# **Psychology of Aesthetics, Creativity, and the Arts**

# A Normed Art Database That Incorporates Diverse Cultures and Genres: The Penn Center for Neuroaesthetics Artwork Repository

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# A Normed Art Database That Incorporates Diverse Cultures and Genres: The Penn Center for Neuroaesthetics Artwork Repository

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We present a comprehensive data set of digitized artworks designed for empirical aesthetics research. This database uniquely includes artwork from underrepresented cultures-Mexican/Central and South American, African, and Middle Eastern and South Asian-and covers subcategories of Western Art, such as Euro-American Modern, American-Public Art, and Euro-American-Religious Art. The collection features 320 paintings, normed on 11 specific aesthetic impact dimensions: pleasure, calm, compassion, anger, challenge, upset, interest, enrapturement, edification, enlightenment, and inspiration, along with general evaluations of beauty, liking, and how familiar were viewers with artworks and artists. Each artwork is normed with both fine-grained (individual impacts and evaluations) and coarse-grained impacts (grouped into positive emotions, negative emotions, immersion, and epistemic transformation). The data set was rated by 814 participants. An interactive digital platform (https://vicenteestradagonzalez.shinyapps.io/CfNdatabase/) organizes the art within a four-dimensional space, mapping artworks across three axes-positive affect, negative affect, and epistemic transformation-with the size of spheres representing the level of motivation/immersion. This enables users to select stimuli based on specific research questions. This data set, available at https://github.com/vstradag/TRT, encompasses a wide range of cultural representations and normed aesthetic impacts, making it a valuable resource for empirical studies and neuroaesthetic research. We propose several potential applications for this database, highlighting its broad utility in exploring the intersections of culture, perception, and aesthetics.

Keywords: aesthetics data set, data set, unrepresented cultures, Mexican Art, Public Art

Artwork databases are important resources in empirical aesthetics, providing standardized stimuli for research. However, existing databases typically suffer from limited cultural diversity and normed evaluations. For example, the JenAesthetics subjective data set includes 1,628 high-resolution paintings, primarily from museum collections via the Google Art Project, representing various styles, periods, and subjects from 410 artists (Amirshahi et al., 2015). The JenAesthetics data set is normed for aesthetic quality, beauty, and preferences for color, composition, and content.

A more recent data set by Fekete and colleagues (2022), the Vienna Art Picture System, contains 999 European paintings from

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13 historical periods and five genres. Viewers rated these paintings on visual complexity, familiarity, emotional valence, emotional arousal, and liking—dimensions relevant to cognitive and affective aspects of visual aesthetic processing.

Similar to the Vienna Art Picture System and JenAesthetics data sets, others like the Assessment of Art Attributes (Chatterjee et al., 2010) and the Museum of Modern and Contemporary Art of Trento and Rovereto data set (Yanulevskaya et al., 2012) are skewed toward Western European and North American art. This bias narrows the perceptual lens and overlooks the rich variety of cultural expressions beyond a Eurocentric perspective, undermining efforts to investigate aesthetic universals and perpetuating cultural biases in art history.

Our study addresses this cultural myopia by curating a data set that embraces a global vision. We included three historically underrepresented art categories: Mexican/Central and South American Art, African Art, and Middle Eastern and South Asian Art, and three subcategories within Western Art: Euro-American Modern, American-Public Art, and Euro-American-Religious Art. Even the category of "Western" art is problematic, in so far as it is used in a way that does not typically acknowledge Indigenous American or Mexican art, which are produced in the West. Additionally, our data set includes contextual descriptions written by experts, setting it apart from many others.

# **Underrepresented Cultures in Empirical Aesthetics**

Mexican, Central, and South American Art is known for its vibrant blend of Indigenous and colonial influences, creating a rich visual culture from ancient civilizations to contemporary expressions. This art integrates pre-Columbian traditions with Spanish colonialism, resulting in a unique artistic identity marked by bold colors, symbolic imagery, and social and political commentary (Paz, 1997; Rochfort, 1993).

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African Art is deeply rooted in tradition and rituals. It is notable because of the integral connection between art and community life, where artworks serve significant cultural, spiritual, and functional roles. This art form includes diverse elements, from the masks and sculptures of West Africa used in rituals and ceremonies to the intricate beadwork and textiles of Southern and Eastern Africa, each conveying stories of identity, social status, and heritage (Willett, 2002).

Middle Eastern and South Asian Art also encompasses diverse forms. Middle Eastern and South Asian aesthetics emphasize intricate geometric patterns, arabesque designs, and calligraphy, reflecting abstract beauty aimed at transcending the physical world (Grabar, 1987). This art form often represents divine unity, a central concept in Islam. South Asian Art is notable for its colorful depictions, such as those from the Mughal period, focusing on spiritual aspects of India's legacy while blending with historical European sensibilities because of its attention to the individual (Singh, 2013).

# Subcategories of Western Art

In 20th-century aesthetics, Walter Benjamin's concept of "Aura" linked the mystical aspect of art creation and appreciation. "Aura" refers to the unique atmosphere surrounding a work of art because of its authenticity, imbuing objects with an intangible, spiritual quality akin to sacredness (Benjamin, 2010). This notion is crucial to religious art, where the "Aura" transcends mere physicality, giving artworks a divine sense. Brent Plate (2005) examined religion in art through its potential to elicit intense affective engagements, mirroring Benjamin's concept of "Aura". Our study includes Euro-American-Religious artworks to explore their capacity to elicit profound emotional and reflective responses, such as enrapturement and enlightenment.

Euro-American Modern Art is relevant to our study for its ability to encapsulate complex concepts beyond conventional representation. Much of modern art's iconography attempts to unlock unspoken aspects of the human unconscious. Engaging with modern art can be an act of discovery, a creative endeavor to identify patterns and meanings within abstract aspects of human cognition (Fineberg, 2015).

Unlike other databases, we include American-Public Art, which moves away from conventional art spaces and engages the public in a participatory experience that bridges art and life. This "postmuseum" approach fosters an inclusive dialogue, engaging a broader audience in aesthetics and societal themes (Riggle, 2010). Philadelphia, home to over 4,000 murals, is considered the mural capital of the world. These murals narrate the stories of the communities they embellish, highlighting social issues and local histories (Golden et al., 2002). They offer insights into the collective memory and identity of a place, telling stories that might otherwise remain untold (Golden et al., 2002).

The significance of public art as a medium for societal dialogue is the reason we included such stimuli in our study. By including murals, we aim to understand the particular impacts associated with sociocultural narratives and community identity expressed through this art form. Additionally, murals' public nature makes them accessible to a wider audience than is true of artworks in galleries and museums.

# The Present Study

In this study, we created a diverse artwork data set capable of eliciting a range of aesthetic impacts. Recognizing the importance of aesthetic emotions in art engagement (Kenett et al., 2023; Menninghaus et al., 2019), we sampled artworks from different cultures. By incorporating such diverse artworks, we aim to enrich empirical aesthetic research with stimuli that reflect a more global narrative. The data set includes 320 artworks chosen for their cultural and historical significance, as well as their potential to invoke a broad range of emotional and cognitive responses, as outlined by the Aesthetic Impact Taxonomy developed by Christensen et al. (2023). This taxonomy was created through collaboration with experts from various fields, including art history, neuroscience, philosophy, psychology, and theology. These experts developed a set of terms describing art's impacts, encompassing both the visual characteristics of the artwork and the subjective experience of the viewer. The resulting taxonomy includes 11 aesthetic dimensions, that in turn correspond to four coarse-grained categories: feelings of compassion, calm, and pleasure (i.e., positive affects); feelings of being challenged, upset, and angry (i.e., negative affect); enraptured and interested (i.e., immersion); and inspired, enlightened, and edified (i.e., epistemic transformation). This comprehensive model goes beyond evaluating whether art is merely beautiful or interesting by probing how art elicits various emotional responses, making it ideal for experiments that manipulate contextual factors to study the emotional impact of art (Kenett et al., 2023).

Given the cultural diversity of our study, participants might recognize certain artworks more than others—for example, people from the United States may be more familiar with Euro-American Modern Art than with African Art. Therefore, evaluating how familiarity might influence aesthetic experiences is crucial.

Our study involved collaboration with experts in various art fields to curate a collection that spans Mexican and Central/South American Art, African Art, Middle Eastern and South Asian Art, Euro-American Modern Art, Euro-American-Religious Art, and American-Public Art. The selected artworks underwent a formal evaluation by laypeople to establish emotional and cognitive impact profiles for each piece. This normed data set diversifies the stimuli available for aesthetic studies and provides a resource showcasing how different art forms might impact viewers.

By offering a standardized collection of artwork stimuli with emotional impact profiles, we provide a resource to enable future studies to probe the complexities of aesthetic experience across cultures.

# **Aims and Predictions**

The primary objective of this study is to provide an inclusive data set of historically relevant artwork images for research. This curated collection spans a wide range of potential aesthetic impacts (Christensen et al., 2023). The data set, along with emotion profiles associated with each artwork, is designed to support researchers in conducting generalizable and replicable experimental aesthetic studies.

We conducted an exploratory analysis to examine potential differences in the aesthetic impact profiles across different cultural origins. Our participant recruitment, limited to U.S.-based individuals, provides a template for conducting similar analyses among other groups. Disparities in responses could reveal how aesthetic perception is culturally modulated and how familiarity influences art appreciation (Darda et al., 2023).

We hypothesize that our participants would be more familiar with Euro-American Modern artworks compared to artworks from other cultural backgrounds (e.g., African Art) and compared to American-Public and Euro-American-Religious Art. To test this assumption, we compare the ratings of familiarity—how familiar participants are with the artworks and artists—between art categories. This familiarity is likely to result in more positive ratings for Euro-American Modern Art, reflecting the influence of cultural exposure on aesthetic preferences.

Building on the work of Amirshahi et al. (2013, 2015), another use of this database is to identify factors that influence individual preferences for artworks. We anticipate that the liking and interest of an artwork will correlate with identifiable impacts such as beauty, familiarity, and pleasure (Brieber et al., 2014). These attributes are expected to predict observers' preferences.

# Method

We followed a two-phase process similar to the one used to derive the Aesthetic Impact Taxonomy (Christensen et al., 2023). Initially, we assembled domain experts to select images of artworks with historical and cultural relevance that they believed sampled a wide range of aesthetic impacts. In the second phase, these images were crowdsourced to norm them on both aesthetic impacts and conventional aesthetic evaluations. This two-step process leverages the domain knowledge of experts and capitalized on the subjective experiences of lay viewers.

# **Artwork Selection**

For the recruitment of stimuli, six experts representing the following categories of art were convened:

- Tania Aedo-Mexican and Central/South American Art
- Ayodeji Ogunnaike—African Art
- · Sonal Khullar-Middle Eastern and South Asian Art
- Natalie Carnes-Euro-American-Religious Art
- Eileen Cardillo-American-Public Art
- Jonathan Fineberg—Euro-American Modern Art

The group gathered at the Penn Center for Neuroaesthetics on March 20, 2023. Each expert selected artworks reflective of our aesthetic taxonomy's impact dimensions. Each expert nominated four to five images for each of the 11 aesthetic impacts from Christensen et al. (2023). The enraptured dimension, for instance, included states such as enraptured, wonder, awe, transported, intoxicated, and swept away. Recognizing that art can and usually does have multiple impacts simultaneously, the experts focused on specific impacts to ensure comprehensive coverage of the taxonomy, which includes the domains: angry, calm, compassionate, challenged, edified, enraptured, enlightened, interested, inspired, pleasure, and upset.

The final set of stimuli included a wide range of art forms, such as engravings, textiles, mosaics, and photographs of performances and sculptures. The selected artworks varied widely in cultural and historical significance, as well as in likely familiarity to the public.

# **Stimuli Characteristics**

Our data set represents artistic expressions in six categories: Mexican/Central and South American Art, African Art, Middle Eastern and South Asian Art, Euro-American Modern Art, American-Public Art, and Euro-American-Religious Art. Table 1 shows the number of artworks included in each category, as well as the periods covered.

# Table 1

Number of Artworks Included in Each Category

Art category	Number of artworks	Year range
Mexican/Central and South American Art	56	1919–2020
African Art	42	1050-2010
Middle Eastern and South Asian Art	56	474-1965
Euro-American-Religious Art	56	1306-2020
American-Public Art	55	1990-2022
Euro-American Modern	55	1786-2022

# **Participants**

In total, 814 individuals participated in rating the artworks. The sample comprised 397 women (average age = 42.35 years, SD = 14.09), 408 men (average age = 38.75 years, SD = 12.34), and nine participants whose sex was not reported (average age = 31.13 years, SD = 8.06). All participants were proficient in English or native speakers and were recruited through Prolific. They provided informed consent before participation. The study received ethical approval from the University of Pennsylvania Institutional Review Board.

#### **Artworks Rating**

The evaluation procedure involved dividing the total corpus of images into 10 subsets, each comprising 32 randomly selected paintings. This randomization ensured that each participant saw a unique, varied collection. Artwork presentations included standard identifications (artist, title, and year of creation) along with a brief description of the artwork's content (see example in Figure 1).

Participants rated each image on a scale from 1 to 5 across the specified 11 aesthetic impact dimensions: angry, calm, compassionate, challenged, edified, enraptured, enlightened, interested, inspired, pleasure, and upset. Additional evaluations included beauty, personal liking, and familiarity. Familiarity-related questions were: "Is this artist familiar to you?" and "Is this image familiar to you?"

To conclude, participants completed a series of questionnaires aimed at capturing their overall aesthetic experience. They also responded to an Openness to Experience questionnaire (Estrada Gonzalez et al., 2024) and provided demographic information.

The Openness to Experience questionnaire assessed key personality traits that may influence participants' aesthetic experiences. It evaluates their tendency to engage with aesthetic activities, embrace novelty, seek new information, and be open to unfamiliar environments or experiences. Participants were presented with a series of "I" statements or opinions describing specific traits and asked to indicate their level of agreement. Examples of these statements include "I believe variety is the spice of life," "Our ideas of right and wrong may not be universal," and "I need a creative outlet." Response options ranged from *strongly disagree* to *strongly agree*. An attention check was also included, instructing participants to select "disagree" for one specific statement. For more information see Darda and Chatterjee (2023).

The assessment of art participation was used to assess participants' art experience and was inspired by the Assessment of Art

#### Figure 1

Example of an Artwork Belonging to the American-Public Art Category



Title and Artist: Industrious Light: Baldwin Locomotive Works by Phillip Adams

**Description:** Part of a series celebrating Philly's industrial history, this mural highlights the role of Baldwin Locomotive and allied industries in ensuring jobs, technical advances, and the growth of the city and nation

*Note.* At the bottom, the information that was provided to the participants in the norming phase is shown. Adapted from *Industrious Light: Baldwin Locomotive Works.* Copyright 2019 by City of Philadelphia Mural Arts Program/Phillip Adams. Photo by Steve Weinik. See the online article for the color version of this figure.

Attributes by Chatterjee et al. (2010). This instrument is designed to quantify the depth of participants' art-related experiences, their familiarity with different art forms, and their level of engagement in artistic activities. We are preparing a separate publication that details the rationale behind this questionnaire (Merseal et al., 2024). This questionnaire targets key aspects of participants' experiences in both art production and perception and includes questions to evaluate how often participants engage with art, visit museums or galleries, create art themselves, and their familiarity with diverse artistic styles.

For the demographic questionnaire, we asked participants to provide basic information regarding their age, gender, sex, and level of education.

# App Development Based on Coarse-Grained Dimensions of Aesthetic Impacts

To streamline access to the artworks in this data set and their corresponding aesthetic impact profiles, we developed an online application using Shiny, an R-based web application framework. Our application features a three-dimensional visualization created with Plotly, offering users an interactive exploration of the artworks' emotional dimensions.

The application's interface is structured around four coarsegrained dimensions synthesized from the original fine-grained 11

# Figure 2

Screenshot of the Online Platform to Access the Penn CfN Data Set



*Note.* It shows a screenshot of the online platform to access the information and display the artwork images of the Penn CfN data set. CfN = Center for Neuroaesthetics. See the online article for the color version of this figure.

dimensions, as derived by Christensen et al. (2023). These four dimensions simplify the complex data into a more digestible format: positive affect (an average of pleasure, calm, and compassionate), negative affect (anger, upset, and challenge), immersion (interest and enrapturement), and epistemic transformation (edification, enlightenment, and inspiration).

In the app's three-dimensional spatial model, each artwork's position and size are determined by these dimensions: positive affect, negative affect, and epistemic transformation plot along the x, y, and z axes, respectively, while the sphere size denotes the degree of immersion. This design facilitates an intuitive user experience, enabling seamless navigation and selection of artworks based on the desired emotional impact criteria, thus enriching the exploration and selection process for empirical aesthetic studies.

This digital tool, accessible at https://vicenteestradagonzalez .shinyapps.io/CfNdatabase/, presents artworks in distinct colors, correlating with their respective categories: African (red), Middle Eastern and South Asian (purple), Mexican/Central and South American (green), Euro-American Modern (turquoise) Euro-American-Religious (blue), and American-Public Art (navy blue). This visual categorization (see Figure 2) simplifies the process of selecting stimuli based on specific affective criteria. For instance, a researcher seeking artwork that elicits predominantly negative emotions can readily identify and select appropriate stimuli by focusing on the corresponding axis in the visualization.

Interactive elements of the app enrich the user experience. Moving the cursor over a datapoint reveals the artwork's identification number and its categorical lineage. Clicking on any datapoint displays the artwork with its description and aesthetic impact profile. This feature not only introduces the artwork but also provides context and a deeper understanding of its aesthetic valence.

Moreover, the app includes a feature to download individual artwork images and a spreadsheet listing the artworks along with basic statistical analyses of the 11 aesthetic impact ratings—means and standard deviations. The data set is also available for download on GitHub at https://github.com/vstradag/TRT.

## Analysis

The primary goal of this study is to assemble an accessible data set of artworks with normed (by U.S. participants) aesthetic impact profiles to assist empirical aesthetics researchers. This data set is designed to streamline research by providing a platform of quantifiable responses to visual art. To enhance the data set's utility and approachability, we developed an online application to serve as a gateway to this collection. The advantages and potential uses of this tool are discussed in the Discussion section.

Here, we examine how different impacts can lead to the most commonly probed aesthetic valuations: liking and interest. This particular analysis does not directly capitalize on the cultural diversity of our art stimuli, but this diversity ensures a wider range of art types than typically used, broadening the scope of aesthetic research.

# **Prediction of Liking**

To determine how the aesthetic impacts rated by participants influenced their overall liking of artworks, we conducted a linear regression analysis. The dependent variable in this analysis was the participants' liking ratings, while the aesthetic impacts served as the independent variables. The model was specified as follows:

These analyses are presented as examples of how impact scores might be used for comparison.

# **Prediction of Interest**

Similarly, to explore how the aesthetic impacts rated by participants drive their interest in artworks, we conducted a linear regression analysis with the same set of aesthetic impacts as independent variables. The model was specified as follows:

# **Relevance of Impacts: Qualitative and Quantitative**

Artworks, irrespective of their semantic context or physical properties, may elicit certain impacts more frequently than others. To understand how participants rated artworks, we conducted two different analyses:

- Frequency analysis: We quantified the frequency of artworks that were rated above 2.5 in each aesthetic impact. A rating of 2.5 was selected as the median of possible ratings on our scale (from 1 to 5).
- 2. Linear mixed models (LMMs)analysis: We performed an LMM analysis to determine the statistical differences

between impacts. The model used was:

Rating  $\sim$  Aesthetic Impact + (1|stimulus) (3)

In this analysis, "compassionate" was selected as the reference category because, in our qualitative analysis, the number of artworks rated above 2.5 for this impact was the median value across all impacts (i.e., 138).

# Familiarity With Artworks and Artists

To verify whether familiarity ratings for artworks ("Is this image familiar to you?") and artists ("Is this artist familiar to you?") differed between art categories, we conducted an LMM analysis. The model accounted for the fixed effects of art categories, art experience, openness to experience, age, and education. It included random intercepts for participants and artworks to account for individual differences and repeated measures.

The model was specified as follows:

Familiarity (artwork|artist)  $\sim$  Art Category + Age

+ (1|SubjectID) + (1|stimulus).

# **Differences Between Art Categories**

We examined the potential differences in the aesthetic impact profiles across the art categories included in our data set. This comparison is done with caution because the comparisons are contingent on the specific stimuli in our set and may not generalize to African and Middle Eastern and South Asian Art overall, for example. LMM analyses were conducted with post hoc pairwise comparisons between the categories to identify specific contrasts.

The model accounted for the fixed effects of art categories, age, education, art experience, and openness to experience, with random intercepts for participants and stimuli to account for individual differences and repeated measures. The model was specified as follows:

Rating – Art Category + Age + Education + Art Experience + Openness to Experience (5) + (1|SubjectID) + (1|stimulus).

# Results

# Prediction of Liking

Given that individuals' liking of artworks stems from various factors, we tested whether the aesthetic impacts rated by participants predicted or influenced their overall liking perceptions. We employed linear models with liking as the dependent variable and the aesthetic impacts as predictors.

Emotional responses such as enraptured, edified, enlightened, inspired, pleasure, calm, compassionate, and beauty positively influenced liking. The coefficients and significance levels were as follows: enraptured ( $\beta = 1.49, p < .001$ ), edified ( $\beta = 1.75, p < .001$ ), enlightened ( $\beta = 1.26, p < .001$ ), inspired ( $\beta = 1.07, p < .001$ ), pleasure ( $\beta = 0.91, p < .001$ ), calm ( $\beta = 0.74, p < .001$ ), compassionate ( $\beta = 0.59$ , p < .001), and beauty ( $\beta = 0.85$ , p < .001). These results indicate that higher levels of these positive emotional states correspond to increased liking ratings for the artworks.

Conversely, emotions such as anger, upset, and challenge had a negative influence on participants' liking ratings. The coefficients and significance levels were anger ( $\beta = -0.78$ , p < .001), upset ( $\beta = -0.63$ , p < .001), and challenge ( $\beta = -0.3$ , p = .005). This indicates that higher levels of perceived anger, upset, and feeling challenged are associated with lower liking ratings for the artworks (see Figure 3).

# **Prediction of Interest**

Positive emotional responses significantly enhanced interest in the artworks. The coefficients and significance levels for these positive impacts were being enraptured ( $\beta = 1.0, p < .001$ ), edified ( $\beta = 1.2, p < .001$ ), enlightened ( $\beta = 0.85, p < .001$ ), inspired ( $\beta = 0.68, p < .001$ ), pleasure ( $\beta = 0.51, p < .001$ ), calm ( $\beta = 0.35, p < .001$ ), compassionate ( $\beta = 0.39, p < .001$ ), and finding beauty ( $\beta = 0.51, p < .001$ ). These results indicate that higher levels of these positive emotional states correspond to increased interest ratings for the artworks.

Conversely, negative emotional responses such as anger and upset were found to diminish interest, with coefficients and significance levels as follows: anger ( $\beta = -0.36$ , p < .001) and upset ( $\beta = -0.27$ , p < .001). However, as shown in Figure 4, the feeling of being challenged had a slight positive effect on interest ( $\beta =$ 0.16, p = .02). This reveals a nuanced relationship where some negative emotions can decrease interest, while others, like feeling challenged, can increase it.

# Figure 3



Coefficient Estimates of Aesthetic Impacts on Liking



# *Note.* Estimate values in blue indicate a positive prediction of liking, whereas those in red (dark gray) correspond to negative predictors. See the online article for the color version of this figure.

# **Relevance of Impacts**

Table 2 displays the mean and standard deviation for each aesthetic impact. The mean ratings reveal notable tendencies across the dimensions. For instance, artworks generally elicit higher levels of interest (M = 3.19, SD = 0.39) and liking (M = 3.11, SD = 0.55), suggesting a prevalent positive affective response among participants. Conversely, dimensions such as feeling challenged (M = 2.10, SD = 0.28) and upset (M = 1.46, SD = 0.40) exhibited comparatively lower mean ratings.

Our qualitative results showed that some aesthetic impacts were more frequently rated above the median value (2.5) on our rating scale. Table 2 also shows the number of artworks that were rated above 2.5 for each aesthetic impact:

The highest number of artworks (302) rated above 2.5 were in the interested category, indicating that participants found most of these artworks interesting. Liking and beauty impacts were also frequent, with 272 and 263 artworks rated above 2.5, respectively, suggesting these attributes are commonly perceived across this selection of artworks. On the other hand, challenged, upset, and angry were least often rated above 2.5, indicating these impacts are less commonly perceived. Specifically, angry had the lowest frequency with only three artworks rated above 2.5. A more detailed view of the qualitative results, organized by category, can be found in Table 3.

From the LMM analysis, the fixed effects estimates reveal the relative differences in ratings between the various aesthetic impacts and the reference category, compassionate. The fixed effects estimates, standard errors, t values, and p values for the aesthetic impacts are summarized in Table 4:

# Figure 4

Estimates of Each Aesthetic Impact Dimension on Interested Ratings





*Note.* Estimate values in blue indicate a positive prediction of liking, whereas those in red (dark gray) correspond to negative predictors. See the online article for the color version of this figure.

 Table 2

 Descriptive Statistics of Aesthetic Impacts Ratings

Aesthetic impact	М	SD	Number of artworks rated above 2.5
Interested	3.19	0.39	302
Liking	3.11	0.55	272
Beauty	3.12	0.63	263
Calm	2.66	0.59	195
Inspired	2.59	0.48	185
Enlightened	2.43	0.37	140
Compassionate	2.47	0.57	138
Pleasure	2.41	0.54	137
Enraptured	2.21	0.33	55
Challenged	2.1	0.28	31
Upset	1.46	0.4	12
Edified	2.06	0.24	11
Angry	1.35	0.32	3

The intercept represents the baseline mean rating for the reference category, compassionate, which is 2.47. The mean ratings for angry, upset, and challenged are significantly lower than compassionate by 1.1 units (p < .001), 1.0 units (p < .001), and 0.36 units (p < .001), respectively. Similarly, the mean ratings for enraptured, edified, and enlightened are also significantly lower than compassionate by 0.26 units (p < .001), 0.4 units (p < .001), and 0.04 units (p < .001), respectively. On the other hand, the ratings for interested, inspired, calm, liking, and beauty are significantly higher than compassionate by 0.7 units (p < .001), 0.12 units (p < .001), 0.2 units (p < .001), 0.64 units (p < .001), and 0.65 units (p < .001), respectively.

# **Familiarity for Artworks**

Euro-American Modern Art was chosen as the reference category for comparison. The intercept (-3.27, p < .001) represents the log odds of artworks not being familiar when all other predictors are zero, indicating a significant baseline likelihood of artworks not being familiar overall.

Artworks from African ( $\beta = -1.04$ , p < .001), Mexican/Central and South American ( $\beta = -1.08$ , p < .001), American-Public Art ( $\beta = -1.0$ , p < .001), and Middle Eastern and South Asian ( $\beta = -1$ , p < .001) categories were significantly less familiar compared to Euro-American Modern Art. However, artworks categorized as Euro-American-Religious did not differ in familiarity compared to Euro-American Modern Art (p = .62).

Art experience ( $\beta = 0.67$ , p < .001) and openness to experience ( $\beta = 0.24$ , p < .001) positively correlated with familiarity, while age and education did not.

### **Familiarity for Artists**

Euro-American Modern artists were used as the reference category for this analysis. Compared to Euro-American Modern Artists, artworks categorized as African ( $\beta = -2.71$ , p < .001), Mexican/Central and South American ( $\beta = -1.77$ , p < .001), American-Public Art ( $\beta = -1.74$ , p < .001), and Middle Eastern and South Asian ( $\beta = -2.1$ , p < .001) showed significantly lower familiarity with the artists. However, familiarity with artists in Euro-American-Religious Art artworks did not differ from Euro-American Modern Art (p = .13). Art experience ( $\beta = 0.68$ , p < .001) and openness to experience ( $\beta = 0.15$ , p = 0.03) were positively associated with familiarity with artists. Age ( $\beta = 0.22$ , p < .001) and education ( $\beta = 0.23$ , p < .001) also showed significant positive associations with familiarity.

## **Differences Between Art Categories**

We examined potential differences in the aesthetic impact profiles across the art categories included in our data set—Mexican and Central/South American Art, African Art, Middle Eastern and South Asian Art, Euro-American-Religious Art, American-Public Art, and Euro-American Modern Art. These comparisons are illustrative and not generalizable to all artworks within these categories.

LMM analyses and post hoc pairwise comparisons between the categories were conducted. American-Public Art was liked more than all other categories, including African ( $\beta = -0.56$ , p < .001), Mexican/ Central and South American ( $\beta = -0.73$ , p < .001), Euro-American Modern ( $\beta = -0.52$ , p < .001), Euro-American-Religious Art ( $\beta = -0.58$ , p < .001), and Middle Eastern and South Asian Art ( $\beta = -0.63$ , p < .001).

The estimates, confidence intervals, and *p* values from the following model are shown in Table 5.

As shown in Table 6, the LMM conducted for beauty revealed significant differences between art categories (p < .001). American-Public Art was also considered more beautiful than African ( $\beta = -0.62$ , p < .001), Mexican/Central and South American ( $\beta = -0.85$ , p < .001), Euro-American Modern ( $\beta = -0.6$ , p < .001), Euro-American-Religious ( $\beta = -0.5$ , p < .001), and Middle Eastern and South Asian artworks ( $\beta = -0.59$ , p < .001).

American-Public Art was rated as inducing more calm than African ( $\beta = -0.44$ , p = .002), Mexican/Central and South American ( $\beta = -0.55$ , p < .001), Euro-American Modern Art ( $\beta = -0.33$ , p = .026), and Euro-American-Religious Art ( $\beta = -0.38$ , p = .006) but not more than Middle Eastern and South Asian Art ( $\beta = -0.22$ , p = .291).

American-Public Art was rated higher in compassion than African ( $\beta = -0.77$ , p < .001), Mexican/Central and South American ( $\beta = -0.7$ , p < .001), Euro-American Modern ( $\beta = -0.67$ , p < .001), Euro-American-Religious ( $\beta = -0.39$ , p < .001), and Middle Eastern and South Asian artworks ( $\beta = -0.72$ , p < .001).

Middle Eastern and South Asian Art evoked more challenge compared to Mexican/Central and South American Art ( $\beta = 0.22$ , p = .05), Euro-American Modern Art ( $\beta = 0.15$ , p = .05), and Euro-American-Religious Art ( $\beta = 0.15$ , p = .05). Compared to African Art ( $\beta = 0.11$ , p = .37) and American-Public Art ( $\beta = -0.14$ , p = .074), Middle Eastern and South Asian Art levels of challenge were not significantly different.

American-Public Art was higher in edification compared to Middle Eastern and South Asian ( $\beta = -0.25$ , p < .001) and Mexican/Central and South American Art ( $\beta = -0.31$ , p < .001). Additionally, Euro-American-Religious artworks exhibited higher edification compared to Mexican/Central and South American ( $\beta = -0.2$ , p < .001), Euro-American Modern ( $\beta = -0.18$ , p < .001), and Middle Eastern and South Asian Art ( $\beta = 0.14$ , p = .01).

American-Public artworks were higher in enraptured ratings than African ( $\beta = -0.27$ , p < .001), Mexican/Central and South

1	

Means and Standard Deviations per Aesthetic Impact for Each Art Category

**Table 3** 

	Mexica	n/Central										
	and Ameri	South can Art	Africa	an Art	Middle Ea South As	astern and sian Art	Euro-Ar Mod	nerican lern	Amer	ican- c Art	Euro-An Relig	ierican- ious
Artwork category	Μ	SD	Μ	SD	Μ	SD	Μ	SD	Μ	SD	W	SD
nterested	3.1	1.32	3.22	1.32	3.06	1.29	3.12	1.29	3.51	1.25	3.14	1.33
iking	2.88	1.34	3.05	1.32	2.97	1.28	3.09	1.27	3.61	1.25	3.04	1.34
Beauty	2.8	1.28	3.02	1.27	3.04	1.23	3.07	1.21	3.64	1.21	3.15	1.27
Calm	2.43	1.22	2.54	1.27	2.75	1.25	2.64	1.22	2.98	1.27	2.6	1.26
nspired	2.37	1.28	2.5	1.31	2.4	1.26	2.53	1.28	3.14	1.35	2.56	1.34
Inlightened	2.25	1.25	2.4	1.3	2.38	1.28	2.3	1.25	2.77	1.35	2.48	1.32
Compassionate	2.3	1.25	2.24	1.25	2.3	1.25	2.33	1.24	3	1.33	2.61	1.32
leasure	2.17	1.21	2.32	1.25	2.37	1.23	2.42	1.22	2.91	1.31	2.28	1.26
Inraptured	2.08	1.21	2.15	1.24	2.11	1.2	2.21	1.25	2.42	1.31	2.25	1.27
Challenged	2.2	1.25	2.09	1.21	1.97	1.15	2.12	1.24	2.12	1.23	2.13	1.22
Jpset	1.52	0.86	1.35	0.76	1.4	0.76	1.54	0.85	1.35	0.75	1.55	0.87
3. dified	1.95	1.13	2.03	1.18	2.01	1.15	1.96	1.16	2.25	1.25	2.14	1.22
Angry	1.41	0.79	1.26	0.67	1.33	0.69	1.39	0.77	1.3	0.7	1.41	0.79
Artist familiarity	0.04	0.17	0.02	0.11	0.03	0.14	0.16	0.29	0.03	0.17	0.11	0.27
Artwork familiarity	0.05	0.21	0.07	0.2	0.07	0.21	0.13	0.27	0.06	0.21	0.12	0.3

American ( $\beta = -0.34$ , p < .001), Euro-American-Religious ( $\beta = -0.17$ , p = .01), Euro-American Modern ( $\beta = -0.2$ , p = .003), and Middle Eastern and South Asian Art ( $\beta = -0.3$ , p < .001). Additionally, Euro-American-Religious works exhibited significantly higher levels of enraptured ratings than Mexican/Central and South American Art ( $\beta = -0.17$ , p = .019).

Similarly, American-Public Art displayed notably higher enlightenment compared to African Art ( $\beta = -0.37$ , p < .001), Mexican/ Central and South American Art ( $\beta = -0.52$ , p < .001), Euro-American-Religious exhibits ( $\beta = -0.28$ , p < .001), Euro-American Modern Art ( $\beta = -0.47$ , p < .001), and Middle Eastern and South Asian Art ( $\beta = -0.39$ , p < .001). Differences also emerged between Mexican/Central and South American and Euro-American-Religious displays ( $\beta = -0.24$ , p = .002).

American-Public Art elicited more interest compared to African  $(\beta = -0.29, p \le .001)$ , Middle Eastern and South Asian  $(\beta = -0.44, p < .001)$ , Mexican/Central and South American  $(\beta = -0.41, p < .001)$ , Euro-American Modern  $(\beta = -0.39, p < .001)$ , and Euro-American-Religious Art  $(\beta = -0.37, p < .001)$ .

American-Public Art consistently elicited higher inspiration compared to African ( $\beta = -0.64$ , p < .001), Middle Eastern and South Asian ( $\beta = -0.73$ , p < .001), Mexican/Central and South American ( $\beta = -0.77$ , p < .001), Euro-American Modern ( $\beta = -0.64$ , p < .001), and Euro-American-Religious ( $\beta = -0.58$ , p < .001) artworks.

The same effect emerged with the pleasure analysis. American-Public Art consistently elicited more pleasure than African ( $\beta = -0.59$ , p < .001), Middle Eastern and South Asian ( $\beta = -0.53$ , p < .001), Mexican/Central and South American ( $\beta = -0.74$ , p < .001), Euro-American Modern ( $\beta = -0.52$ , p < .001), and Euro-American-Religious ( $\beta = -0.62$ , p < .001) artworks. For anger and upset, the pairwise comparison showed no significant differences across art categories.

# Discussion

This study makes available a normed database that reflects a wide spectrum of aesthetic impact profiles in art from different cultures. The inclusion of artworks from traditionally underrepresented cultures addresses the limits of a Eurocentric bias in current databases, broadening the diversity of stimuli available to be used in experimental aesthetics. Artworks within the database were selected for their historical and cultural significance and for their potential to evoke distinct profiles of emotional and cognitive states as identified by our Aesthetic Impact Taxonomy (Christensen et al., 2023).

# **Digital Tool**

The digital tool developed for this database offers an innovative way to categorize and select art stimuli. Its user-friendly design and interactive features make it easy for researchers and art practitioners to precisely select stimuli for various research purposes. Beyond academic research, this tool also provides artists and educators with a platform to explore the emotional impact of different art forms.

In its three-dimensional interactive environment, each artwork is mapped according to its position and volumetric representation, reflecting its impact profile across four dimensions: positive affect,

 Table 4

 Results of LMM Analysis With Aesthetic Impacts as Fixed Effects

 and Compassionate as Reference Category

Fixed effects	Estimate	t	$\Pr(> t )$
Intercept	2.47	135.65	< 0.0001***
Interested	0.72	67.21	< 0.0001***
Beauty	0.65	60.49	< 0.0001***
Liking	0.64	59.34	< 0.0001***
Calm	0.20	18.32	< 0.0001***
Inspired	0.11	10.62	< 0.0001***
Enlightened	-0.04	-3.38	< 0.0001***
Pleasure	-0.05	-5.05	< 0.0001***
Enraptured	-0.26	-24.43	< 0.0001***
Challenged	-0.36	-33.50	< 0.0001***
Edified	-0.41	-37.87	< 0.0001***
Upset	-1.01	-93.43	< 0.0001***
Angry	-1.11	-102.82	< 0.0001***

Note. LMM = linear mixed model.

\*\*\* p < .001.

negative affect, epistemic transformation, and immersion. This spatial mapping acts as both a visual and analytical aid, providing a clear overview of the data set's aesthetic landscape.

The application enhances the data set's usability, allowing researchers to filter and select stimuli not only by traditional categories but also by the emotional responses they wish to study or evoke in an experimental setting. This dual functionality represents a novel approach in empirical aesthetics, where the selection of stimuli is often limited by less dynamic and more time-consuming processes.

# **General Aesthetic Impact Rating**

The aesthetic impacts of interest, beauty, and liking received the highest positive ratings compared to compassionate—selected as a reference category in our analysis—indicating that participants defaulted to positive evaluations when engaging with these curated

#### Table 5

Results of LMM Analyzing the Difference Between Art Categories on Liking

		Liking	
Predictor	Estimates	CI	р
Analysis between art categories			
Intercept	3.12	[3.05, 3.19]	<.001
Art category	-0.48	[-0.63, -0.34]	<.001
Age	0.00	[-0.05, 0.05]	.928
Education	0.02	[-0.03, 0.07]	.354
Art experience	0.16	[0.11, 0.21]	<.001
Openness to experience	0.16	[0.11, 0.21]	<.001
Random effects			
$\sigma^2$	1.22		
T <sub>00</sub> SubjectID	0.43		
$\tau_{00}$ standardized stimulus	0.24		
ICC	.36		
N <sub>subjectID</sub>	814		
$N_{\text{standardized stimulus}}$	316		
Observations	26,443		
Marginal $R^2$ /conditional $R^2$	.050/.389		

*Note.* Bold values indicate statistically significant effects (p < .05). LMM = linear mixed model; CI = confidence interval; ICC = intraclass correlation coefficient.

#### Table 6

Results of LMM Analyzing the Difference Between Art Categories on Beauty

		Beauty	
Predictor	Estimates	CI	р
Analysis between art categories			
Intercept	3.14	[3.06, 3.22]	<.001
Art category	-0.59	[-0.75, -0.43]	<.001
Age	-0.01	[-0.06, 0.03]	.571
Education	0.03	[-0.02, 0.08]	.209
Art experience	0.16	[0.11, 0.22]	<.001
Openness to experience	0.16	[0.11, 0.21]	<.001
Random effects			
$\sigma^2$	1.04		
T <sub>00subjectID</sub>	0.46		
$\tau_{00}$ standardized stimulus	0.31		
ICC	.42		
N <sub>subjectID</sub>	814		
N <sub>standardized</sub> stimulus	316		
Observations	26,443		
Marginal $R^2$ /conditional $R^2$	.064/.460		

*Note.* Bold values indicate statistically significant effects (p < .05). LMM = linear mixed model; CI = confidence interval; ICC = intraclass correlation coefficient.

artworks. This tendency could be attributed to the nature of art to evoke positive emotions or the selection biases of our experts who chose artworks they liked. It might also reflect a societal inclination to appreciate and value art as a symbol of creativity and human expression, leading individuals to favorably evaluate their experience.

Despite the general trend of positive ratings, it is important to note that our data set of images includes artworks with a wide spectrum of aesthetic impact profiles. For example, artwork 60, titled "The Seven Vices: Desperation" by Giotto from 1,306 and shown in Figure 5, depicts the sin of desperation through the image of a woman who has committed suicide. This artwork elicited high ratings in negative impacts: angry (M = 2.26, SD = 1.35) and upset (M = 3.14, SD = 1.49).

# Liking and Interest

Why do people like art? Our analysis revealed that artworks that inspire, enlighten, and provide pleasure are liked. Conversely, negative emotions correlated with lower liking, suggesting that while challenge and upset may be integral to some artwork's message, they are less conducive to enjoyment. This finding underscores the balance between challenge and pleasure in art appreciation and supports the idea that aesthetic experiences are multifaceted, blending cognitive, emotional, and evaluative components.

Similarly, our analysis showed that positive emotions also predicted increased interest, indicating that feelings of being enraptured, edified, enlightened, inspired, experiencing pleasure, calm, compassion, and recognizing beauty enhance viewers' interest in art. In contrast, negative emotions such as anger and upset were found to predict interest negatively.

The most important distinction between liking and interest is the experience of feeling challenged. People do not "like" being challenged by their artwork, and yet a challenging experience enhances interest in viewers. Interest and liking may follow different routes,

**Figure 5** *The Seven Vices: Desperation by Giotto* 



*Note.* An example of an artwork from the PCfN data set that received predominantly negative ratings. PCfN = Penn Center for Neuroaesthetics. See the online article for the color version of this figure.

with interest aided by the presence of a challenge, while liking is hampered by it. While speculative, this interpretation opens up new avenues for understanding nuanced dynamics of aesthetic experiences.

# **Familiarity Between Art Categories**

The familiarity results underscore the importance of cultural exposure in shaping aesthetic experiences. As expected, our U.S.-based participants found Euro-American Modern Art more familiar than African, Mexican/Central and South American, Middle Eastern and South Asian artworks and, interestingly, than American-Public Art. This level of familiarity likely influences arts' emotional and cognitive impacts on viewers (Song et al., 2021; Zajonc, 1968).

Euro-American-Religious artworks did not significantly differ in familiarity from Euro-American Modern Art. This finding aligns with the notion that religious art, often depicting universal themes, may resonate more broadly with diverse audiences. While religious art might not be as popular as modern art, both types belong to the Western tradition. In the future, evaluating these stimuli on different populations would advance our understanding of the role of familiarity in art appreciation.

Our study also confirms the role of individual differences in art experience and personality traits that shape familiarity with both artworks and artists. More experience with art and openness to experience were positively associated with familiarity, suggesting that people who are more exposed to art and have a greater willingness to engage with novel experiences are more likely to recognize and appreciate diverse artworks. This aligns with previous findings that art expertise and personality traits influence aesthetic preferences and perceptions (Silvia & Berg, 2011).

Additionally, the significant associations of age and education with familiarity in the context of artists indicate that older and more educated people might have broader knowledge and recognition of artists, perhaps because of prolonged and varied exposure to art over their lifetimes. Darda et al. (2023) found that age and education modulate the in-group bias—a preference for artworks by members of one's own cultural group compared to those from outside their group. The authors found that older and more educated people are better able to distinguish between different art styles and their origins. This enhanced ability likely stems from cumulative exposure to diverse artworks and cultures over time, which enriches their aesthetic experiences and judgments.

# **Aesthetic Impact Differences Between Art Categories**

Our findings illustrate the varying aesthetic impacts that different cultural art forms have on viewers from specific backgrounds. Any claims we make in comparing art forms are made with caution. A different sample of art from a specific culture might elicit different responses. Participants from different cultures are likely to have different responses. For instance, Middle Eastern and South Asian Art elicited a significantly higher level of challenge in our participants (based in the United States) compared to Euro-American Modern, Mexican/ Central and South American, and Euro-American-Religious Art. This suggests our particular selection of Middle Eastern and South Asian artworks' intricate narratives and representations might stimulate more cognitive engagement and reflection, particularly in a population less familiar with this tradition.

Furthermore, Euro-American-Religious artworks, rich in symbolism and spiritual meaning, were rated higher on edification than Mexican/ Central and South American and Euro-American Modern art, indicating their potential to provoke introspection and contemplation.

Conversely, African Art, with its strong and vivid storytelling, did not reach the high levels of pleasure observed in American-Public Art, reflecting perhaps a more solemn or reflective engagement with viewers as opposed to the more immediately impactful nature of American-Public Art.

American-Public Art was notable for being liked and thought to be most beautiful, perhaps reflecting its more accessible nature compared to the other art categories. Its public and often political nature may resonate with contemporary viewers, offering relatability that can be lacking in more traditional or historical art forms. In addition, the significant impact of American-Public Art across all eight positive emotional impacts (calmness, compassion, edification, enraptured, enlightenment, interest, pleasure, and inspiration) and both general aesthetic evaluations (liking and beauty) attests to its power to elicit a strong, positive aesthetic experiences. Perhaps could imagine the murals on a large scale because of their contextual surroundings, such as people walking, other buildings, and cars. This perception of scale might convey a sense of greatness and grandeur. Previous studies (Estrada-Gonzalez et al., 2020) have shown that the larger an artwork is perceived, the more visual engagement it attracts. Most importantly, these observations highlight the importance of public art grounded in local communities that might have an immediate impact on people that is more powerful than art sequestered in important and often inaccessible museums.

The observed differences in impact ratings across art genres confirm our study's predictions: diversifying the art spectrum, beyond the Eurocentric bias in previous data sets, enriches the potential for a wider array of emotional and cognitive responses to these stimuli.

Overall, by integrating a culturally expansive selection of artworks, this resource fills a gap in the diversity used in empirical art research. The emotional and cognitive responses captured offer an inclusive tool for the empirical aesthetics community.

# **Further Directions**

The possibilities for future studies are many. Researchers can leverage the database to design experiments with a richer set of variables, potentially uncovering new insights into the psychology of art perception. One could more easily examine the response profiles of groups from different cultures. One could also leverage the detailed impact profiles associated with each artwork for nuanced investigation into how art evokes different responses across individual differences. Moreover, the database can facilitate studies on the effects of repeated exposure to diverse art forms, potentially revealing how aesthetic preferences and cultural competencies develop over time. We offer some examples below.

A study could investigate how repeated exposure to African art influences a sense of community and cognitive engagement compared to repeated exposure to Western art. Participants could be exposed to these art forms over several weeks, and their responses in terms of positive affect could be measured at different intervals. The study might reveal that frequent interaction with African Art, with its deep-rooted cultural and communal significance, enhances social connectedness more than Western art, which might instead foster individual introspection and intellectual appreciation. Such research could provide valuable insights into how different art forms benefit social or even mental health aspects, and how cultural exposure shapes aesthetic experiences and preferences over time.

This data set could be used to explore the therapeutic uses of art, assessing how diverse aesthetic experiences contribute to emotional well-being and cognitive expansion. For example, Mexican/Central and South American Art, known for its bold colors and dynamic imagery, may provide stimulating and uplifting experiences that may help reduce anxiety by shifting focus away from stressors and enhancing mood. On the other hand, Middle Eastern and South Asian art, characterized by spiritual themes, might be particularly effective in meditation settings, promoting relaxation and mindfulness.

One could compare responses to art from different cultures or groups. For example, would people who regard themselves as religious be impacted differently by religious art than our mostly lay participants? Would people who are religious but not from a Judeo-Christian background react similarly to the mostly Euro-American-Religious iconography and its symbolic nature rooted in a western culture.

One could take images (across cultures) that are high on the "challenged" impact and investigate whether other variables like curiosity mediate whether such images are experienced as confusing or as inspiring, both impacts residing close to challenge in our semantic network of aesthetics impacts (Christensen et al., 2023).

The contextual information provided could be used to determine if such information is more valuable in art appreciation for unfamiliar art or art from a different culture.

Finally, one could use the profiles to probe the biological bases of art impacts. One could select images that vary parametrically on "challenged" or on "edified" and model neural responses that also vary parametrically with such impacts.

In sum, this study enhances our comprehension of the multifaceted nature of art appreciation and equips researchers with a robust platform to explore systematically aesthetic experiences across the global artistic landscape and across different kinds of cognitive and affective impacts.

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