What Makes a Painting Emotional? Using Deep Learning and Art Theory to Interpret the Emotional Character of Paintings

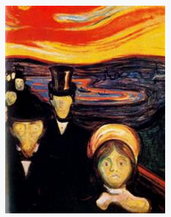
Student: WenXin Dong wxd@stanford.edu

Mentor: Panos Achlioptas optas@stanford.edu

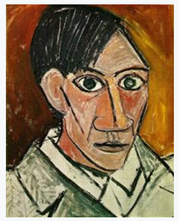
Department of Computer Science, Stanford University

1. Motivation

To understand what makes a painting emotional.



Fear
Sadness
Something else



Disgust
Contentment
Amusement
Sadness

Contentment
Awe
Sadness

Sadness
Amusement
Fear

Awe
Fear
Sadness
Something else

2. Goal

Compare and contrast Art Theory with deep model's knowledge on the task of emotion classification of paintings

3. Method

Dataset: We use a subset of 30k paintings from ArtEmis that have a dominant emotion in the ground-truth emotion distribution.

First, build pipeline for analyzing art-theory feature importance

We utilize 3 ranking methods: SHAP value of each handcrafted feature in a linear SVM classifier, prediction accuracy of linear SVM using single feature input, feature importance for each feature in a Decision Tree classifier trained with all handcrafted features. We repeat the 3 methods for binary classification and multiclass classification to obtain 6 individual rankings and obtain an overall ranking by taking the average.

Second, train a ResNet-34 model on 9-class emotion classification of paintings without pertained weight, on the full 80k Artemis dataset.

We extract second-to-last linear layer's output as learned features.

Third, use statistical analysis to find correlation between learned features and art-theory features.

Calculate shared variance between handcrafted features and learned features through canonical correlation analysis.

4. Results

1. Amount of local saturation contrast is the most important handcrafted feature for predicting emotion in paintings

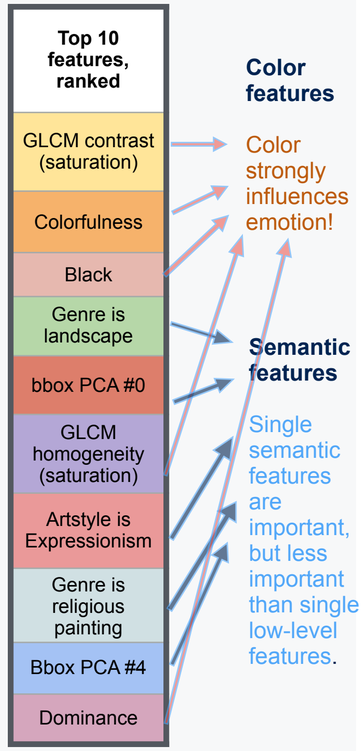
Low GLCM contrast (saturation) → High GLCM contrast (saturation)

2. Ranked importance of **feature categories**

1. Hue
2. Texture
3. Art style
4. Genre
5. Bounding box of person
6. Rule of third
7. Saturation and brightness
8. Rotational symmetry
9. Bilateral symmetry
10. Faces and skin
11. Lines

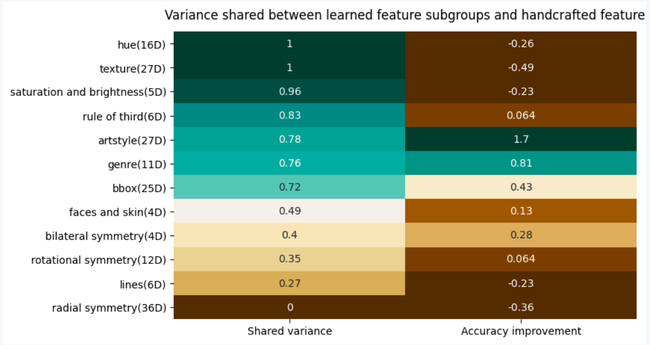
3. Per **emotion class contribution**

- **Local contrast in saturation** correlates positively with amusement AND disgust
- **Amount of black** correlates positively with fear, sadness AND amusement.
- **Religious paintings** correlate positively with awe, fear, and sadness



Full feature ranking, highest toward bottom

4. Information shared between learned features and handcrafted features



Deep model almost **fully encode hue, texture, and saturation and brightness** related information. **Art style, genre and bounding boxes**, are very helpful to the prediction task but the model **did not fully learn** them.

5. Better emotion classifier by combining learned and handcrafted features.

	Learned features	Handcrafted features	Combined
Multiclass classification	**0.354**	**0.333**	**0.392**
Binary classification	**0.714**	**0.716**	**0.722**

*linear SVM prediction accuracy. Multilayer perceptron and decision tree classifier obtained similar improvement in accuracy.

CODE : https://github.com/affective-low-level-features/affective-low-level-features.github.io