.001
Harmony in variety	0.11	0.02	2219	5.44	<0.001
Meaningful	0.08	0.02	2227	3.34	0.001
Complex (squared)	-0.02	0.01	2192	-2.58	0.010
Interesting	0.17	0.02	2225	7.61	<0.001
Exciting (squared)	-0.01	0.01	2215	-0.81	0.418
Learning from the experience	-0.02	0.02	1482	-1.13	0.257
Understandable	0.03	0.02	2144	1.53	0.127
Music × pleasure	-0.21	0.06	2204	-3.64	<0.001
Music × moved	-0.03	0.06	2222	-0.57	0.568
Music × exceeded expectation	-0.02	0.05	2212	-0.47	0.638
Music × harmony in variety	-0.07	0.05	2236	-1.37	0.170
Music × meaningful	0.14	0.05	2228	2.52	0.012
Music × complex (squared)	0.01	0.02	2226	0.29	0.773
Music × interesting	-0.15	0.06	2227	-2.76	0.006
Music × exciting (squared)	0.00	0.02	2223	0.07	0.941
Music × learning from the experience	0.29	0.04	2217	6.53	<0.001
Music × understandable	0.08	0.05	2230	1.59	0.113

236 *Notes.* Significant fixed effects are highlighted in bold. The model explained 70 % of the
 237 variance in beauty ratings (on scale of 1 to 7) with an RMSE of 0.94.

238

239 *Comparison between responses and psychologists' definitions.* The ratings for images,
 240 music, and memories reveal a link to beauty for seven out of the eleven here-considered
 241 characteristics that psychologists claim are linked to beauty. In all of our surveys, intense beauty
 242 was associated with intense pleasure, as claimed by Fechner (1876), the first psychologist to do
 243 so. A strong link between beauty and being moved was also evident, as reported by Vessel and
 244 colleagues (2013). The notion that a positive prediction error contributes to beauty (Salimpoor, et
 245 al., 2015) was also confirmed. Harmony in variety, the central beauty criterion in Diessner and
 246 colleague's (2018) theory was associated with beauty, too, and so was meaningfulness (see
 247 Leder et al., 2004). We found mixed results regarding Berlyne's (1971) claims. While our results
 248 indeed suggest an inverted-u-shaped relation between subjective complexity and beauty, where

249 medium complexity levels are associated with most intense beauty, we did not find such a
 250 relationship between beauty and arousal (assessed as excitement). Our music results reject
 251 Kivy's (1990) claim that musical beauty is linked to interest.

252 Information-seeking — i.e. learning, interest, and wanting to understand the experience—
 253 was not systematically linked to beauty in our studies, contrary to previous claims (Biederman &
 254 Vessel, 2006). Our results reject Reber and colleague's (2004) claim that ease of processing—
 255 i.e., understanding—of the experience is tied to its beauty. The other cognitive dimension we
 256 included, learning, was also not associated with beauty, contrary to claims by Armstrong and
 257 Detweiler-Bedell's (2008). Taken together, these negative findings indicate that information-
 258 seeking is not important for experiencing beauty.

259 *Meaningful.* In his essay “The abuse of beauty”, the philosopher and art critic Arthur
 260 Danto (2002) notes that until World War I and the dada movement, it was generally accepted
 261 that beauty was central to the definition of art. Danto notes that the dada and the subsequent
 262 postmodern movements “disconnect[ed] beauty from art”. Art today is much more general than
 263 just beauty. Danto says that beauty is merely one of many attributes that art can have and that the
 264 only necessary one is meaning. However, Danto's strict dichotomy between beauty and meaning
 265 is undermined by finding that beauty is associated with meaningfulness in our participants'
 266 reports.

267 *Text analyses.* To achieve a characterization of beauty experiences independent of our
 268 rating scales, we analyzed the beauty memory descriptions that our participants wrote down
 269 before rating them (available with all data at https://github.com/aenneb/characterizing_beauty).
 270 **Table 3** lists the top ten most frequently used words (excluding stop-words) for each experiment
 271 (extracted using NLTK; Loper, & Bird, 2002). Going beyond the count of word frequencies, we
 272 used the *empath client* (Bates, Maechler, Bolker, & Walker, 2015) to analyze which lexical
 273 categories are most represented in our beauty descriptions compared to a standard text corpus.
 274 We find that the top ten lexical categories in the beauty memory descriptions were, in order:
 275 beauty, attractive, feminine, weather, children, love, beach, vacation, positive emotion, and
 276 party. These stand in stark contrast to most of the top themes emerging in relief memories, i.e.,
 277 negative emotion, contentment, joy, traveling, party, family, driving, home, listen, pain. Thus,
 278 the remembered experiences were typically active and social, like a family holiday, unlike the
 279 passive solitary appraisal of art emphasized in aesthetics.

280 The **Supplementary Material** contains detailed text analyses for each experiment.
 281 Writings in aesthetics emphasize passive solitary appraisal of art, but the beautiful experience
 282 recalled by our participants was more typically active and social, like a family holiday.

283

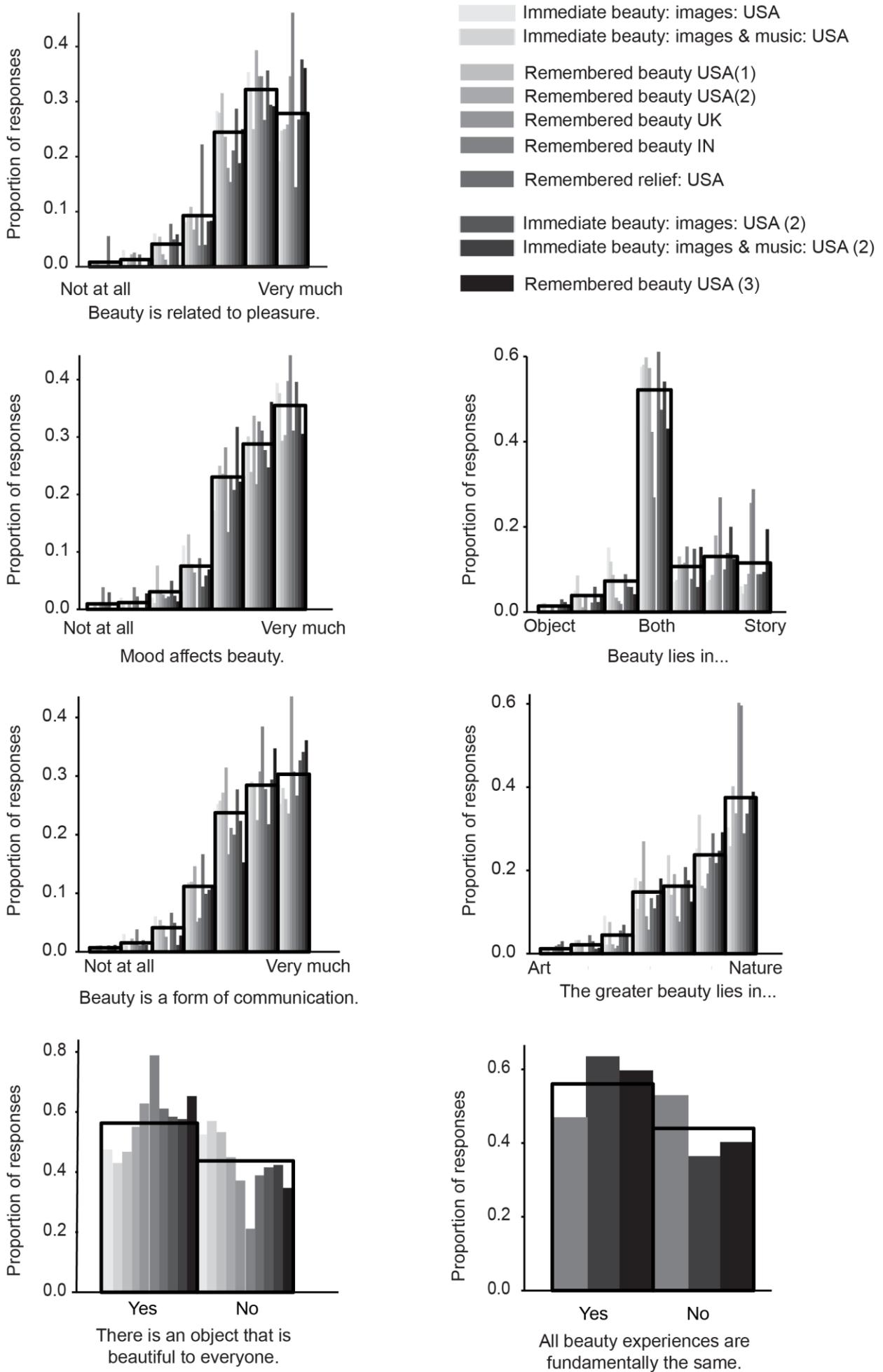
284 **Table 3. Top-ten most frequently appearing words across beauty memory descriptions per**
 285 **experiment**

Frequency rank	Exp 2a (USA)	Exp 2b (USA)	Exp 3a (UK)	Exp 3b (India)	Exp6 (USA)	All
1	Beautiful	Beautiful	Day	Beautiful	Beautiful	Beautiful
2	Experience	Beauty	Beautiful	Felt	Time	Day
3	Could	Felt	Time	Feel	Day	Time
4	Like	Time	Could	Day	Beauty	Beauty
5	Beauty	Day	Like	Beauty	Remember	Like
6	See	Like	See	Time	One	Felt
7	One	Went	Felt	Like	See	One
8	Time	Nature	Smell	Experience	Went	See
9	Went	One	Beauty	Life	Mountains	Went
10	Remember	First	Sun	Place	Feel	Could

286 *Notes.* Counts for each word per experiment are provided in the Supplementary Material.
 287

288 *People's explicit beliefs about beauty.* Participants in all experiments answered the same
 289 six questions about their general beliefs about beauty at the end of the experiment (total
 290 $n = 851$). As illustrated in **Figure 2**, participants in all countries did endorse the statement that
 291 pleasure and beauty are closely related, that sharing beauty is a form of communication, and that
 292 mood influences beauty, $Md = 6$ each on a 1 (not at all) to 7 (very much) scale. They also
 293 perceived beauty to lie in nature more than in art, $Md = 6$ on a 1 (art) to 7 (nature) scale, and both
 294 within the object itself as well as in the story it tells, $Md = 4$. The only question that divided
 295 people was whether a universally beautiful object exists: About half of our participants (56.29%)
 296 agreed, the remainder did not. We asked those participants to tell us of such an object. Their
 297 answers fell into a few categories. The great majority (78% of 479) named an element of nature,
 298 mostly flowers (22%), the sky, sun, or related phenomena (22%). Of the much rarer non-nature-
 299 related answers, the most common ones referred to valuable objects (6%), mostly diamonds, or
 300 artworks (broadly construed: 6%). Participants who answered questions based on psychological
 301 theories ($N = 258$) were also asked whether all beauty experiences are fundamentally the same,
 302 since this statement is the central claim emerging from a series of fMRI studies (Ishizu & Zeki,
 303 2011). About half of these participants agreed with the statement (56%). This answer was
 304 somewhat related to people's belief in a universally beautiful object. 64% of participants who
 305 said there is a universally beautiful object also said that all beauty experiences are the same,

306 whereas only 44% of those who did not believe in a universally beautiful object said that all
 307 beauty experiences are the same.
 308



309

310 Figure 2. Histograms of ratings in response to the seven questions on participants' general
 311 beliefs about beauty posed at the end of each experiment. Each solid bar indicates the

312 proportion per experiment, differentiated by shades of gray. Immediate beauty USA (2) and
313 remembered beauty USA (3) refers to the people who rated psychology-based questions. Open
314 bars indicate the overall distribution of ratings across all experiments.
315

316 *Implications for the science of beauty.* Our results provide an empirical characterization
317 of the beauty experience. They will inform current theories of aesthetic appreciation (e.g., Leder
318 & Nadal, 2014; Pelowski et al., 2017) and provide a first broad test of philosophy- and
319 psychology-based theories of beauty. Our findings complement previous efforts that contrasted
320 people's theoretical conceptions of beauty to other aesthetic evaluations (Menninghaus, Wagner,
321 Kegel, Knoop, & Schlotz, 2019; see **Supplementary Material** for a quantitative comparison
322 between their and our data).

323 Our findings are in line with the notion that beauty is a positive emotion, i.e., strongly
324 correlated with pleasure (Armstrong & Detweiler-Bedell, 2008; Fechner, 1876) and being moved
325 (Vessel et al., 2013). We did not find a correlation between intense beauty and information-
326 seeking here, i.e., wanting to understand the experience, learning, or interest, despite the
327 prevalence of these notions in several psychological theories (Armstrong & Detweiler-Bedell,
328 2008; Kivy, 1990; Reber, Schwarz, & Winkielman, 2004). We did, however, find that several
329 other features mentioned in contemporary literature were indeed correlated with beauty, such as
330 the feeling that the experience exceeded expectation (Salimpoor et al., 2015), harmoniously
331 combined various elements (Diessner et al., 2018), and meaningfulness (Leder et al., 2004).

332 The descriptions of beautiful memories our participants provided as well as their explicit
333 beliefs about beauty call the focus on art in models of aesthetic appreciation into question.
334 Participants endorsed the statement that beauty lies in nature, rather than art, and a typical
335 memory of an intense beauty experience was a family vacation on the beach or the mountains,
336 rather than a museum visit. In addition, most people who did believe in a universally beautiful
337 object thought it to be an element of nature, like flowers or the sky, and only a small minority
338 named artworks of any kind. Thus, research on aesthetic appreciation that wants to claim
339 relevance for everyday beauty experiences should include such social and nature-related
340 experiences.

341 Our current study documents what feelings are correlated with beauty. This list of beauty-
342 associated characteristics offers a basis for developing a predictive model. The development of a
343 model that can predict the beauty intensity of a given experience with as few predictors as
344 possible would be a big step in explaining beauty.

345 *Conclusion.* The experience of beauty is characterized by: intense pleasure, an impression
346 of universality, wanting to continue the experience, perceived harmony in variety, exceeded
347 expectation, and meaningfulness. This holds true for images, music, and memories across three
348 culturally-diverse English-speaking countries. The remembered experiences were typically
349 active and social, like a family holiday, unlike the passive solitary appraisal of art emphasized in
350 aesthetics. Among seven renowned philosophers of aesthetics, Kant's definition best matches the
351 results of our survey of the feeling of beauty. Our results are in line with several psychological
352 theories of beauty but not with those that emphasize information seeking. This broad new
353 characterization of the feeling of beauty comes from the answers of 851 people to questions
354 about their top-rated beauty experiences, both immediate and recalled.
355

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357 first manuscript draft, and created figures and tables. AN, as a philosopher, prepared the rating
358 questions and estimated how the philosophers (except Danto) would have responded. DGP co-
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369
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371
372 **Contact.** Further information and requests for resources and reagents should be directed to and
373 will be fulfilled by the Lead Contact, Aenne Brielmann (aenne.brielmann@nyu.edu).

374
375 **Data and software availability.** All data and main analyses files for this article are accessible on
376 GitHub: https://github.com/aenneb/characterizing_beauty.

377

378

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433

Methods

434 For each experiment, we recruited 100 or more participants via Amazon mechanical Turk
435 (mTurk). Inclusion criteria were: mTurk workers with an approval rate of at least 90%, who have
436 completed at least 50 HITs, and reside in the country targeted in the particular experiment. All
437 participants consented to participate according to a consent form approved by the NYU UCAIHS
438 (university committee on activities involving human subjects; IRB-FY2016-404) by checking a
439 box in the online form. Participants were reimbursed \$15 per hour; the payment depended on the
440 duration of the experiment. All data were collected between April 2019 and May 2020.

441

442 **General methods.**

443 *Procedures.* Participants rated images (Experiment 1a), images and music (Experiment 1b)
444 or memories (Experiment 2-4) on the same 12 dimensions: beauty, pleasure, surprise, wanting to
445 experience the stimulus longer, feeling free of desire, feeling alive, wanting to understand the
446 experience more, mind wandering, number of connections felt with the experience, how far the
447 experience tells a story, how far the experience is beautiful (or relief in Experiment 4) for everyone,
448 and longing. Participants in Experiments 2-4 rated experiences on a further 2 dimensions. In
449 Experiment 2b, an additional set of four questions was added as well as a question about whether
450 they had the experience alone. All questions are listed in the **Supplementary Material**. All ratings
451 were given on a scale from scale from "not at all" (1) to "very much" (7), except for the scale
452 asking about the number of connections with the experience ("None" (1) to "Many" (7)). At the
453 end of each experiment, participants also answered six questions about their general beliefs about
454 beauty, their age and gender. Participants in Experiments 1a and 2b also provided additional
455 demographic information. These additional questions were removed from other experiments
456 because none of these additional variables correlated with the ratings.

457 *Analyses.* After initial inspection, data was analyzed with R version 3.5.3 or higher, python
458 version 3.6.8 or higher, and MATLAB version R2018b.

459

460 **Experiment 1a: Rating images of varying beauty.**

461 *Participants.* Of the 100 recruited participants, 99 completed the survey. Of these, 66
462 were male, 31 female, and 2 did not disclose their gender. Their ages ranged from 20 to 72 with a
463 mean age of 34.8 ($SD = 9.9$). Most had earned a college degree ($n = 50$), or at least some college

464 education ($n = 24$). The remaining participants either had a high school ($n = 17$) or graduate
465 degree ($n = 8$). Most participants had neither any formal art ($n = 83$) nor any philosophy
466 education ($n = 87$). Few attended some art ($n = 13$), or philosophy courses ($n = 11$). Only three
467 participants had a degree in art or art history, and only one had a degree in philosophy. Most
468 participants' household income ranged between \$50,000 and \$70,000 ($n = 42$), with 17 falling
469 below that range, and 40 above. Most ($n = 73$) participants were white, seven identified as
470 American Indian and multiracial each, five identified as black and Hispanic each, and one
471 identified as South Asian and other each. On average, participants identified as more liberal than
472 conservative on a 1 (very liberal) to 8 (very conservative) scale, $M = 3.3$, $SD = 1.9$.

473 *Stimuli.* We selected the five most beautiful image from the open affective standardized
474 image set (OASIS; Kurd, Lozano, & Banaji, 2017) based on a previous study conducted by our
475 lab (Briemann & Pelli, 2019), as well as three images with median beauty ratings. The OASIS
476 consists of a diverse set of stock images. We will therefore refer to these stimuli as *beautiful*
477 *stock-images (B)* and *neutral stock-images (N)*, respectively. In addition, we selected the five
478 most beautiful art images of a diverse set of paintings previously used by Belfi and colleagues
479 (2019). We will refer to these images as *beautiful art-images*.

480 *Procedures.* On each trial, participants saw one image with a rating scale below it. The
481 image and rating scale were displayed until the participant did the rating and clicked the "next"
482 button. Thus, each trial got one rating for one stimulus. Four beautiful art- and stock-images and
483 two neutral stock-images were rated on each of 12 dimensions. One image of each category was
484 rated twice on each dimension, the remaining stimuli were rated once. The order of images and
485 ratings was randomized for each participant.

486 *Analyses.* For all analyses involving demographics, we binarized the art and philosophy
487 education demographic into "has" (either some courses or degree) vs. "has not". We fit linear
488 mixed-effects models with the R package *lme4* (Bates, Maechler, Bolker, & Walker, 2015) and
489 obtained further statistics with the *lmerTest* (Kuznetsova, Brockhoff, & Christensen, 2017) and
490 *MuMIn* packages (Bartón, 2019). The linear models predicted beauty ratings. We successively
491 evaluated linear mixed-effects models, starting with the simplest (only including random effects
492 of either stimulus or participant), then adding fixed effects of all remaining eleven ratings, and
493 lastly exploring the interaction of demographic variables with the linear combination of the
494 eleven ratings. We used the built-in ANOVA comparison of models to find the best fitting model

495 considering the number of parameters. Differences between continuous variables were tested
496 with two-tailed t-tests, those between ordinal variables with Wilcoxon-rank-sum tests and those
497 between proportions with the built-in *prop.test* function in R. We used MATLAB R2018b to run
498 cluster analyses.

499

500 **Experiment 1b: Rating beautiful images and music**

501 *Participants.* Of the 100 recruited participants, 99 completed the survey. We excluded an
502 additional six participants due to $\geq 5\%$ wrong responses on the question asking about the
503 stimulus type (see **Procedures** below). We thus analyzed data from 93 participants. Of these, 51
504 were male, and 42 female. Their ages ranged from 18 to 64 with a mean age of 36.8 ($SD = 10.8$).

505 *Stimuli.* Participants saw the same five most beautiful images from the OASIS (Kurdi
506 Lozano, & Banaji, 2017) as used in Experiment 1a. In addition, they listened to the “greatest-hot-
507 100-singles of all time” according to the music billboard charts
508 (<https://www.billboard.com/charts/greatest-hot-100-singles>). Both images and music were
509 chosen so as to maximize the beauty rating.

510 *Procedures.* The procedures were identical to Experiment 1a except for the changes
511 necessary to ensure that participants listened to the music. To do so, the main experiment was
512 preceded by explicit instructions to turn on speakers or headphones and a sound check question.
513 In 50% of the trials in this experiment, one of the five songs started to play from the start. After
514 each trial, we asked participants whether they saw an image or listened to a song with an
515 additional open-ended “other” option. Trials in which “other” was selected were excluded from
516 the analyses.

517 *Analyses.* We used the same linear mixed model analyses as in Experiment 1a.

518

519 **Experiment 2a: Rating remembered beauty**

520 *Participants.* Of the 100 recruited participants, 99 completed the survey. Based on the
521 written memory descriptions provided, we excluded seven participants (4 men, 3 women) due to
522 apparent non-compliance. Of the remaining 92 participants, 71 were male, 21 female. Their ages
523 ranged from 19 to 70 with a mean of 34.3 years ($SD = 10.2$).

524 *Procedures.* We told participants to “Please think back to an experience during which
525 you felt intense beauty. Picture the experience. Remember as many details as you can: what you

526 saw, heard, smelled, and felt. Let the memory linger for a minute.” A timer counted down one
527 minute in 10-second intervals. Participants were only able to continue the survey after a
528 minimum of one minute had elapsed. Next, we asked them to provide a written description of
529 their experience. On the next page, we asked them how long ago the experience had occurred,
530 and let them rate the experience on the 12 dimensions listed in **General Methods** plus two
531 dimensions that we added based on further discussion of the results of Experiment 1, namely
532 perfection and peacefulness.

533 *Analyses.* We compared ratings for top-rated immediate- and remembered-beauty trials
534 (i.e., trials with beauty ratings = 7). For the data of Experiment 1, this means that we included 1
535 to 18 trials of 71 participants, a total of 356 trials. Fifty-three of the 90 participants in
536 Experiment 2 were included. We used the python package *NLTK* (Loper & Bird, 2002) and
537 *empath-client* (<https://github.com/Ejhfast/empath-client>; Fast, Chen, & Bernstein, 2016) to
538 analyze written memory descriptions.

539

540 **Experiment 2b: replication and extension of Experiment 2a**

541 *Participants.* One hundred and one participants completed the survey. Based on the
542 written memory descriptions provided, we excluded 12 participants due to apparent non-
543 compliance. Of the remaining 89 participants, 57 were male, 32 female. Their ages ranged from
544 19 to 64 with a mean of 34.9 years ($SD = 11.0$). Similar to our first experiment, we collected
545 more extensive demographic information regarding education as well as religion, which is
546 available in the **Supplementary Material**.

547 *Procedures & analyses.* The main procedures and analyses were identical to Experiment
548 2a with two exceptions.

549 One, we added a perceptual task to assess response biases. Participants were shown two
550 gray circles for one second and asked to rate which one was bigger and by how much.
551 Importantly, the latter rating was given on the same scale from “Not at all” (1) to “Very much”
552 (7) scale than all other ratings. The right circle’s diameter was 90% of the left circle’s. With this
553 rating, we assessed potential response biases by correlating the circle-size comparison rating
554 with ratings on all other dimensions using Pearson’s correlations.

555 Two, we included six new questions after reviewing the data from Experiments 3-6: 1)
556 “Did this experience give you a new perspective on other experiences?”, 2) “How strong do you

557 think this experience would be if you had it again?”, 3) “Would sharing this experience with
558 friends make it better?”, 4) “Did this experience give you a new perspective on yourself?”, 5)
559 “Were you alone when you had this experience?”, 6a) if “yes” to 5: “Did you wish you could
560 share this experience with others?”, 6b) if “no” to 6: “Did the experience make you feel more
561 connected with the people you were with?”.

562

563 **Experiment 3a: Remembered beauty in the UK**

564 *Participants.* We initially aimed to recruit 100 participants from the UK via amazon
565 mechanical Turk. Of the 100 recruited participants, 99 completed the survey. Based on the
566 written memory descriptions provided, we excluded 21 participants due to apparent non-
567 compliance. Of the remaining 78 participants, 51 were male, 27 female. Their ages ranged from
568 19 to 70 with a mean of 34.3 years ($SD = 10.2$).

569 *Procedures & analyses.* All procedures and analyses were identical to Experiment 2a.

570

571 **Experiment 3b: Remembered beauty in India**

572 *Participants.* Even though we requested only 150 participants, 154 completed the survey.
573 completed the survey. Based on the written memory descriptions provided, we excluded 102
574 participants due to apparent non-compliance: including several duplicate answers, copy-pasted
575 responses unrelated to the task at hand, and one-word beauty memory descriptions. Of the
576 remaining 52 participants, 43 were male, 9 female. Their ages ranged from 22 to 40 with a mean
577 of 27.9 years ($SD = 4.4$).

578 *Procedures & analyses.* The main procedures and analyses were identical to Experiment
579 2b. The exception was that we decreased the size of the smaller circle for the perceptual task to
580 80% the diameter of the larger one.

581

582 **Experiment 4: Remembered relief (USA)**

583 *Participants.* We recruited 100 participants from the USA via amazon mechanical Turk.
584 All completed the survey. Based on the written memory descriptions provided, we excluded 10
585 participants due to apparent non-compliance. Of the remaining 90 participants, 57 were male, 33
586 female. Their ages ranged from 20 to 69 with a mean of 35.8 years ($SD = 12.1$).

587 *Procedures & analyses.* All procedures and analyses were identical to Experiment 2a. To
588 compare 14D ratings of remembered beauty and relief, we first tested whether an overall
589 difference exists with a MANOVA, followed up with separate two-sided t-tests for each rating.
590

591 **Experiments 5-6: Rating stimuli on dimensions derived from psychology literature**

592 After establishing which dimensions considered by philosophers were correlated with
593 people's beauty experiences, we turned to contemporary theories of beauty to test which of their
594 suggested features correlate with beauty. To do so, we replicated Experiments 1a, 1b, and 2b
595 with a different set of questions derived from the main psychological theories that make
596 statements about the experience of beauty (see **Supplementary Material** for details and
597 references). All stimuli and instructions were kept the same. We list the most important
598 information about the participants below. More extensive demographic information is available
599 in the **Supplementary Material**.

600 *Experiment 5a – rating images.* One hundred and one participants completed the survey.
601 Of these, 63 were male, and 38 female. Their ages ranged from 20 to 73 with a mean age of 37.8
602 ($SD = 11.9$).

603 *Experiment 5b – rating images and music.* One hundred participants completed the
604 survey. We excluded fifteen participants due to $\geq 5\%$ wrong responses on the question asking
605 about the stimulus type (see Experiment 2b above). We thus analyzed data from 85 participants.
606 Of these, 48 were male, and 37 female. Their ages ranged from 22 to 72 with a mean age of 37.8
607 ($SD = 11.5$).

608 *Experiment 6 – rating memories.* Of the 100 recruited participants, 99 completed the
609 survey. Based on the written memory descriptions provided, we excluded 27 participants due to
610 apparent non-compliance. Of the remaining 72 participants, 34 were male, 36 female, one
611 identified with another gender, and one preferred not to answer the question. Their ages ranged
612 from 22 to 69 with a mean of 39.5 years ($SD = 12.5$).