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Evaluative judgment across domains: Liking balance, contour, symmetry and complexity in melodies and visual designs

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ABSTRACT

Evaluative judgment—i.e., assessing to what degree a stimulus is liked or disliked—is a fundamental aspect of cognition, facilitating comparison and choosing among alternatives, deciding, and prioritizing actions. Neuroimaging studies have shown that evaluative judgment involves the projection of sensory information to the reward circuit. To investigate whether evaluative judgments are based on modality-specific or modality-general attributes, we compared the extent to which balance, contour, symmetry, and complexity affect liking responses in the auditory and visual modalities. We found no significant correlation for any of the four attributes across sensory modalities, except for contour. This suggests that evaluative judgments primarily rely on modality-specific sensory representations elaborated in the brain's sensory cortices and relayed to the reward circuit, rather than abstract modality-general representations. The individual traits art experience, openness to experience, and desire for aesthetics were associated with the extent to which design or compositional attributes influenced liking, but inconsistently across sensory modalities and attributes, also suggesting modality-specific influences.

Evaluative judgment—assigning hedonic values to current and anticipated objects and events—is a fundamental feature of human cognition. Being able to evaluate stimuli as good or bad, liked or disliked, preferred or not, facilitates comparing and choosing among alternatives, deciding, and prioritizing actions (Berridge & Kringelbach, 2013; Pessiglione & Lebreton, 2015; Rangel, Camerer & Montague, 2008). People assign hedonic values to concrete and biologically relevant objects, such as food and other people's faces (Aharon et al., 2001; Kampe, Frith, Dolan, & Frith, 2001; O'Doherty et al., 2003; Winston, O'Doherty, Kilner, Perrett, & Dolan, 2007). But they also assign value to many kinds of abstract and cultural objects, from money to art (Blood & Zatorre, 2001; Erk, Spitzer, Wunderlich, Galley, & Walter, 2002; Harvey, Kirk, Denfield, & Montague, 2010; Kirk, Harvey, & Montague, 2011).

Neuroimaging evidence has shown that hedonic values are computed by the mesocorticolimbic reward circuit, a distributed system of brain regions including the nucleus accumbens, caudate nucleus, pallidum, amygdala, orbitofrontal cortex (OFC), anterior cingulate cortex (ACC), and insula (Bartra, McGuire, & Kable, 2013; Brown, Gao, Tisdelle, Eickhoff, & Liotti, 2011; Sescousse, Caldú, Segura, & Dreher, 2013). Reward signals computed by neurons in these structures assess the hedonic value of perceptual properties of objects relayed from sensory cortices (Becker et al., 2019; Berridge & Kringelbach, 2015; Skov, 2019). For instance, Salimpoor and colleagues (2013) collected blood oxygenation level–dependent activity while participants listened to excerpts of unfamiliar music and placed economic bids to hear them again. Their results showed that activity in the nucleus accumbens was the best predictor of the amount participants were willing to bid, and that functional connectivity between the nucleus accumbens and the primary and surrounding auditory cortices increased significantly when participants listened to the excerpts they found most desirable. In another study, Cheung and colleagues (2019) showed that musical pleasure

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arises from combinations of the uncertainty of perceivers' musical expectations and their surprise when musical events deviate from those expectations: musical pleasure is greatest when events are highly surprising in a low-uncertainty context, or when events are not very surprising in a high-uncertainty context. Moreover, the interaction between uncertainty and surprise was related to brain activity in the amygdala, hippocampus, and auditory cortex.

Evaluative judgment, therefore, involves the integration of information about perceptual attributes (e.g., tonal pattern processing in the auditory domain, or contour and symmetry processing in the visual domain) and about hedonic attributes (e.g., reward prediction, reward value). This interaction between sensory and hedonic processes is so crucial, that sensory information that is not relayed to these nuclei in the reward circuit fails to acquire hedonic value. This is the case with Specific Musical Anhedonia (SMA), the inability to experience pleasure from music. Diffusion tensor imaging studies show that people with SMA have reduced white matter connectivity between auditory brain regions and the ventral striatum, a key region of the brain's reward circuit (Sachs, Ellis, Schlaug, & Loui, 2016). Even in people without SMA, individual sensitivity to musical pleasure correlates with differences in connectivity between the auditory cortex and the reward circuit (Loui et al., 2017; Martínez-Molina, Mas-Herrero, Rodríguez-Fornells, Zatorre, & Marco-Pallarés, 2016).

This integration of sensory and hedonic information is not only crucial to the computation of hedonic values; it also marks the distinction between different sorts of hedonic values. The same reward circuit is involved in the pleasurable experiences we get from many sources, including music, food, and drugs (Levy & Glimcher, 2012; Mallik, Chandra, & Levitin, 2017; Nadal & Skov, 2018). What distinguishes those pleasures from each other is the sort of sensory information that is relayed to the reward circuit and the path it is relayed along (Mas-Herrero, Maini, Sescousse, & Zatorre, 2021).

How do perceptual attributes trigger the process of hedonic valuation? A thorough account is only coming into focus (Skov, 2020; Skov & Nadal, 2021). Multiple studies have shown that perceptual properties such as balance, contour, symmetry, or complexity affect liking for visual stimuli (Leder & Nadal, 2014; Pelowski, Markey, Lauring, & Leder, 2016). Findings from these studies indicate that most people prefer balanced, smooth, symmetric, and complex visual designs (Bertamini, Palumbo, Gheorghes, & Galatsidas, 2016; Jacobsen & Höfel, 2003; Jacobsen & Höfel, 2001; Nadal, Munar, Marty, & Cela-Conde, 2010; Wilson & Chatterjee, 2005). However, a growing number of experiments have demonstrated that such group-level effects mask remarkable individual differences (Corradi et al., 2019; Corradi, Chuquichambi, Barrada, Clemente, & Nadal, 2020; Jacobsen, 2004; Jacobsen & Höfel, 2002). For example, in contrast to general trends, some people prefer visual designs with low balance, jagged contours, asymmetry, or simplicity (e.g., Leder et al., 2019).

Understanding differences in the way people value objects is crucial to understanding the process of valuation itself. One of the ways in which people differ in liking is the extent to which they take into account certain object features. Corradi and colleagues (2020) showed that people differ in the extent to which they rely on balance, contour, symmetry, and complexity when deciding about how much they like visual designs, and that these differences are stable in time. While most people were sensitive to those features, in the sense that they determined people's liking—i.e., they liked balanced, smooth, symmetric, and complex objects, or unbalanced, jagged, asymmetric, and simple objects most— some were indifferent to one or more of these features—in the sense that their liking ratings were unrelated to those features (Corradi et al., 2020). Furthermore, Corradi and colleagues (2019) showed that this individual sensitivity to particular stimulus features, at least to visual contour, seems to be consistent across kinds of visual objects: People who liked real objects with jagged contours also tended to like abstract designs with jagged contours, whereas people who were indifferent to contour for one kind of visual object also tended to be indifferent to the other kind.

Results from a comparable study with musical stimuli showed that people also vary considerably in their aesthetic sensitivity to auditory features and that musical aesthetic sensitivities are also stable in time (Clemente, Pearce, & Nadal, 2021). Clemente and colleagues (2020) created four sets of 50 short melodies varying either in balance, contour, symmetry, or complexity, and asked participants to listen to and rate their liking for each of them (Clemente et al., 2021). Their results showed that, as a group, participants liked more unbalanced, melodically jagged, rhythmically smooth, asymmetric, and melodically complex melodies—note that in these and the present studies, *melodic* contour and complexity refer to *pitch-related* contour and complexity, respectively. However, together with these general trends, and in line with Corradi and colleagues' (2020) results, they also found considerable variation among participants in the extent to which musical balance, contour, symmetry, and complexity influenced people's liking, and that these differences were stable in time (Clemente et al., 2021).

Here, we investigated whether aesthetic sensitivity, defined as the extent to which specific stimulus features influence someone's liking, holds across the visual and auditory modalities. For example, is someone's liking determined by complexity, regardless of the sensory modality? Or is it the case that complexity might influence liking in the visual but not the music domain, or vice versa? Finding that people have common aesthetic sensitivities to musical and visual complexity, for instance, would suggest that the basis for the computation of hedonic value by the reward system is a modality-general representation of complexity—i.e., an abstraction of the common features contributing to musical and visual complexity. Information density is a plausible candidate for this kind of modality-general representation. If the reward system operates on this sort of modality-general representations, then information-dense stimuli should be liked or disliked to a similar degree irrespective of whether they are visual or auditory.

On the other hand, finding that people have different aesthetic sensitivities to musical and visual complexity would suggest that the basis for the computation of hedonic value by the reward system is a modality-specific representation of complexity—i.e., a representation of the auditory features that contribute specifically to musical complexity, such as expectation in tonal sequences (Cheung et al., 2019; Gold, Pearce, Mas-Herrero, Dagher, & Zatorre, 2019; Salimpoor, Zald, Zatorre, Dagher, & McIntosh, 2015), the degree of rhythmic syncopation or chord dissonance (Matthews, Witek, Heggli, Penhune, & Vuust, 2019), or a representation of the visual features that contribute specifically to visual complexity, such as the number and heterogeneity of angles in a figure, variety of colors, or irregular spatial arrangements (Nadal et al., 2010). If the reward system operates on such modality-specific representations, liking for visual complexity should be unrelated to liking for auditory complexity because the nature of the cues that drive liking for one and the other is substantially different. The same could be said about other features like balance, contour, and symmetry.

In sum, hedonic liking is computed by reward-related processes in mesocorticolimbic reward circuit operating on information about stimulus attributes relayed from sensory cortices. But what sort of attributes are these? Here we aim to clarify whether the information about the stimuli that the reward system relies upon resembles an abstract modality-general representation—e.g., information density—, or a concrete modality-specific representation—e.g., number and variety of angles or spatial arrangement of parts in a visual design, and tonal sequence predictability or rhythmic syncopation in a melody. To examine these alternatives, we tested whether aesthetic sensitivity to visual balance, contour, symmetry, and complexity correlate with aesthetic sensitivity to musical balance, contour, symmetry, and complexity. Specifically, we obtained liking ratings for visual and auditory stimuli varying systematically in balance, contour, symmetry, and complexity. We then examined whether individual aesthetic sensitivity profiles for these attributes show any correspondence across the two modalities.

Evaluative judgments of visual art and design and music are modulated by domain expertise in visual art and design (Belke, Leder, & Augustin, 2006; Pang, Nadal, Müller-Paul, Rosenberg, & Klein, 2013) and music (Lahdelma & Eerola, 2020; Popescu et al., 2019), respectively, art interest and knowledge (Silvia, 2005; Specker et al., 2020), desire for aesthetics (Lundy, Schenkel, Akrie, & Walker, 2010), and personality traits such as openness to experience (Chamorro-Premuzic, Reimers, Hsu, & Ahmetoglu, 2009; Furnham & Chamorro-Premuzic, 2004) and need for cognitive closure (Ostrofsky, & Shobe, 2015; Wiersema, van der Schalk, & van Kleef, 2012). Therefore, to explore potential factors underlying individual differences in aesthetic sensitivities, we also examined influences of various personality measures, including interest and knowledge in music and visual art, openness to experience, need for cognitive closure, and desire for aesthetics.

1. Method

1.1. Participants

Forty-eight self-reported non-experts in music and visual art (26 female, 22 male, aged between 18 and 29 years, $M = 22.72$, $SD = 3.09$) took part in the study. All participants reported normal or corrected-to-normal vision and hearing and no cognitive impairments. All participants were students at the University of the Balearic Islands. Participants were unaware of the purpose of the study and provided written informed consent before participating. The study was conducted following the Declaration of Helsinki and received approval from the Committee for Ethics in Research of the Balearic Islands (approval number IB 3573/17 PI).

1.2. Procedure

Participants undertook the experimental tasks in the Laboratory of Psychology of the University. They were first welcomed and briefed about the entire procedure. Each participant was then asked to enter one of the individual sound-attenuated testing cabins, all of which had the same computers, software, adequate light conditions, and headphone sets. In the testing cabin, participants received the same standard verbal and onscreen instructions. Participants sat approximately 45 cm from the screen and self-regulated their headsets' volume at the beginning of the auditory task. The whole experiment was performed through Open Sesame (Mathôt, Schreij, & Theeuwes, 2012).

Participants rated their liking for 66 visual designs and 96 melodies varying in balance, contour, symmetry, or complexity, presented one at a time. Ratings were self-paced and given on a 1–5 Likert scale anchored by *not at all* (1) to *very much* (5). Participants were requested to base their responses on the subjective feelings of pleasure, interest, enjoyment, and desirability evoked or elicited by the stimulus, and allowed to repeat each auditory stimulus before rating it. The order of visual and auditory tasks was counterbalanced between participants, and the stimuli were individually randomized. After completing the tasks, participants completed five computer-based questionnaires. The experimental session lasted between 30 and 40 min.

1.3. Materials

For the visual task, we used the same three sets of b/w abstract designs as in Corradi et al. (2020). The first was a set of 22 stimuli designed by Wilson and Chatterjee (2005), which we used to assess aesthetic appreciation of visual balance (Fig. 1, first column). They consist of diverse configurations of seven hexagons of different sizes varying in balance (*unbalanced–balanced*), measured as the average of eight symmetry components over the image's axes. The second was a set of 24 stimuli, designed following Bertamini and colleagues' (2016) guidelines, to assess aesthetic sensitivity to visual contour (Fig. 1, second column). Half of them had *smooth* contours—defined by cubic splines linking the figure's vertexes—, and the other half had *jagged* contours—defined by straight lines linking the figure's vertexes. To incorporate some variability in the stimuli, we included equal numbers of figures with 22 and 26 vertices, and the same number of designs created from *circles*, *ovals*, and *lobed ovals*. The third set was composed of 20 of Jacobsen and Höfel's (2002) stimuli. These stimuli were designed as a series of solid black circles with a centered white square containing triangles arranged to form designs varying in mirror symmetry (Fig. 1, third column)—i.e., with respect to vertical, horizontal, and diagonal axes—and complexity (Fig. 1, fourth column)—defined as the number of elements. We chose ten *symmetric* and ten *asymmetric* stimuli matched for different degrees of complexity, corresponding to the number of constituent elements (*simple–complex*). The image sizes of all visual stimuli were 450 pixels on a 1920 × 1080 computer screen of 21″.

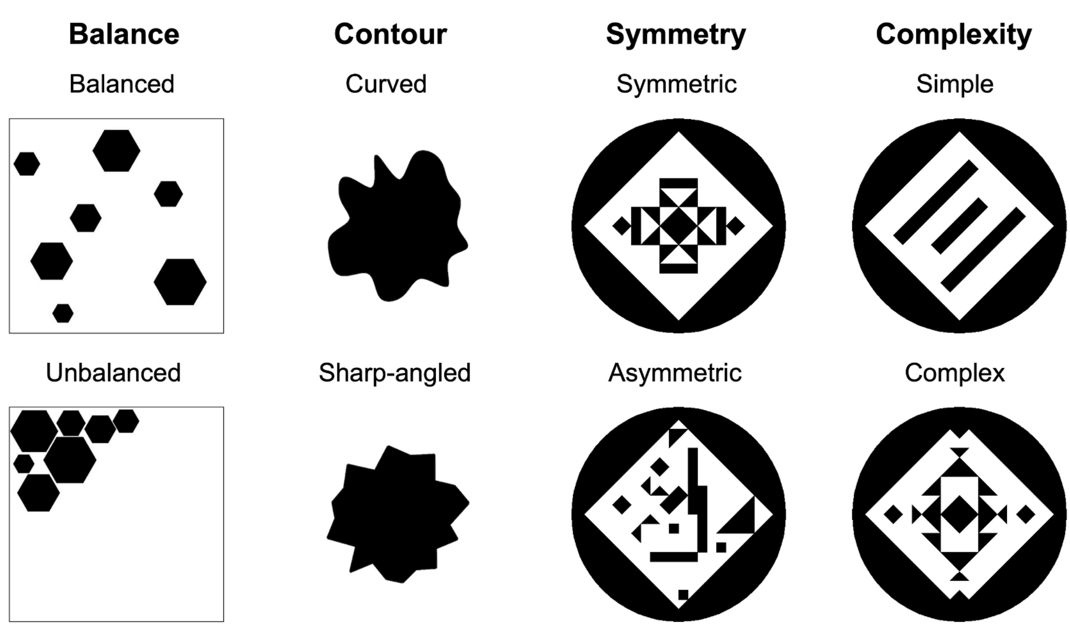

Fig. 1. Examples of visual stimuli designed by Wilson & Chatterjee (2005) for balance (first column), Bertamini et al. (2016) for contour (second column), and Jacobsen & Höfel (2002) for symmetry and complexity together (third and fourth columns).

For the auditory task, we used Clemente et al.'s (2020) MUST abridged stimulus set, the same as in Clemente et al. (2021). These musical stimuli are 4-second monophonic piano-like melodies in C-Major (Fig. 2) with the same musical idiom and acoustic features, expressly composed for empirical studies and designed to combine experimental control and musical appeal. The MUST set comprises four subsets of melodies that vary in either balance, contour, symmetry, or complexity. The parameters of variation in each subset are analogous to those used to generate the visual sets (Clemente et al., 2020): Balance was defined as the homogeneity of the event distribution across the melody and the central position of the climax for *balanced* melodies, and the accumulation of events at either end of the melody for *unbalanced* ones. Melodic contour was defined by the interval width, with wider and more varied intervals for melodically *jagged* melodies and rhythmic contour was determined by the presence of sudden rhythmic changes for rhythmically *jagged* melodies, and smaller melodic and rhythmic intervals for *smooth* melodies. Symmetry was defined as the mirror-reversed melodic correspondence from the midpoint of each stimulus. *Symmetric* melodies are musical palindromes (i.e., they have a mirror reflection structure): the second half is a literal retrograde repetition of the first half—e.g., A(B)A, ABC(C)BA. A*symmetric* melodies are not musical palindromes: they lack such retrograde repetition. Thus, the only form of symmetry considered here is temporal mirror symmetry. Finally, complexity was defined by the number and variety of events or notes. *More complex* melodies have many notes varying widely in duration, pitch interval size, and register. Conversely, *simpler* melodies have a small number of highly predictable notes with repeated uncomplicated patterns. To minimize variation in all attributes other than the intended one, all melodies in the Balance subset are asymmetric, have mild contours, and overall medium complexity; those in the Contour subset are balanced, asymmetric, and with overall medium complexity; those in the Symmetry subset are balanced and have mild contours and overall medium complexity; and the stimuli in the Complexity subset are symmetric, balanced, and with mild contours.

The temporal nature of music could make processing the musical stimuli more challenging than processing the visual stimuli, especially in the case of symmetry, which involves comparing two mirror-reversed halves of a melody. To facilitate the processing of each of these musical features, Clemente et al. (2020) minimized variation in all parameters not contributing directly to the structural feature of interest, kept tonal and harmonic relationships simple and homogeneous, and used brief stimuli. Thus, all stimuli were composed using the same musical idiom, including language and style (Western tonal-functional), key (C Major), texture (monophonic), timbre (piano-sampled; Garritan Sound Library for Finale, MakeMusic), duration (4 s), overall and instantaneous loudness (no changes in musical dynamics or spatial cues), and other acoustical properties, avoiding expressive performance and recording inconsistencies and variability (Clemente et al., 2020). Even if the perception of musical symmetry is more demanding (e.g., working-memory load) than that of visual symmetry, Clemente et al. (2020) showed that the stimuli were correctly perceived and categorized well above chance.

Following Clemente et al.'s (2021) approach, we used the abridged set, which includes the 12 most extreme stimuli in each pole for which the agreement in perceptual judgments was maximal (Clemente et al., 2020). During the analyses, we found that two pairs of the stimuli belonging to the Symmetry and Complexity abridged subsets were unintentionally duplicated: S4 = K8 and S5 = K9. Their presentation order did not influence ratings significantly (all *ps* > 0.050 in the *t*-tests of block order for each stimulus, meaning no effects of familiarity), so including them in the analyses would not affect the direction of the results. However, to be sure of no adverse impact, we decided to exclude them from the present analyses, leaving us with 12 *balanced* – 12 *unbalanced,* 12 *smooth* – 12 *jagged*, 10 *symmetric* – 12 *asymmetric*, and 10 *simple* – 12 *complex*. The melodies were presented in WAV format through headphones. The MUST (Clemente et al., 2020) also includes

Fig. 2. Sample scores of musical stimuli in each subset.

composite computational measures specific for the characteristic structural properties of each subset: Balance and symmetry were defined by single composite measures of balance (BC1) and symmetry (SC1), respectively. Two components quantified the structural parameters of contour: one for melodic (pitch-related) contour (CC1) and the other for rhythmic contour (CC2). Likewise, two components quantified complexity: a measure of melodic complexity KC1 (encompassing event density and pitch-related entropy) and a measure of rhythmic complexity KC2 (duration entropy). Higher values in these composite measures correspond to lower balance and greater jaggedness, asymmetry, and complexity, respectively.

Participants also responded to five questionnaires. The first addressed the demographic traits age, sex, academic degree, formal artistic education, professionalization, and expertise in music and visual art. Following Corradi et al. (2020), the second was adapted from the Art experience questionnaire (AEQ; Chatterjee, Widick, Sternschein, Smith II, & Bromberger, 2010) on art interest and knowledge. The third was the Openness to experience scale (NEO-FFI-R; McCrae & Costa, 2004). The fourth consisted of the first 12 items of the Spanish adaptation of the Need for cognitive closure scale (NCC; Horcajo, Díaz, Gandarillas, & Briñol, 2011). The experiment concluded with an abridged, adapted, and translated version of the Desire for aesthetics scale (DFAS; Lundy et al., 2010). The items in our AEQ and DFAS versions were also reformulated for the music domain. Except for the NCC, the questionnaires were translated (AEQ, Openness, DFAS) into Spanish or written in Spanish (demographic) by the first author. The adapted questionnaires are available in the Appendix.

1.4. Data analysis

1.4.1. Individual aesthetic sensitivities.

Following Corradi et al. (2020) and Clemente et al. (2021), we fitted linear mixed-effects models (Hox, Moerbeek, & van de Schoot, 2010; Snijders & Bosker, 2012) to assess the effect of the main predictors on participants' liking judgments for the stimuli in each visual and musical set. The models were set up to reflect each set's main predictors on participants' responses. In all cases, we followed Barr, Levy, Scheepers, and Tily's (2013) suggestion to model the maximal random-effects structure justified by the experimental design. This avoids the loss of power, reduces type I error, and enables the generalizability of results to other participants and stimuli.

The model of liking for visual balance included Wilson and Chatterjee's (2005) objective balance index for each visual design as a fixed effect. It also included intercept and slope for balance as random effects within participants. The model of liking for visual contour included the interaction between contour (*smooth*, *jagged*), shape (circle, oval, lobed oval), and vertices (22, 26) as fixed effects. It also included intercept and slope for each of these features and their interactions as random effects within participants. The model of liking for visual symmetry (*symmetric*, *asymmetric*) and complexity (number of elements) included the interaction between both features. It also included intercept and slope for both of these features and their interaction as random effects within participants. The model of liking for musical balance included the MUST composite measure of balance (BC1) as a fixed effect. It also included intercept and slope for BC1 as a random effect within participants. The model of liking for musical contour included the interaction between the MUST composite measures of melodic (CC1) and rhythmic (CC2) contour as fixed effects. It also included intercept and slope for both of these measures and their interaction as random effects within participants. The model of liking for symmetry included the MUST composite measure of asymmetry (SC1) as a fixed effect. It also included intercept and slope for SC1 as a random effect within participants. Finally, the model of liking for musical complexity included the interaction between the MUST composite measures of melodic (KC1) and rhythmic (KC2) complexity as fixed effects. It also included intercept and slope for both of these measures and their interaction as random effects within participants.

All models also included random intercepts within stimuli. Continuous predictors were mean-centered to allow comparisons with categorical variables. Categorical predictors were deviation-coded using the *contrasts()* function in the 'stats' package (R Core Team, 2020), ranging from -0.5 to 0.5. Reference levels (i.e., -0.5) for the categorical variables were: *man* for gender; *jagged*, *lobed oval*, and *22 vertices* in the model of visual contour; and *asymmetric* in the model of visual symmetry.

Our primary aim was to understand individual differences in responsiveness to structural properties driving liking. In linear mixed-effects models, this corresponds to the individual slope estimated from the models' random-effect structure, which we take as our aesthetic sensitivity measure. We used it to describe individual aesthetic sensitivity to visual balance, contour, symmetry, and complexity, and to musical balance, melodic and rhythmic contour, musical symmetry, and melodic and rhythmic complexity to study the relationships between these sensitivities. Shapiro–Wilk tests were used to assess the distributions' normality.

All analyses were carried out within the R environment for statistical computing, R version 4.0.3 (R Development Core Team, 2020). We used the *lmer()* function of the 'lme4' package (Bates, Maechler, Bolker, & Walker, 2015) and the 'lmerTest' package (Kuznetsova, Brockho, & Christensen, 2012) to estimate the *p*-values for the *t*-tests based on the Satterthwaite approximation for degrees of freedom, which produces acceptable type I error rates (Luke, 2017). Effect sizes of each factor in the models were calculated with the function *effectsize()* of the 'effectsize' package (Ben-Sachar, Makowski, & Lüdecke, 2020). To interpret the effect sizes, we followed Chin's (1998) method. Semi-partial coefficients of determination (r^2) were computed for each fixed effect in the mixed models with the *r2beta()* function of the 'r2glmm' package (Jaeger, 2017). For their interpretation, we followed Gignac and Szodorai's (2016) recommendations.

1.4.2. Relations between visual and auditory aesthetic sensitivities.

Spearman's correlations were used to ascertain the relationships between aesthetic sensitivities to the same attribute across sensory modalities. We preferred a non-parametric test given the significant results in the Shapiro-Wilk tests regarding the distributions of aesthetic sensitivities derived from the linear mixed-effects models.

1.4.3. Relations between aesthetic sensitivities and other traits

Multiple linear-regression analyses were used to explore the degree to which interest and knowledge in visual art and music, openness to experience, need for cognitive closure, and desire for aesthetics explained between-subject variance in aesthetic sensitivity. Given that we did not have any specific hypothesis or expect the demographic variables to affect sensitivity, this part of the analysis was exploratory. Continuous predictors were centered and scaled using the *scale()* function in the 'base' R package. To compute and interpret effect sizes for each predictor, we used the same function and criteria as for the linear mixed-effects models described above. The partial η2 describes the proportion of total variation attributable to a given factor, partialling out (i.e., excluding) other factors from the total non-error variation. For this, we used the *etasq()* function of the 'heplots' package (Fox, Friendly, & Monette, 2008).

2. Results

2.1. Individual aesthetic sensitivities

2.1.1. Models of visual liking

Visual balance. Visual balance did not significantly influence overall liking ratings (Table 1, Fig. 3A), with very small effect size and very weak semi-partial r^2. The individual slopes of liking for balance ranged from −0.071, indicating greater liking for lower balance, to 0.056,

Table 1
Linear Mixed-effects Models for each Attribute in the Visual and Musical Domains.

Modality	Model	Predictor	*b*	ß	*df*	*t*	*p*	*d* [95% CI]	r^2 [95% CI]
Visual	**Balance**	**VB**	0.008	0.128	55.802	1.897	0.063	0.13 [0.00, 0.26]	0.02 [0.01, 0.04]
	Contour	**VC**	0.729	0.626	36.447	5.683	< 0.001	0.63 [0.41, 0.84]	0.10 [0.07, 0.13]
	Symmetry* Complexity	**VS**	0.910	0.728	46.498	6.391	< 0.001	0.73 [0.50, 0.95]	0.14 [0.10, 0.18]
		VK	0.032	0.155	27.973	3.623	0.001	0.15 [0.07, 0.24]	0.03 [0.01, 0.05]
		VS*VK	0.030	0.148	19.964	1.948	0.066	0.15 [0.00, 0.30]	0.01 [0.00, 0.02]
Auditory	**Balance**	**BC1**	−0.267	−0.246	29.724	−3.856	< 0.001	−0.25 [-0.37, −0.12]	0.06 [0.04, 0.09]
	Contour	**CC1**	0.166	0.144	33.600	1.824	0.077	0.14 [-0.01, 0.30]	0.02 [0.01, 0.04]
		CC2	−0.109	−0.115	21.190	−1.123	0.274	−0.11 [-0.32, 0.09]	0.01 [0.000, 0.02]
		CC1*CC2	−0.077	−0.081	20.440	−1.240	0.229	−0.08 [-0.21, 0.05]	0.01 [0.00, 0.02]
	Symmetry	**SC1**	0.203	0.196	19.870	2.979	0.007	0.20 [0.07, 0.33]	0.04 [0.02, 0.07]
	Complexity	**KC1**	0.315	0.333	42.037	4.486	< 0.001	0.33 [0.19, 0.48]	0.07 [0.04, 0.10]
		KC2	−0.092	−0.078	25.515	−1.522	0.140	−0.08 [-0.18, 0.02]	0.01 [0.00, 0.02]
		KC1*KC2	−0.085	−0.092	18.427	−1.987	0.062	−0.09 [-0.18, 0.00]	0.01 [0.00, 0.02]

Note. The predictors of individual liking ratings in the linear mixed-effects models are visual balance (VB), visual contour (VC), visual symmetry (VS), number of visual elements (VK), musical balance (BC1), melodic contour (CC1), rhythmic contour (CC2), musical symmetry (SC1), melodic complexity (KC1), and rhythmic complexity (KC2). *b* refers to the estimated group-level slope, ß to the standardized beta coefficient, *df* to the degrees of freedom, *t* to the *t*-value, *p* to the *p*-value, *d* to the effect size, and r^2 to the semi-partial coefficient of determination of each parameter to the model.

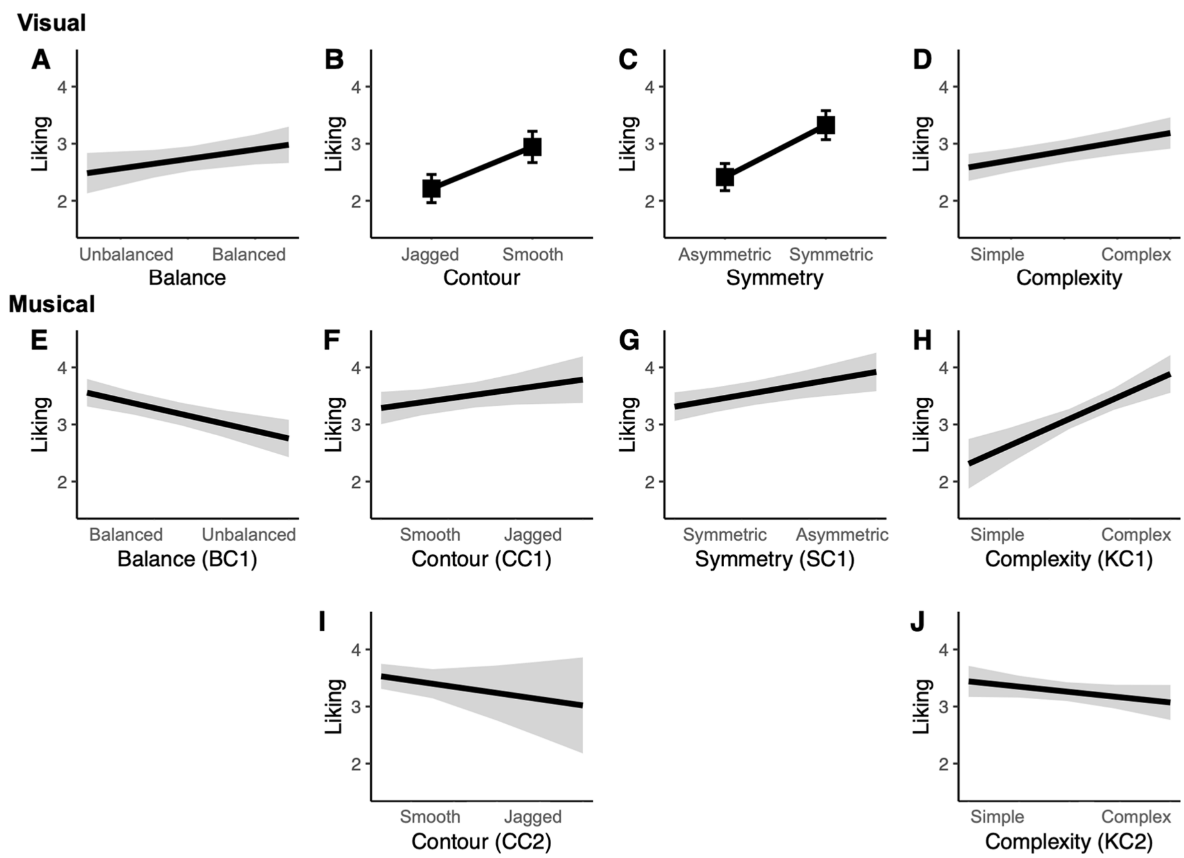

Fig. 3. Main effects on participants' liking for (A) visual balance, (B) visual contour, (C) visual symmetry, (D) visual complexity, (E) musical balance, (F) melodic contour, (G) musical symmetry, (H) melodic complexity, (I) rhythmic contour, and (J) rhythmic complexity. Higher values mean more balanced (VB), smooth (VC), symmetric (VS), and more complex (VK) images; and less balanced (BC1), more melodically (CC1) and rhythmically (CC2) jagged, asymmetric (SC1), and melodically (KC1) and rhythmically (KC2) complex melodies, respectively. Gray ribbons correspond to 95% CI.

indicating greater liking for higher balance, and were normally distributed (Table 2, Fig. 4A).

Visual contour. Overall, participants liked more smooth images (Table 1, Fig. 3B), with large effect size and very weak semi-partial r^2. Shape, number of vertices, and their interactions did not show significant effects (all *ps* > 0.100). The slopes of liking for contour ranged from −0.131, indicating greater liking for jagged figures, to 2.730, indicating greater liking for smooth designs, and were not normally distributed (Table 2, Fig. 4B).

Visual symmetry and complexity. Overall, participants liked more symmetric images (Table 1, Fig. 3C), with large effect size and very weak semi-partial r^2, and liking increased with complexity (Table 1, Fig. 3D), with very small effect size and very weak semi-partial r^2. No significant interaction between symmetry and complexity was found (Table 1), with very small effect size and very weak semi-partial r^2. The slopes of liking for symmetry ranged from −0.470, indicating greater liking for asymmetry, to 2.652, indicating greater liking for symmetry, and were normally distributed (Table 2, Fig. 4C). The slopes of liking for

Table 2
Distributions of Individual Slopes of Liking for Images and Music.

Sensory modality	Model	Predictor	*M*	*SD*	Shapiro–Wilk Tests			
					W	*p*	Skew	Kurtosis
Visual	Balance	VB	0.008	0.024	0.969	0.233	–	–
	Contour	VC	0.729	0.586	0.940	0.016	0.971	1.149
	Symmetry* Complexity	VS	0.910	0.702	0.974	0.362	–	–
		VK	0.032	0.027	0.948	0.033	0.484	2.001
Auditory	Balance	BC1	−0.267	0.145	0.964	0.144	–	–
	Contour	CC1	0.166	0.279	0.988	0.891	–	–
		CC2	−0.109	0.090	0.952	0.048	−0.293	−0.924
	Symmetry	SC1	0.203	0.010	0.973	0.330	–	–
	Complexity	KC1	0.315	0.303	0.925	0.004	−1.002	0.940
		KC2	−0.092	0.140	0.981	0.618	–	–

Note. The predictors of individual liking ratings in the linear mixed-effects models are visual balance (VB), visual contour (VC), visual symmetry (VS), number of visual elements (VK), musical balance (BC1), melodic contour (CC1), rhythmic contour (CC2), musical symmetry (SC1), melodic complexity (KC1), and rhythmic complexity (KC2). *M* refers to the mean slope, *SD* to the standard deviation, *W* to the *t*-value of the Shapiro–Wilk test, and *p* to its *p*-value. Skewness and kurtosis are reported when $p < .050$.

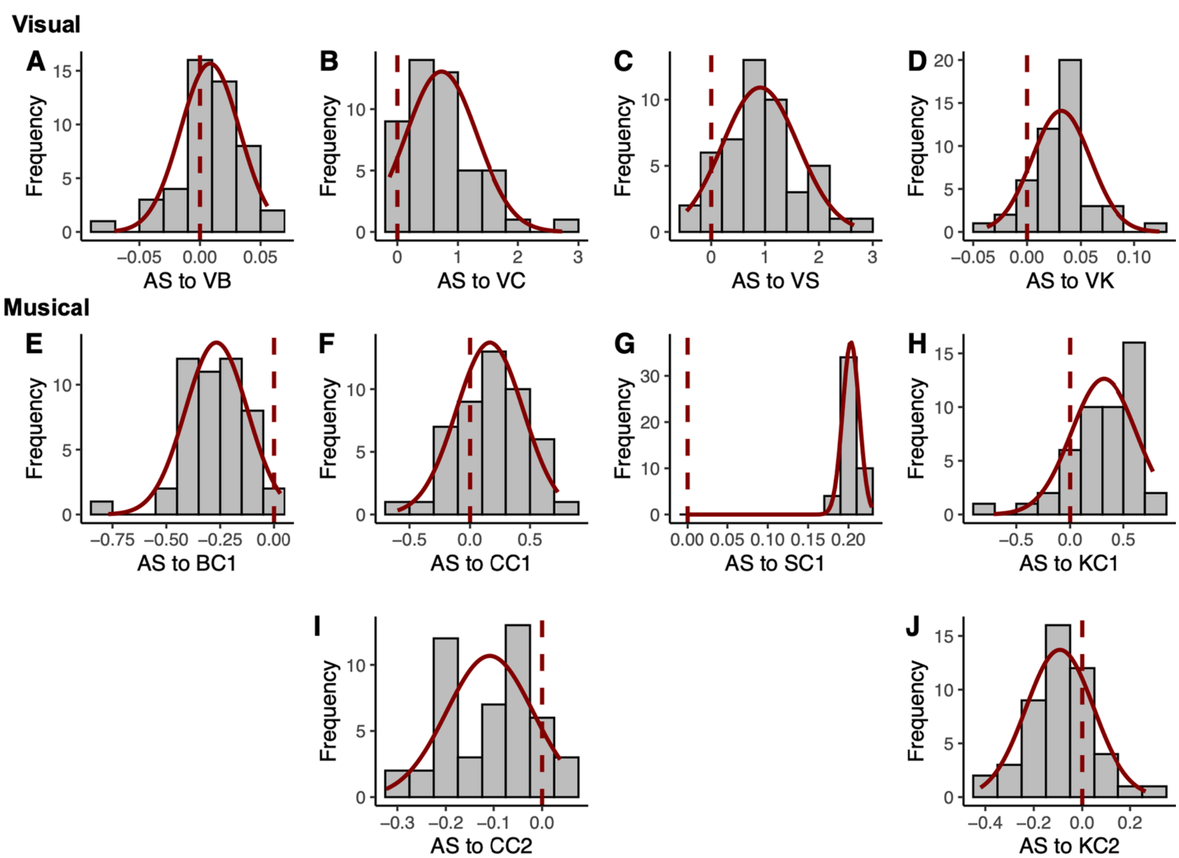

Fig. 4. Aesthetic sensitivity (AS) to visual and musical attributes: histograms of individual slopes of liking for (A) visual balance, (B) visual contour, (C) visual symmetry, (D) visual complexity, (E) musical balance, (F) melodic contour, (G) musical symmetry, (H) melodic complexity, (I) rhythmic contour, and (J) rhythmic complexity. Vertical dashed lines correspond to a slope of 0, meaning complete indifference, irresponsiveness, or insensitivity towards each structural property concerning liking judgments. Positive slopes indicate higher liking for more balanced (VB), smooth (VC), symmetric (VS), and more complex (VK) images; and less balanced (BC1), more melodically (CC1) and rhythmically (CC2) jagged, asymmetric (SC1), and melodically (KC1) and rhythmically (KC2) complex melodies, respectively. Negative slopes indicate higher liking for less balanced (VB), more jagged (VC), asymmetric (VS), and simple (VK) images; and more balanced (BC1), melodically (CC1) and rhythmically (CC2) smooth, symmetric (SC1), and melodically (KC1) and rhythmically (KC2) simple melodies, respectively. Fitted curves are outlined, although note that individual slopes of liking for visual contour and complexity, rhythmic contour (CC2), and melodic complexity (KC1) are not normally distributed.

complexity ranged from −0.037, indicating greater liking for simplicity, to 0.123, indicating greater liking for complexity, and were not normally distributed (Table 2, Fig. 4D).

2.1.2. Models of auditory liking

Musical balance. Overall, liking increased with increasing balance (Table 1, Fig. 3E) with small effect size and very weak semi-partial r^2. The individual slopes ranged from −0.769, indicating greater liking for balance, to 0.029, indicating greater liking for lack of balance, and were normally distributed (Table 2, Fig. 4E).

Musical contour. Overall, liking judgments were not significantly predicted by either melodic contour (Table 1, Fig. 3F), rhythmic contour

(Table 1, Fig. 3I), or their interaction (Table 1), all with very small effect size and very weak semi-partial r^2. The slopes for melodic contour ranged from −0.598, indicating greater liking for smooth melodic contours, to 0.730, indicating greater liking for jagged melodic contours, and were normally distributed (Table 2, Fig. 4F). The slopes for rhythmic contour ranged from −0.323, indicating greater liking for smooth rhythms, to 0.037, indicating greater liking for jagged rhythms, and were not normally distributed (Table 2, Fig. 4I).

Musical symmetry. Participants liked more asymmetric melodies (Table 1, Fig. 3G) overall, with small effect size and very weak semi-partial r^2. The slopes ranged from 0.184 to 0.229, indicating greater liking for asymmetry, and were normally distributed (Table 2, Fig. 4G).

Musical complexity. Overall, liking increased with melodic complexity (Table 1, Fig. 3H), with small effect size and very weak semi-partial r^2. The effect of rhythmic complexity was not significant (Table 1, Fig. 3J), and the interaction between melodic and rhythmic complexity verged on significance (Table 1), both with very small effect sizes and very weak semi-partial r^2. The slopes for melodic complexity ranged from −0.709, indicating greater liking for melodic simplicity, to 0.775, indicating greater liking for melodic complexity, and were not normally distributed (Table 2, Fig. 4H). The slopes for rhythmic complexity ranged from −0.420, indicating greater liking for rhythmic simplicity, to 0.264, indicating greater liking for rhythmic complexity, and were normally distributed (Table 2, Fig. 4J).

2.2. Relations between sensitivities to the same attribute across sensory modalities

We found only one significant correlation between aesthetic sensitivities to the same attribute in the two sensory modalities (Table 3): aesthetic sensitivity to melodic contour correlated significantly with aesthetic sensitivity to visual contour (ρ = -0.422, p = .003). This indicates that participants who liked more smooth melodies also tended to like more smooth visual designs.

2.3. Relations between aesthetic sensitivities and other traits

We ran one multiple regression analysis for each structural property to determine whether visual art interest and knowledge (visual AEQ), musical interest and knowledge (musical AEQ), openness to experience (OTE), need for cognitive closure (NCC), and desire for aesthetics (DFAS) accounted for differences in aesthetic sensitivity between participants.

Interest and knowledge in visual art was the only significant predictor of aesthetic sensitivity to visual balance, with medium effect size (b = -0.012, ß = −0.477, t = -2.917, p = .006, d = -0.48 [-0.82, −0.15], partial η^2 = 0.168), and complexity, with large effect size (b = 0.017, ß = 0.633, t = 4.241, p < .001, d = 0.64 [0.34, 0.94], partial η^2 = 0.300). Namely, people with higher art interest and knowledge also tended to like less balanced (Fig. 5A) and more complex designs (Fig. 5B). Regarding musical aesthetic sensitivities, there was a significant relation between aesthetic sensitivity to musical balance and openness to experience with medium effect size (b = -0.057, ß = −0.395, t = -2.423, p = .020, d = -0.40 [-0.73, −0.07], partial η^2 = 0.123): liking for balanced music tended to increase with openness to experience (Fig. 5C). No other significant results were found. Together, the predictors explained between 1 and 27% of the variability in the models of aesthetic sensitivities.

3. Discussion

Evaluative judgments of many different kinds of objects entail the assessment of the hedonic value of their perceptual attributes (Berridge & Kringelbach, 2015; Pessiglione & Lebreton, 2015; Skov, 2020). Hedonic values arise from activity in the mesocorticolimbic reward circuit and sensory brain regions that integrates information about perceptual and hedonic attributes. These mechanisms give rise to the anticipation and enjoyment of art, food, and drugs (Levy & Glimcher, 2012; Mallik, Chandra, & Levitin, 2017; Nadal & Skov, 2018). The relay of sensory information to the reward circuit is not only crucial to the generation of hedonic value. The sort of information that is relayed, and the path it follows, marks the difference between the enjoyment of different kinds of objects (Mas-Herrero et al., 2021).

If the way sensory information is conveyed to the reward circuit plays such a key role in determining evaluative judgments, it is important to understand what sort of sensory attributes are conveyed. Our goal was to clarify whether it takes the form of an abstract modality-general representation or of a concrete modality-specific representation. It is known that perceptual features such as balance, contour, symmetry, and complexity influence liking. Previous experiments examining liking for these attributes found that they elicit different subjective responses when mediated by visual (Corradi et al., 2019, 2020) and auditory (Clemente et al., 2021) objects. One possibility is that liking is the result of reward processes that operate on modality-specific cues—e.g., variety of colors in the visual domain vs. rhythmic syncopation in the musical domain—that contribute specifically to visual or auditory representations of balance, contour, symmetry, and complexity. Another possibility is that liking results from reward processes that operate on abstract modality-general representations—e.g., complexity—that emerge from cues that are common to visual and auditory balance, contour, symmetry, and complexity—e.g., number of elements or events.

In the present study, we directly compared responses to auditory and visual stimuli from the same cohort to ascertain whether aesthetic sensitivity is specific to each sensory modality or common across modalities. If the reward system operates on modality-general representations, then stimuli that share the same balance, contour, symmetry, and complexity profiles, regardless of whether they are visual or auditory, should be liked (or disliked) to a similar degree. If, on the contrary, the reward system operates on modality-specific representations, liking for visual balance, contour, symmetry, and complexity should be unrelated to liking for auditory balance, contour, symmetry, and complexity because of the substantially different nature (spatial vs. temporal) of the cues that drive liking in each modality. Noteworthy, the musical set used in this study purposely emulated the variation in the visual sets in the music domain, allowing us to investigate liking for balance, contour, symmetry, and complexity as comparably as possible across sensory modalities.

Table 3
Pairwise Correlations Between Individual Aesthetic Sensitivities Across Domains.

		Musical					
		BC1	CC1	CC2	SC1	KC1	KC2
Visual	VB	−0.089					
	VC		−0.422**	−0.116			
	VS				−0.152		
	VK					−0.215	0.118

Note. Spearman correlation coefficients of data from 48 participants regarding their liking for visual balance (VB), contour (VC), symmetry (VS), and complexity (VK); and musical balance (BC1), melodic contour (CC1), rhythmic contour (CC2), asymmetry (SC1), melodic complexity (KC1), and rhythmic complexity (KC2); ** p < .01.

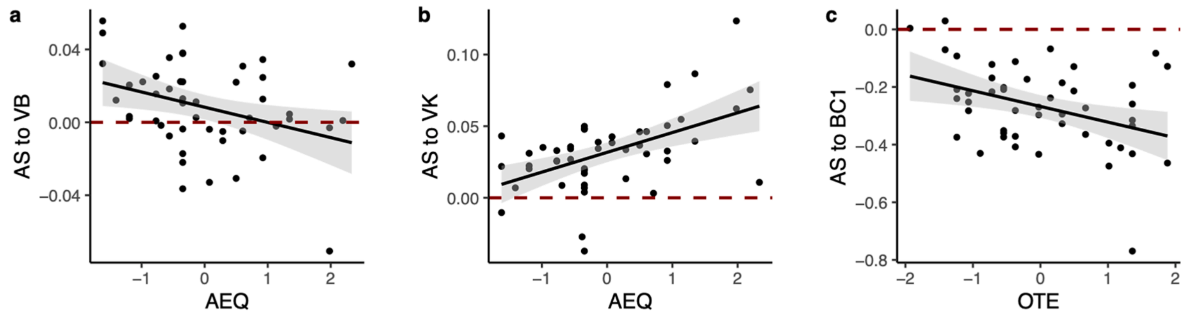

Fig. 5. Aesthetic sensitivities predicted by individual traits: (a) aesthetic sensitivity to visual balance (AS to VB) and (b) to visual complexity (AS to VK) predicted by interest and knowledge in visual art (AEQ), and (c) aesthetic sensitivity to musical balance (AS to BC1) predicted by openness to experience (OTE). Higher sensitivity values mean greater liking for higher visual balance and complexity, and lower musical balance, respectively. Gray ribbons correspond to 95% CI. Horizontal dashed lines mark the level of aesthetic indifference to each feature.

From a nomothetic perspective—i.e., at the group level—, our results support the notion of a general trend for people to prefer smooth (Bertamini et al., 2016; Palumbo, Ruta, & Bertamini, 2015), symmetric (Gartus & Leder, 2013), and complex designs (Nadal et al., 2010), and more balanced, asymmetric, and melodically complex melodies (Clemente et al., 2021; Marin, Lampatz, Wandl, & Leder, 2016; Marin & Leder, 2013). However, from an idiographic perspective—i.e., at the individual level—, the distributions of individual slopes demonstrate that people differ considerably in the degree and manner in which balance, contour, symmetry, and complexity influence their liking judgments. This discrepancy between nomothetic and idiographic approaches should caution against mistaking general tendencies for uniformity: overall trends in the features that influence liking coexist with substantial individual variations (Clemente et al., 2021; Corradi et al., 2019, 2020; Jacobsen, 2004; Jacobsen & Höfel, 2002).

In general, we found almost no evidence that aesthetic sensitivities correspond across the visual and auditory sensory modalities. For balance, symmetry, and complexity, the object features that our participants relied on to judge liking for visual designs were not equivalent to those they relied on to judge liking for melodies. The fact that one attribute influences someone's liking for music does not mean that the same attribute influences that person's liking for visual designs. Someone might, for instance, be aesthetically sensitive to visual complexity—e.g., complex designs are more liked than the simple ones—, but not to musical complexity—e.g., liking for melodies is not influenced by their complexity. This suggests that evaluative judgments entail the assessment by the reward circuit of modality-specific sensory attributes. Thus, evaluative judgments of visual designs and melodies are not based on abstract representations of balance, symmetry, and complexity, but on visual- and auditory-specific instantiations of such attributes: e.g., accumulation of all elements in a corner of the image in the case of visual balance, and concentration of all notes at the beginning or end in the case of musical balance; acute angles in the case of visual contour, and wide intervals in the case of musical contour; lack of correspondence in the elements at both halves of the image in the case of visual symmetry, and the absence of retrogradation from the middle point of a melody in the case of musical symmetry; many and varied constituting elements in the case of visual complexity, and highly unpredictable events in the case of musical complexity.

These results suggest that terms like *balance*, *complexity* or *symmetry* might be useful labels to describe and classify stimuli, but they seem to be inadequate and imprecise descriptions of the sort of attributes the sensory cortices convey to the reward system during evaluative judgments. This conclusion is in line with the results of a recent study that used magnetoencephalography to measure the amplitude of the magnetic N1 (N1m) component in response to auditory surprise in music experts and nonexperts: Quiroga-Martinez and colleagues (2020) found that the amplitude of the N1m increased with surprise. But they also found that it was pitch interval size, and not predictability, that was responsible for the modulation of the N1m component: when interval size was kept constant, surprise had no effect on N1m amplitude, but when surprise was kept constant, larger interval sized led to greater N1m amplitude. Quiroga-Martinez and colleagues (2020) concluded that N1m amplitude is explained better by the lower-level sensory processing of interval size than by probabilistic prediction, while the latter may be reflected by later components of the neural responses such as the P3am.

The only exception to the general pattern of results was a significant correlation between visual and melodic contour: participants who liked smooth images also tended to like melodically smooth melodies, and vice versa. We suggest that this correlation reflects similar negative affective effects of jagged musical contours and angular visual designs. *Smooth* music is deemed less arousing than more *energetic* or *intense* music (Zhang, Huang, Jiang, Gao, & Tian, 2010), reduces salivary cortisol secretion (Nomura, 2009), and is experienced as relaxing (Yu, Funk, Hu, & Feijs, 2018). Moreover, music around the world is characterized by melodic contours composed of small intervals (Mehr et al., 2019; Savage, Brown, Sakai, & Currie, 2015), probably reflecting energy constraints in production (Savage, Tierney, & Patel, 2017). Jagged melodies, therefore, are unlike familiar music in that they include mostly large intervals. Participants in our study, therefore, might have felt tension in response to their unusualness and high unpredictability (Clemente et al., 2021). Likewise, figures with angular contours are usually regarded as threatening or dangerous and induce greater activity in the amygdala than smooth counterparts (Bar & Neta, 2006, 2007; Gómez-Puerto, Munar, & Nadal, 2016). Thus, preference for contour in melodies and visual designs seems to reflect a lesser or greater degree of susceptibility to the affective responses to arousing, unusual, unpredictable, and potentially harmful visual or auditory stimuli. Further research is needed to ascertain whether this susceptibility is a specific expression of a broader suit of traits, such as affective reactivity, general anxiety, or aversion to broken patterns, known to influence different kinds of evaluative judgments (Gollwitzer & Clark, 2019; Landy & Piazza, 2019).

Finally, we modeled individual variability in aesthetic sensitivities as a function of art interest and knowledge, openness to experience, need for cognitive closure, and desire for aesthetics. Our results suggest that, overall, these factors explained minimal variation among participants in aesthetic sensitivity. There were three exceptions: On the one hand, openness to experience was only related to aesthetic sensitivity to musical balance, in line with Corradi et al. (2020), who found no effects of this trait on visual aesthetic sensitivities. One plausible explanation for this effect is that more balanced melodies may connote a stronger sense of development and continuity, in the sense of a more open musical discourse. On the other, visual art experience was related to aesthetic sensitivity to visual balance and complexity. The more participants were interested and knew about visual art, the more they liked complex and disliked balanced visual designs. This finding is in line with prior research showing that different forms of experience and expertise in visual art lead to a higher preference for complex and unbalanced visual designs (Eysenck, 1972; Eysenck & Castle, 1970). These results show no correspondence across the visual and auditory modalities in the way openness to experience and visual art interest and knowledge relate to aesthetic sensitivity. This lack of convergence also supports the notion that liking is influenced by concrete modality-specific representations of visual and auditory features and not by abstract amodal representations of those features.

This study is limited by the character of the stimuli employed. Further research is required to elucidate the extent to which these results hold with longer, polyphonic, non-Western, or atonal music, and with natural landscapes, paintings, or other sorts of visual stimuli. In addition, it is possible—and also desirable—to characterize and manipulate visual and musical balance, contour, symmetry, and complexity in other ways. Future studies using different criteria to define the same features we have taken into consideration could clarify the extent to which our results depend on the definitions that guided the design of the visual and musical stimuli we used.

In conclusion, our study shows that people vary substantially in the extent to which their evaluative judgments of visual designs and melodies depends on balance, contour, symmetry, and complexity. However, these differences in aesthetic sensitivity do not generally hold across modalities: the fact that complexity influences someone's liking for visual designs does not mean that complexity also influences their liking for melodies. This suggests that, in the process of hedonic valuation, the sort of attributes that are conveyed from sensory brain regions to the reward circuit correspond to concrete and modality-specific representations of visual and auditory features, rather than abstract modality-general representations of those features. The only exception was contour. We believe that this may reflect differences in people's general sensitivity to negative and arousing affect resulting from the potential threat, unusualness, and uncertainty inherent to jagged melodies and visual objects, and, conversely, positive and calm affect elicited by smooth music and figures.

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Appendix:. Adapted questionnaires

Adaptation from the Art Experience Questionnaire (AEQ)
Chatterjee, Widick, Sternschein, Smith II, and Bromberger (2010)

1 How interested are you in art? (0–6)

2 $_{\text{visual}}$. How often do you visit art museums or galleries?

2 $_{\text{auditory}}$. How often do you go to concerts?

3 How often do you look at art magazines or catalogs?

4 $_{\text{visual}}$. How often do you look at art on the Internet?

4 $_{\text{auditory}}$. How often do you listen to music?

5 $_{\text{visual}}$. How often do you speak about art with friends or family?

5 $_{\text{auditory}}$. How often do you speak about music with friends or family?

6 How many art history courses did you take during or after high school?

7 How many art creation courses did you take during and after high school?

8 $_{\text{visual}}$. How often do you create visual art?

8 $_{\text{auditory}}$. How often do you practice or make music?

9 $_{\text{visual}}$. How many hours on average do you spend creating visual art?

9 $_{\text{auditory}}$. How many hours on average do you spend making music?

Responses (2): Never / Once a year / Twice a year / Every three months / Once a month / Every second week / Weekly

Responses (3–5, 8): Never / Very rarely / Seldom / Few times / Sometimes / Often / Very often

Responses (6, 7, 9): 0–6 or more

NEO-FFI-R Openness to Experience Scale
McCrae and Costa (2004)

1. I like to concentrate on a dream or fantasy and, letting it grow and develop, explore all its possibilities.
2. I think it is interesting to learn and develop new hobbies.
3. The forms I find in art and nature arouse my curiosity.
4. I believe that allowing young people to hear people whose opinions are controversial can only confuse or mislead them.
5. Poetry has little or no effect on me.
6. I would have difficulty letting my thought wander without control or direction.
7. I seldom realize the humor or emotions that exist in each environment or moment.
8. I experience a lot of emotions or feelings.
9. Sometimes, when I read poetry, listen to music or contemplate a work of art, I feel a deep emotion or excitement.
10. I have little interest in thinking about the nature of the universe or the human condition.
11. I am very curious about intellectual issues.
12. I often enjoy playing with abstract theories or ideas.

Responses: Totally disagree / Disagree / Neutral / Agree / Totally agree

Adapted version of the Desire for Aesthetics Scale (DFAS)
Lundy, Schenkel, Akrie, and Walker (2010)

1 When I see beautiful things in daily life I rarely feel passionate about them.

2 One of the reasons I love traveling is seeing gorgeous scenery.

3 $_{\text{visual}}$. When watching a movie or series I enjoy noticing visual details (e.g., photography, framing, colors).

3 $_{\text{auditory}}$. When watching a movie or series I enjoy noticing musical details.

4 $_{\text{visual}}$. I enjoy spending time appreciating architecture.

4 $_{\text{auditory}}$. I enjoy spending time appreciating music.

5 I often find myself staring in awe at beautiful things.

6 I notice the details of brand logos.

7 I notice and care about design.

8 $_{\text{visual}}$. I notice and attend to the details in paintings, architecture, sculpture, and graphic work.

8 $_{\text{auditory}}$. I notice and attend to the details in music.

9 $_{\text{visual}}$. The details I notice in paintings, architecture, sculpture, and graphic work evoke emotions in me.

9 $_{\text{auditory}}$. The details I notice in music evoke emotions in me.

Responses: Totally disagree / Moderately disagree / Slightly disagree / Neutral / Slightly agree / Moderately agree / Totally agree

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