

The background image is a dark, moody painting depicting a group of figures in what appears to be a dramatic or religious setting. Several figures are visible, including a man in a dark robe with a red cross on his chest, a woman with curly hair, and a young girl. The lighting is low, creating strong shadows and highlights on the figures' faces and clothing.

# Luz y caos:

# Análisis y clasificación automatizada de obras de arte

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¿Es posible analizar  
obras de arte con  
análisis de datos?

# Contexto



# Movimientos artísticos de la Historia del Arte

## Edad Moderna / Edad Contemporánea

- Técnica del óleo sobre lienzo
- Boom figura del pintor
- Temas ya no son simbólicos / religiosos
- Aparece concepto moderno del **Arte**

Renacimiento (XV - XVII)

Barroco (XVII)

Rococó (XVIII)

Neoclásico (XVIII)

Romanticismo y Realismo (XIX)

Impresionismo (finales XIX)

Post - Impresionismo (finales XIX)

Vanguardias (XX)

1400

1600

1750

1780

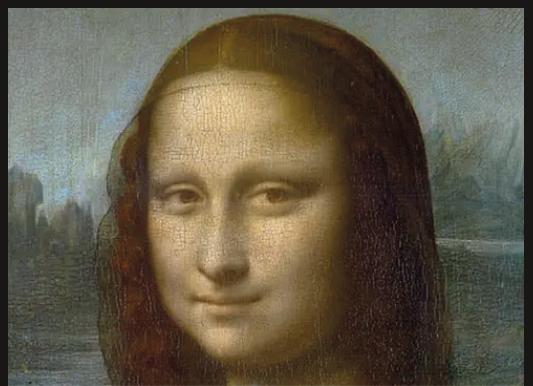
1800

1860

1880

1900

## Renacimiento



## Barroco



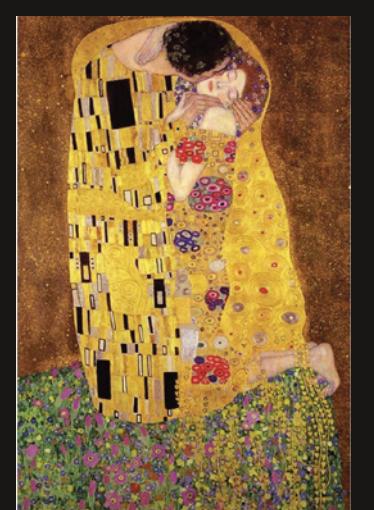
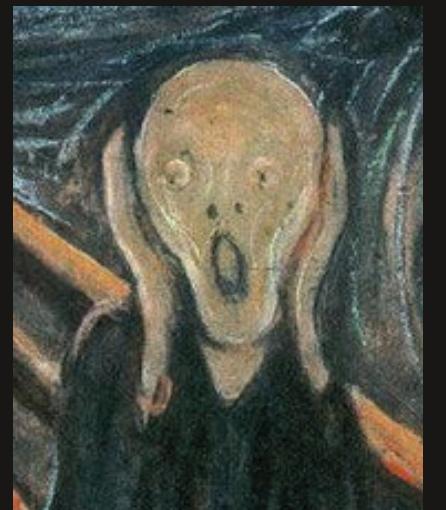
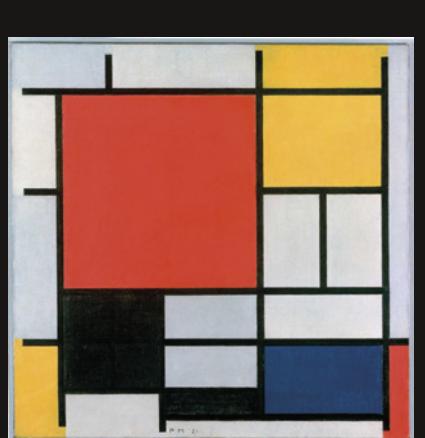
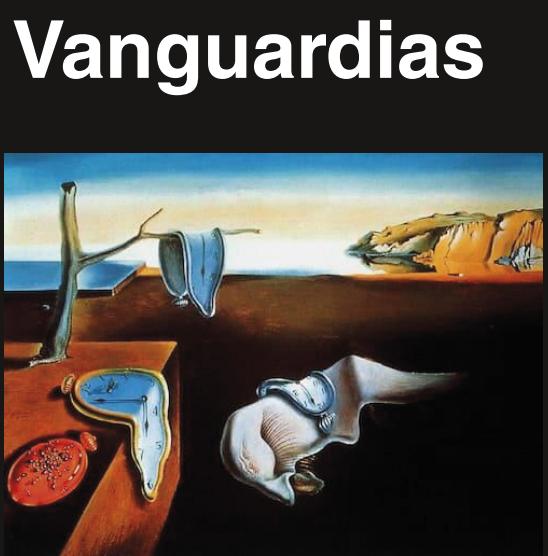
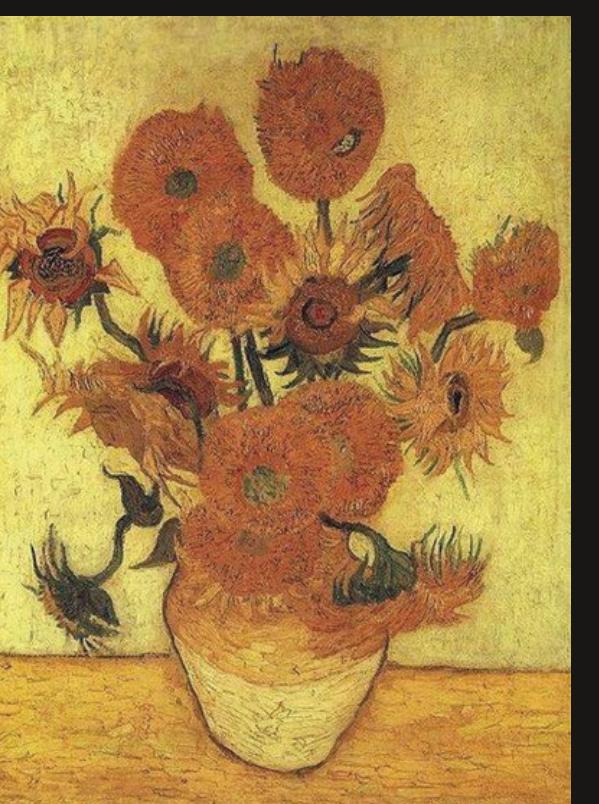
## Romanticismo y Realismo



## Impresionismo



## Post-Impresionismo



A dark, historical painting depicting a group of men in 17th-century attire gathered around a cadaver for a dissection. One man in the foreground, wearing a black cap and coat, is focused on the procedure, using surgical instruments on the exposed muscles of the deceased. The other men, some with beards and white ruffs, observe the scene from behind, creating a somber and educational atmosphere.

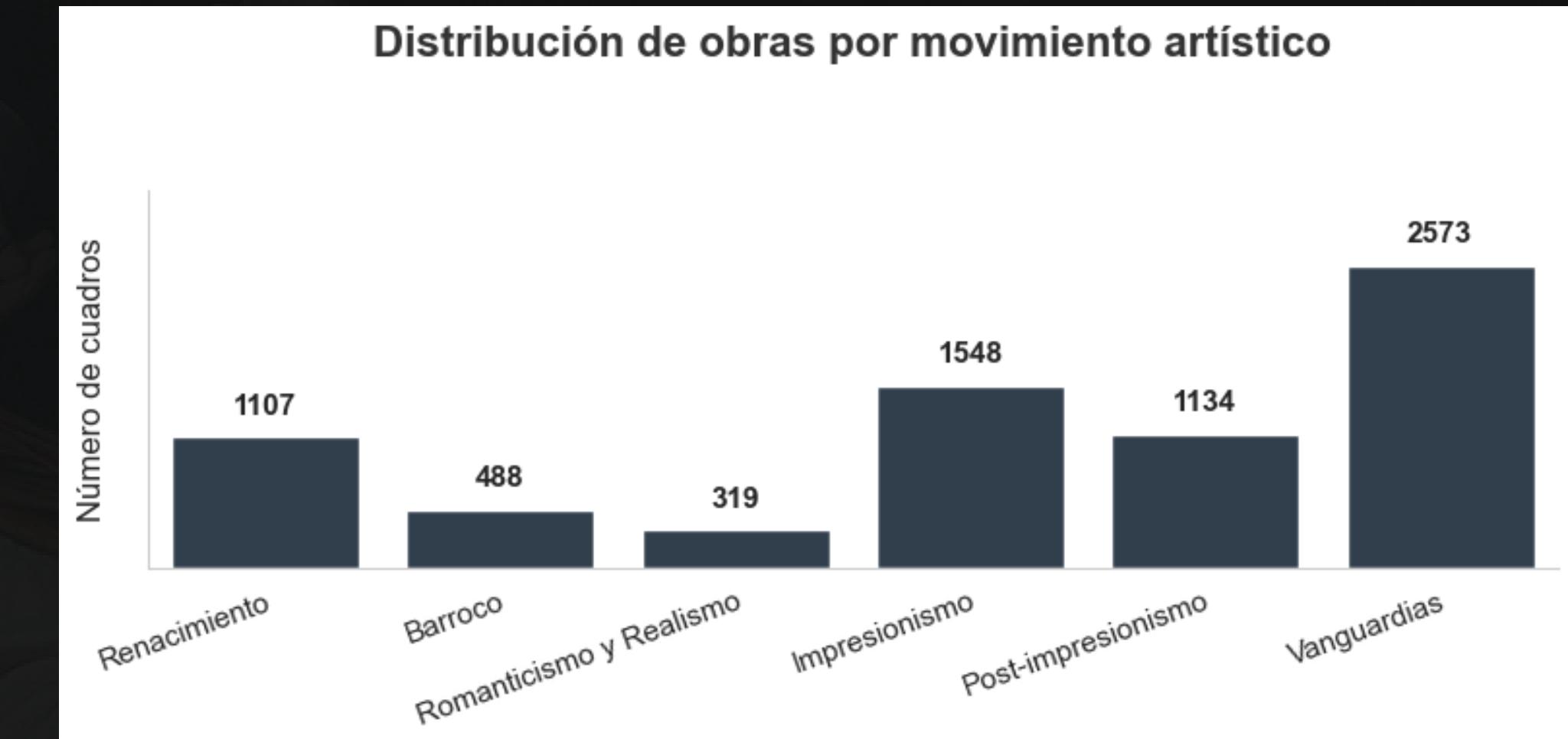
# Dataset

# Dataset

Colección de pinturas de los 50 artistas más influyentes de todos los tiempos

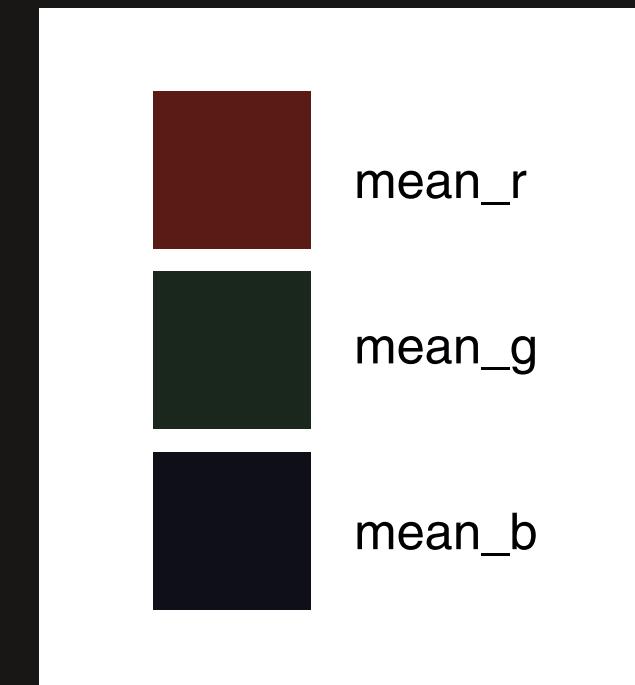
	<b>id</b>	<b>artista</b>	<b>movement</b>	<b>paintings</b>	<b>sub_estilo</b>	<b>nombre_archivo</b>	<b>mean_r</b>	<b>mean_g</b>	<b>mean_b</b>	<b>saturation</b>	<b>brightness</b>	<b>entropy</b>	<b>contrast</b>	<b>homogeneity</b>	<b>edge_density</b>
2361	6	Edouard Manet	Impresionismo	90	Impresionismo	Edouard_Manet_55.jpg	80.662500	42.896910	41.196452	144.270841	80.662976	6.737028	133.689444	0.188413	0.038806
1307	25	Caravaggio	Barroco	55	Barroco	Caravaggio_36.jpg	114.812657	79.977550	63.508026	110.342630	114.819894	7.026594	33.157695	0.280422	0.020484
2446	30	Edgar Degas	Impresionismo	702	Impresionismo	Edgar_Degas_14.jpg	135.045763	113.816989	65.451234	134.900198	135.471437	7.321020	26.175489	0.272027	0.011649
7506	5	Salvador Dali	Vanguardias	139	Surrealismo	Salvador_Dali_137.jpg	155.385364	168.864403	207.945710	65.947564	207.945713	6.795313	68.519355	0.326885	0.016151
7391	4	Rene Magritte	Vanguardias	194	Surrealismo	Rene_Magritte_33.jpg	97.380772	99.437604	125.140819	79.198865	132.217984	7.113835	105.743221	0.272327	0.078802

- Agrupación de estilos artísticos
- Extracción features
- Filtro bocetos
- Desequilibrio dataset
- Downsampling para PCA y Kmeans

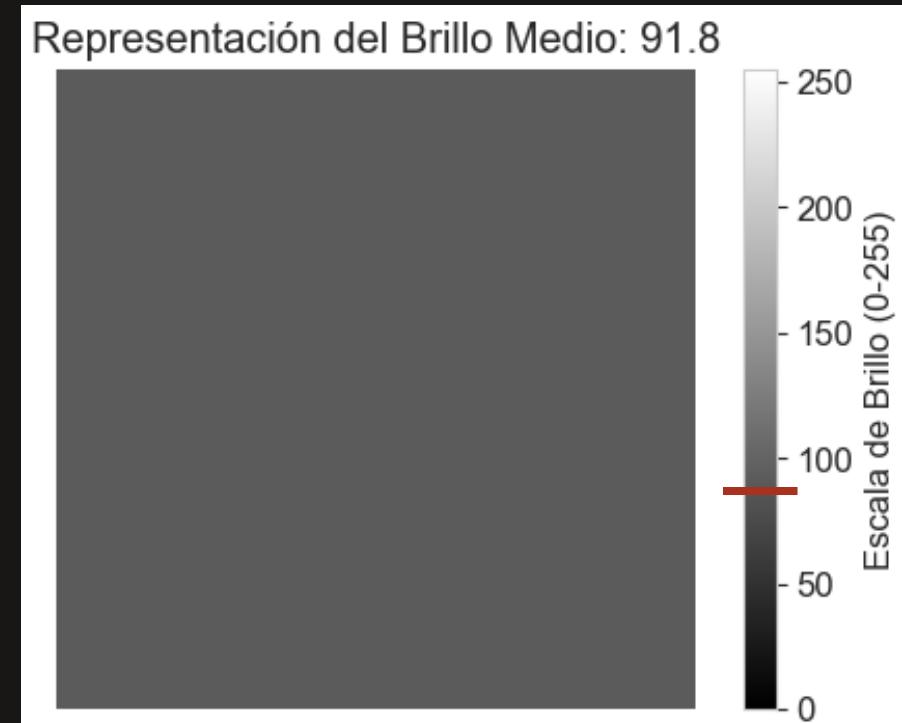


Python (OpenCV, Skimage, Pandas, Scikit-learn, Matplotlib, Seaborn)

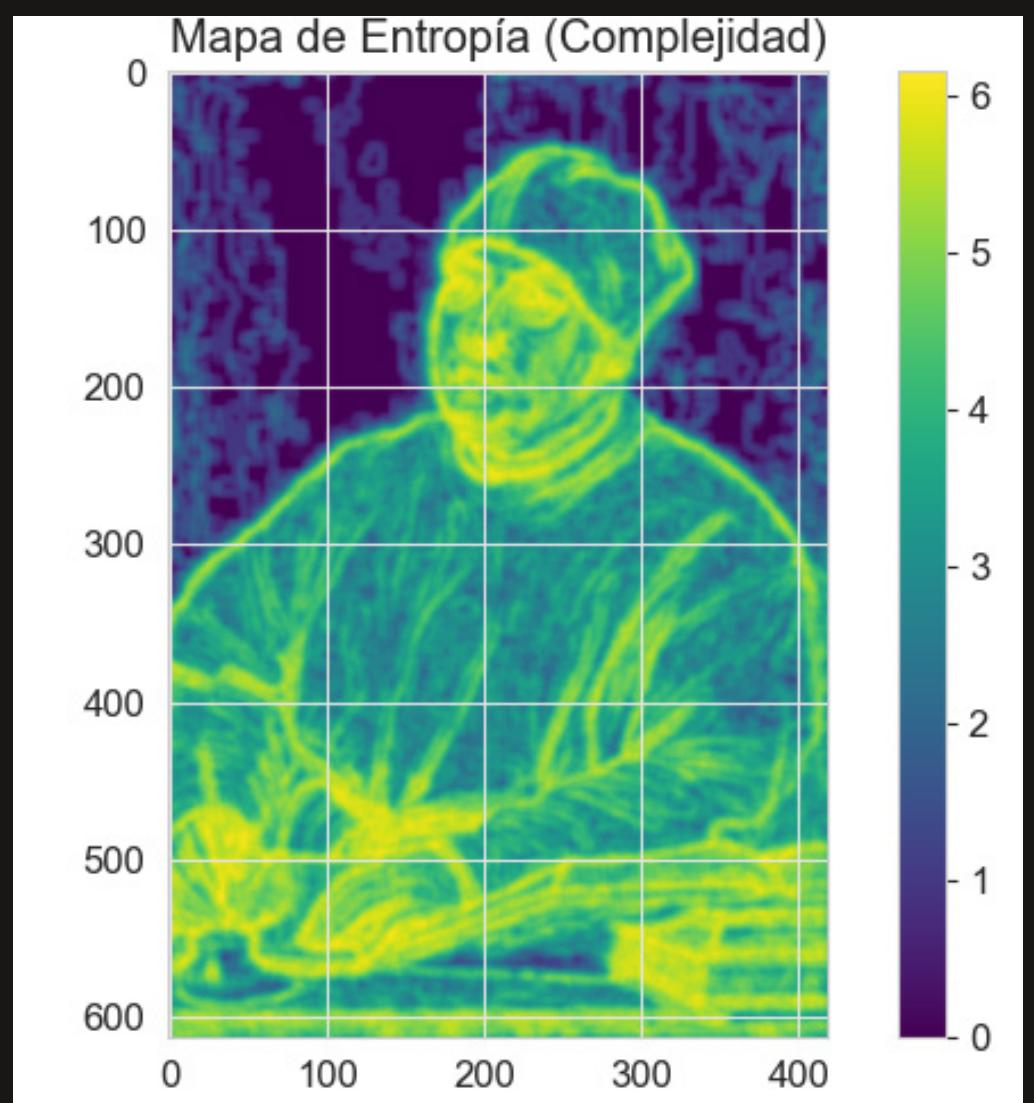
	<b>mean_r</b>	<b>mean_g</b>	<b>mean_b</b>	<b>saturation</b>	<b>brightness</b>	<b>entropy</b>	<b>contrast</b>	<b>homogeneity</b>	<b>edge_density</b>	<b>nombre_archivo</b>
795	90.34642	40.857832	27.372311	169.75153	91.899754	6.512132	49.022322	0.541555	0.038268	Raphael_93.jpg



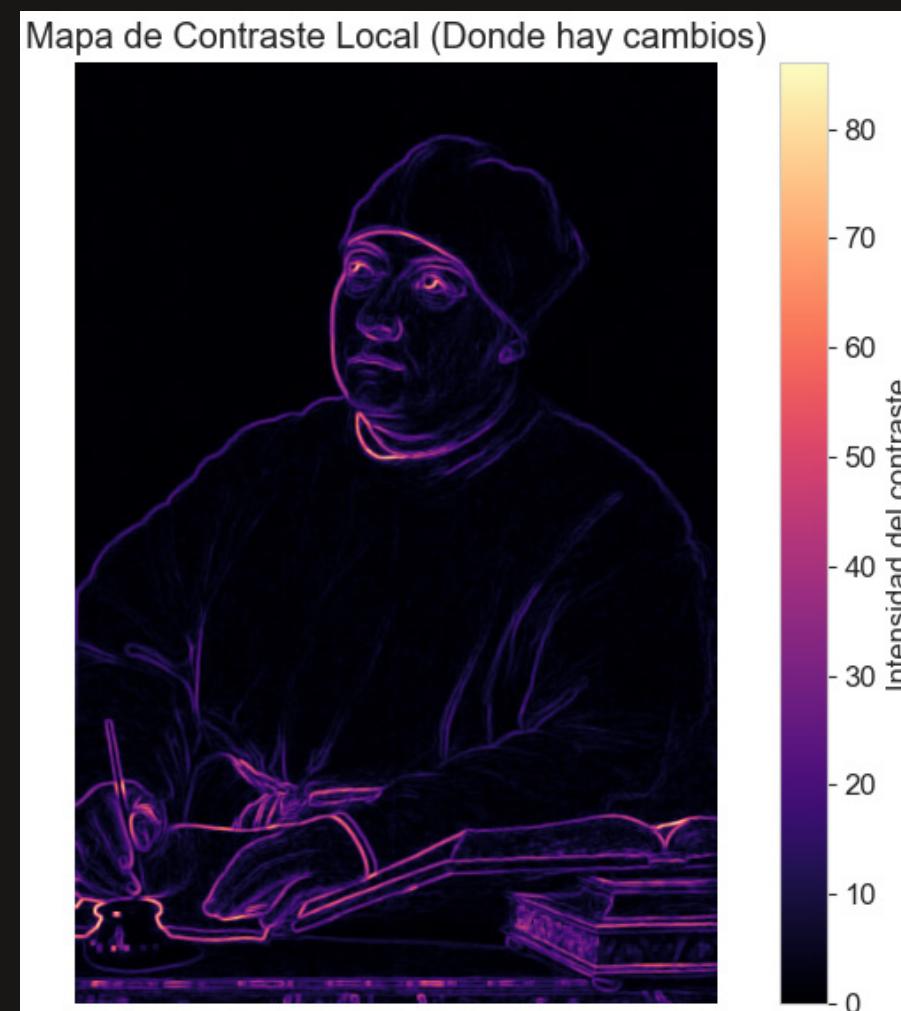
**mean\_brightness**



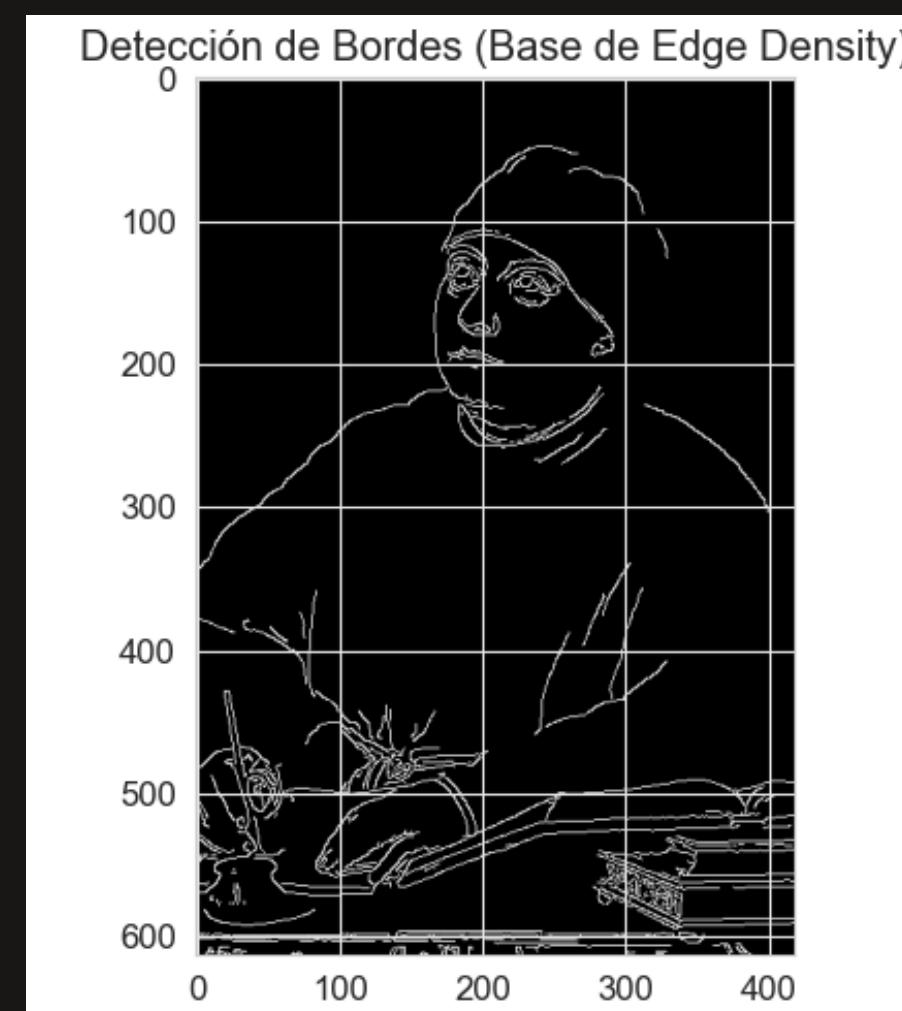
**entropy**



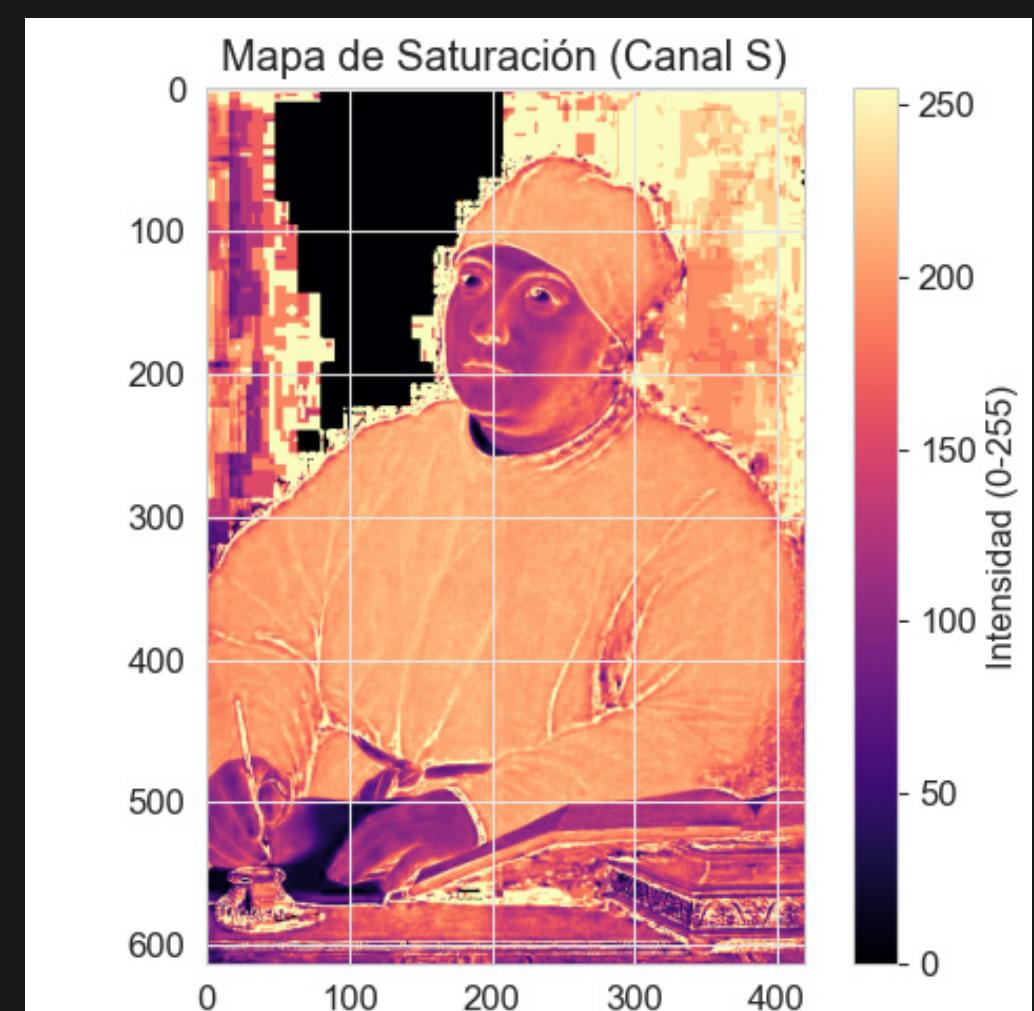
**contrast**



**edge\_density**



**mean\_saturation**



A dark, atmospheric scene featuring a man with reddish-brown hair, seen from behind, wearing a dark coat and a hat. He is standing in a desolate, rocky landscape under a dark sky. In the background, there are faint outlines of mountains and hills. The overall mood is mysterious and somber.

# Exploración y clustering

# PCA (Principal Component Analysis)

Variables originales

mean_r	mean_g	mean_b	saturation	brightness	entropy	contrast	homogeneity	edge_density
125.374744	114.551141	105.488083	58.059038	128.693475	7.575626	332.790275	0.159483	0.111725
106.565048	77.132793	60.401572	114.442137	106.653324	7.084821	258.610947	0.155474	0.152206
78.987697	69.750101	51.374814	100.305007	80.824384	7.222613	208.215379	0.153135	0.136309
106.051204	93.350047	75.127603	75.188186	109.045608	7.366184	50.423471	0.347372	0.042229
90.395957	67.258031	45.842380	121.546702	90.420778	7.244456	116.633888	0.194962	0.072958

75% varianza

Nuevas variables

	0	1	2	3	4	5	6	7	8
0	-3.866379	-0.271046	-0.040242	-0.117039	-0.120169	-0.126569	0.077010	0.011910	-0.040569
1	-4.012435	0.777075	0.056340	-0.856788	0.688669	0.576270	0.058771	0.222420	-0.098933
2	-4.417537	0.530492	-1.343778	-0.049678	-0.764752	-0.579680	-0.142574	0.096698	0.100665
3	0.577162	0.440531	-0.306874	0.774310	0.161256	0.081464	-0.414012	-0.124883	0.041561
4	-4.250532	0.432563	-0.848798	-0.206426	-0.586318	-0.407012	-0.063349	0.114039	0.037007

([0.527, 0.749, 0.862, 0.94 , 0.964, 0.981, 0.994, 0.999, 1. ])

pca.explained\_variance\_

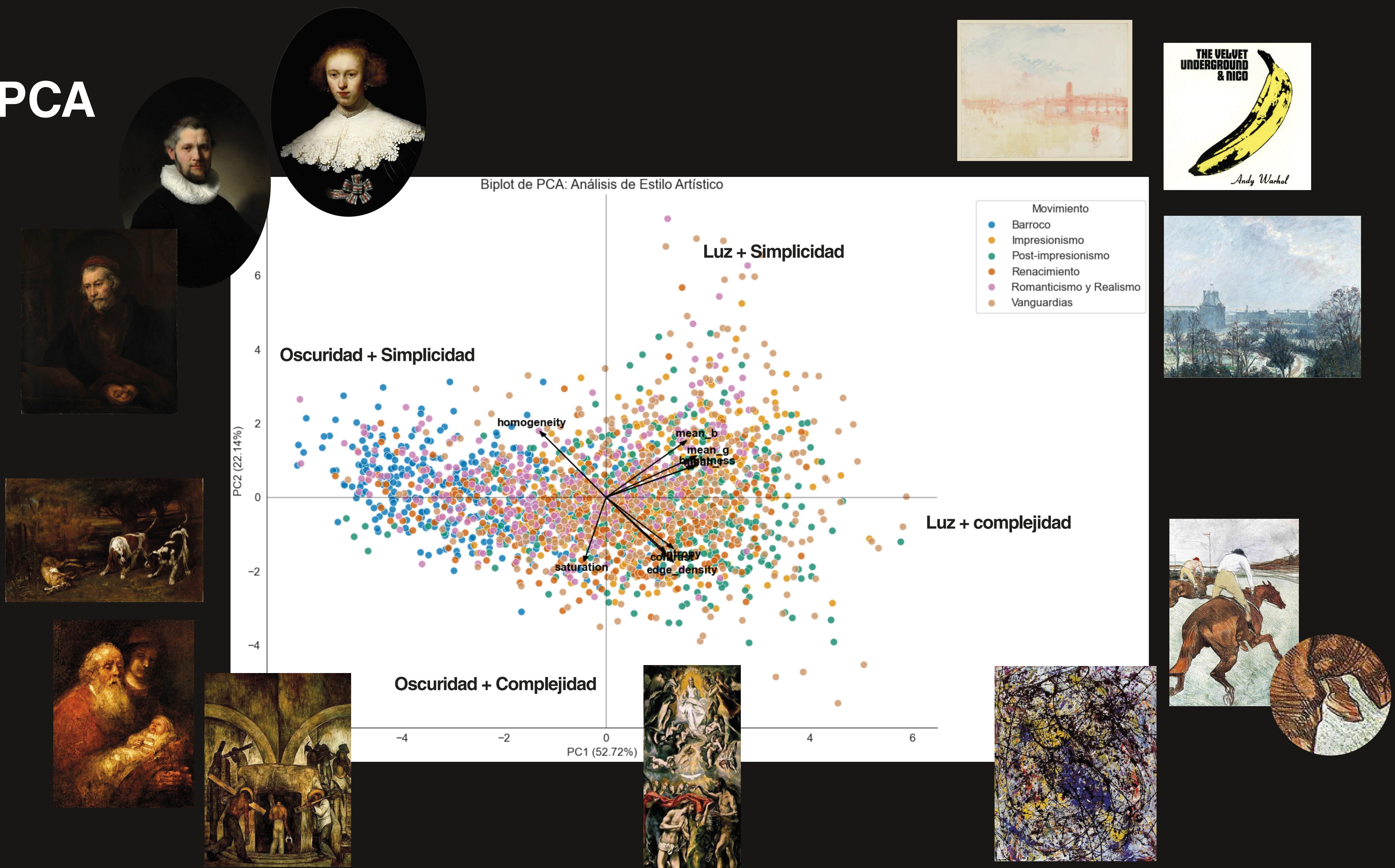
Contribución variables originales (loadings)

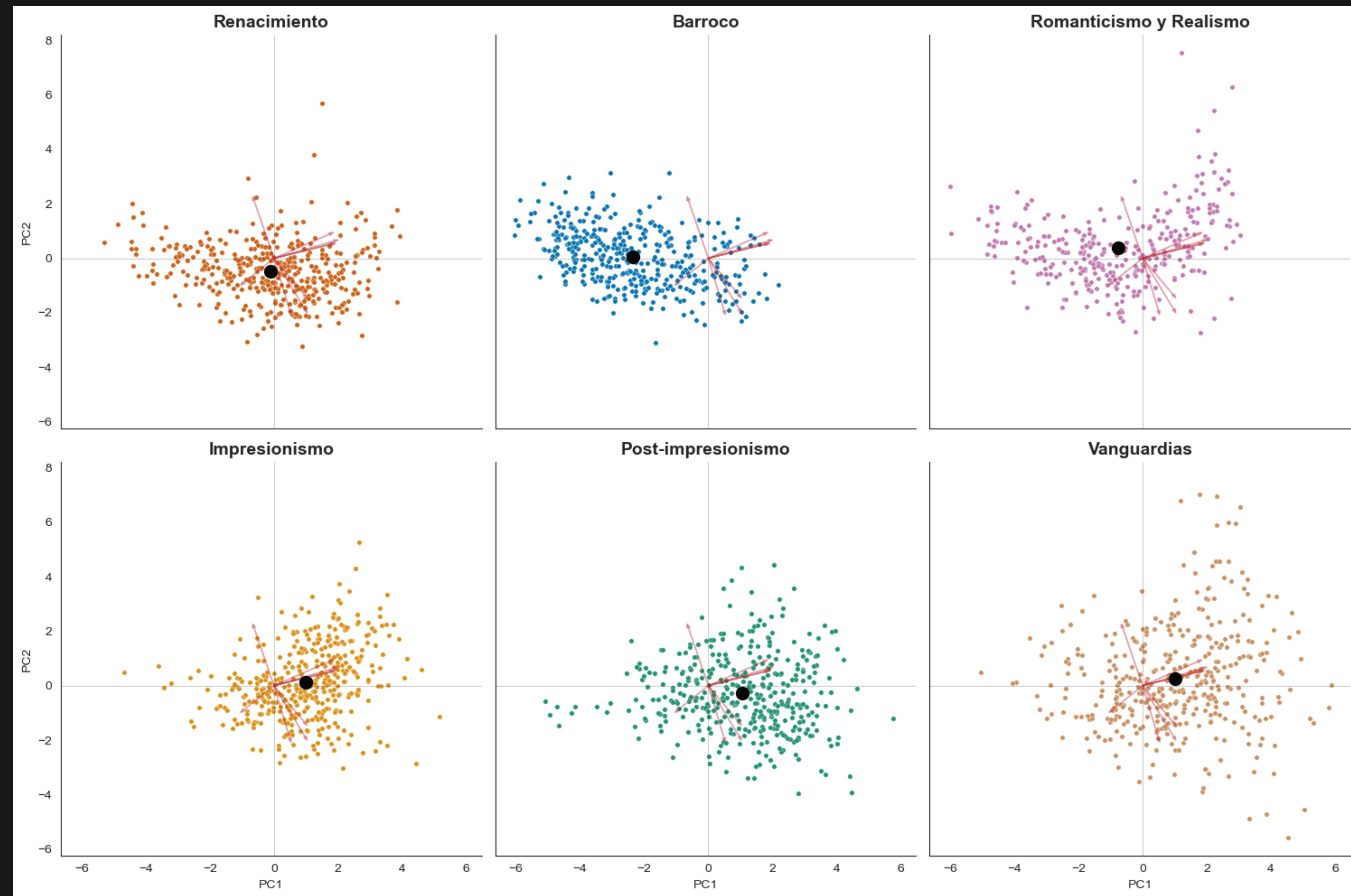
	mean_r	mean_g	mean_b	saturation	brightness	entropy	contrast	homogeneity	edge_density
pca1	15.797877	17.260419	13.626580	0.981467	17.030242	9.334695	7.231031	9.176452	9.561237
pca2	3.883293	6.906536	12.936240	15.927172	4.092810	10.270291	11.689065	17.433843	16.860749

- Eje color / luz

- Eje complejidad

# PCA

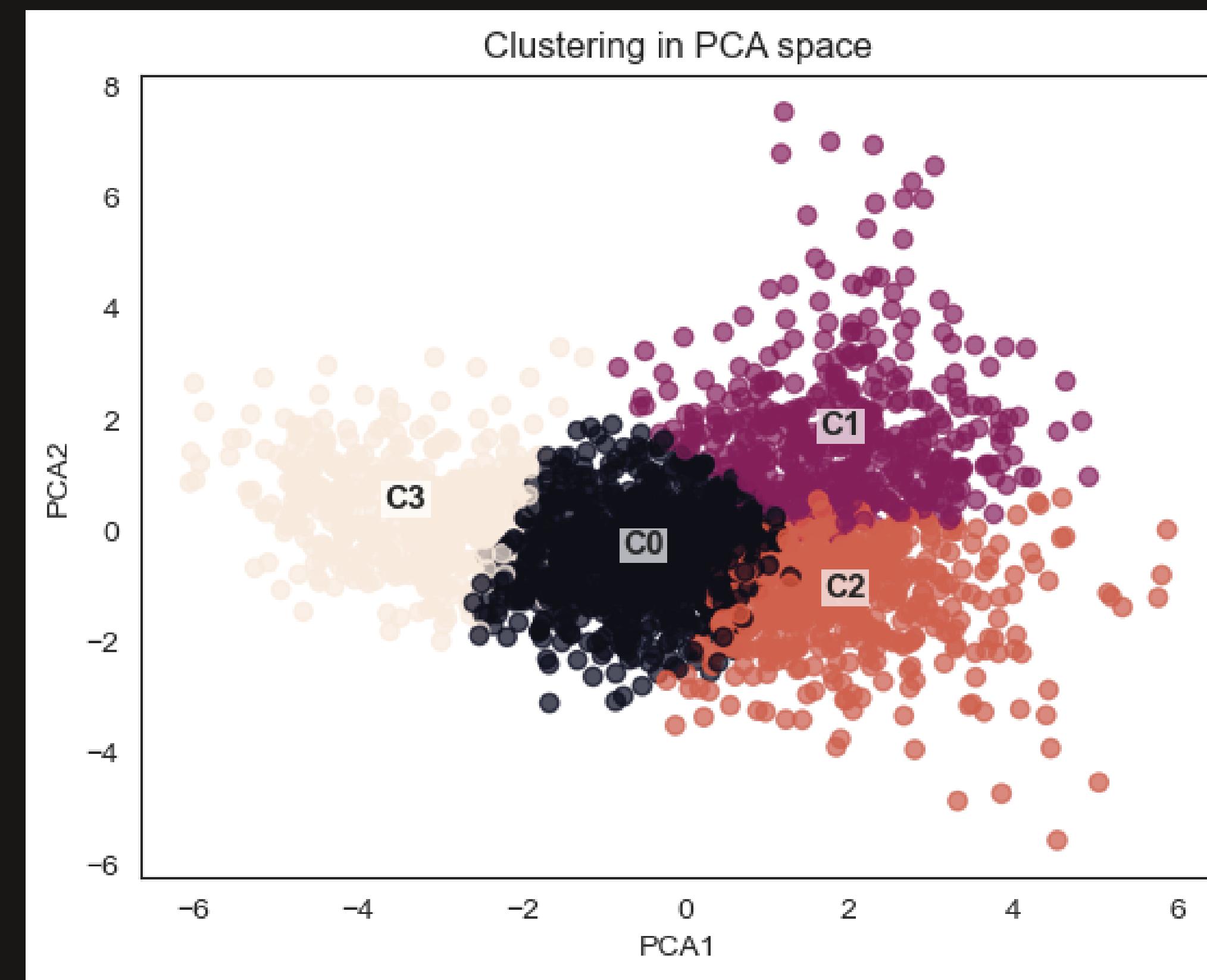




# Clustering (Kmeans)

cluster	0	1	2	3
movement				
Renacimiento	49.000000	7.500000	28.500000	15.000000
Barroco	34.750000	2.000000	4.500000	58.750000
Romanticismo y Realismo	46.708464	23.197492	5.329154	24.764890
Impresionismo	38.500000	34.750000	25.000000	1.750000
Post-impresionismo	31.750000	24.000000	39.250000	5.000000
Vanguardias	32.000000	33.000000	28.000000	7.000000

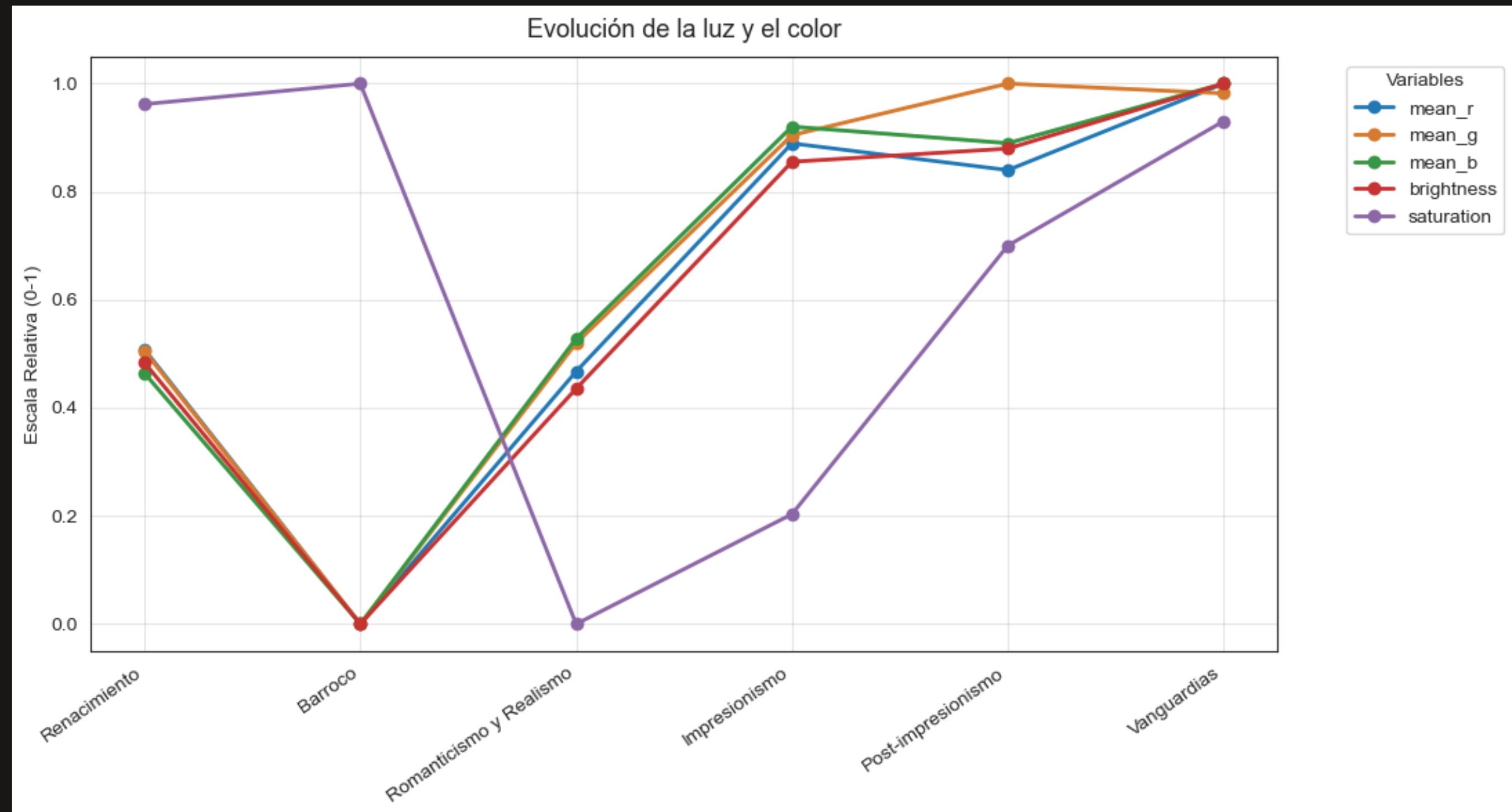
A diferencia del Renacimiento o el Barroco, que tenían reglas más estrictas, el arte moderno experimenta con todo el espectro de color y textura. El K-means detecta esta "dispersión" como una falta de un cluster único dominante.



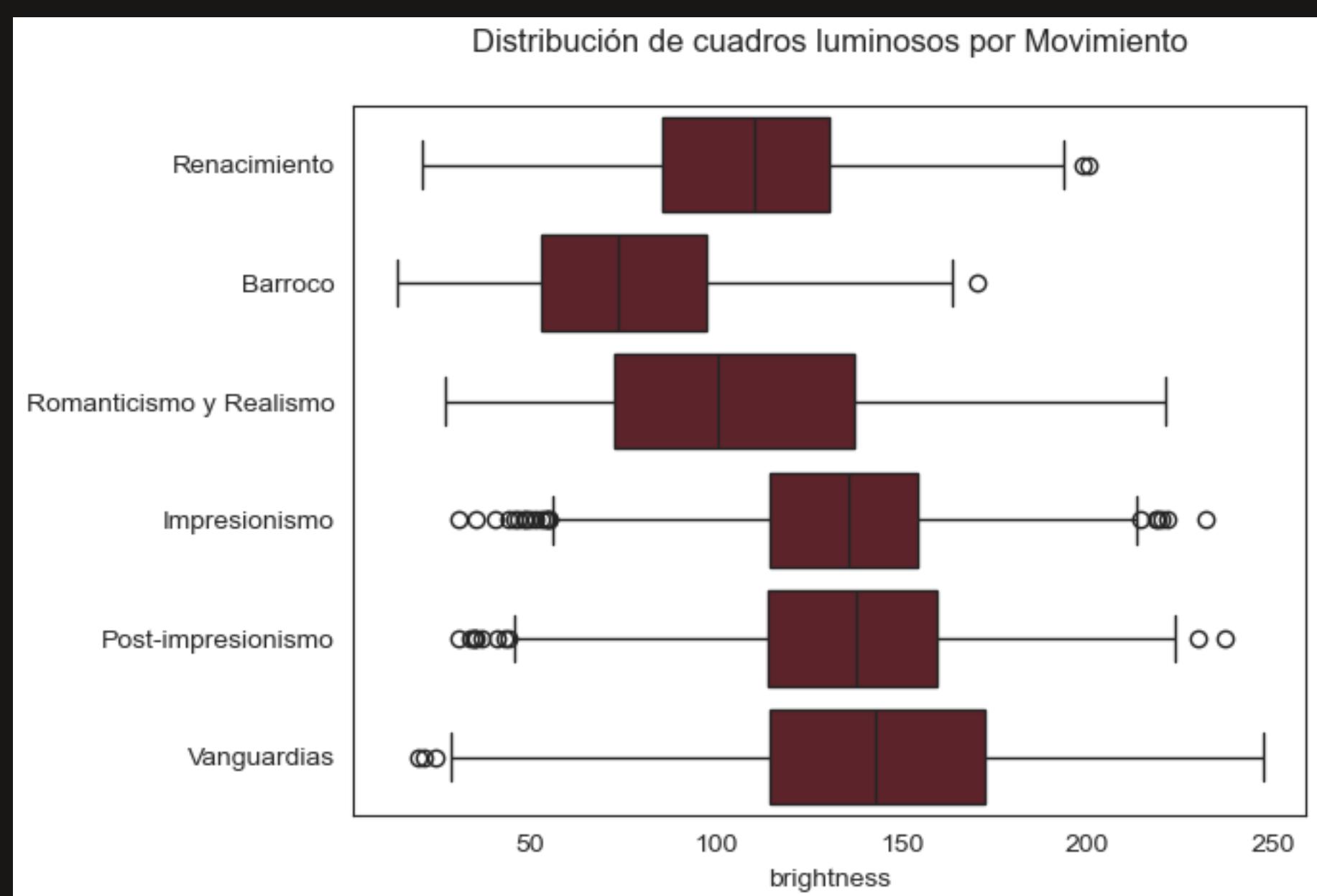
A dramatic painting depicting a scene of chaos and movement, possibly a flood or a divine judgment, with figures in various states of distress and flight.

# Evolución movimientos

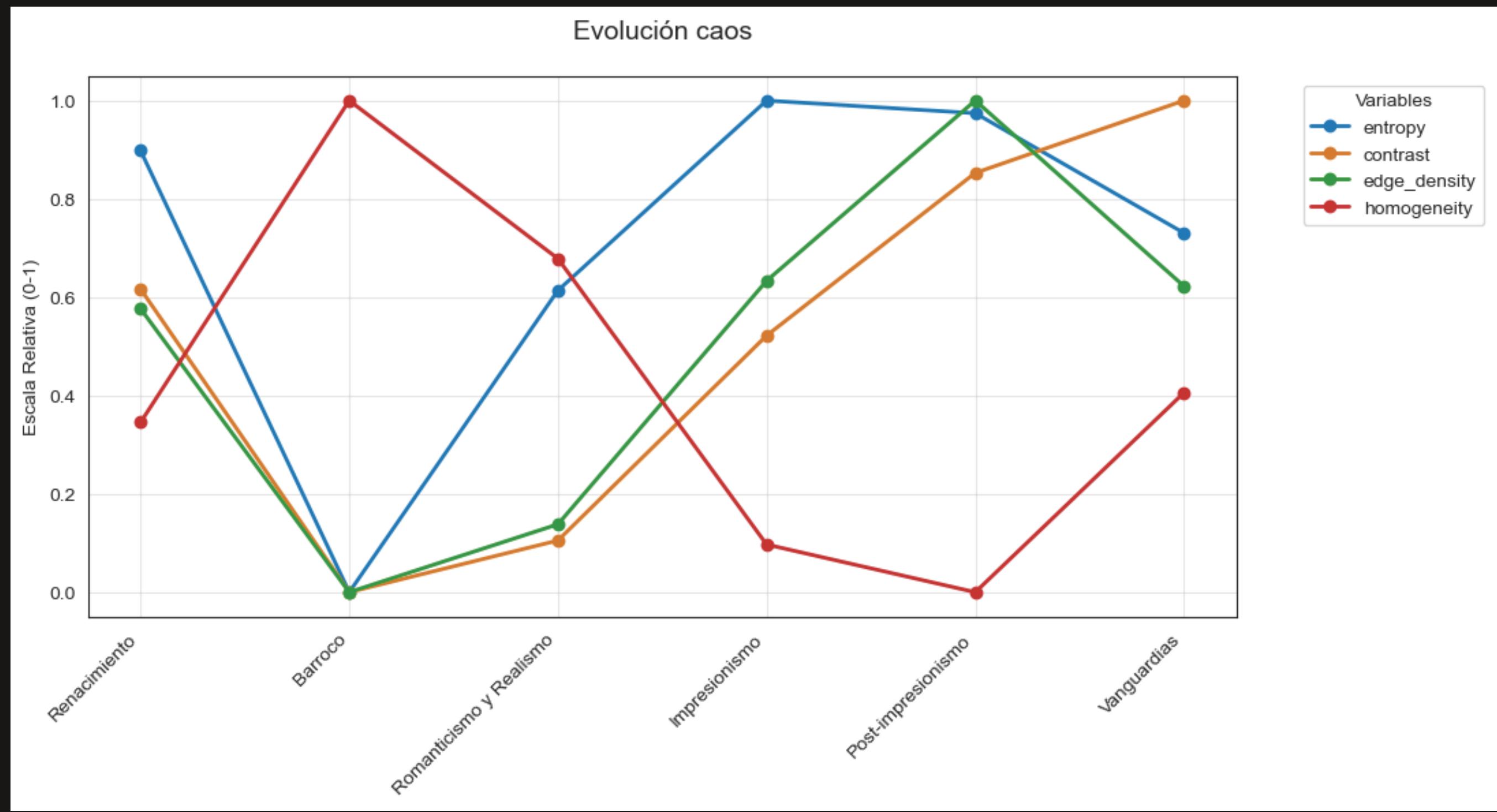
# Análisis de los ejes principales (Luz)



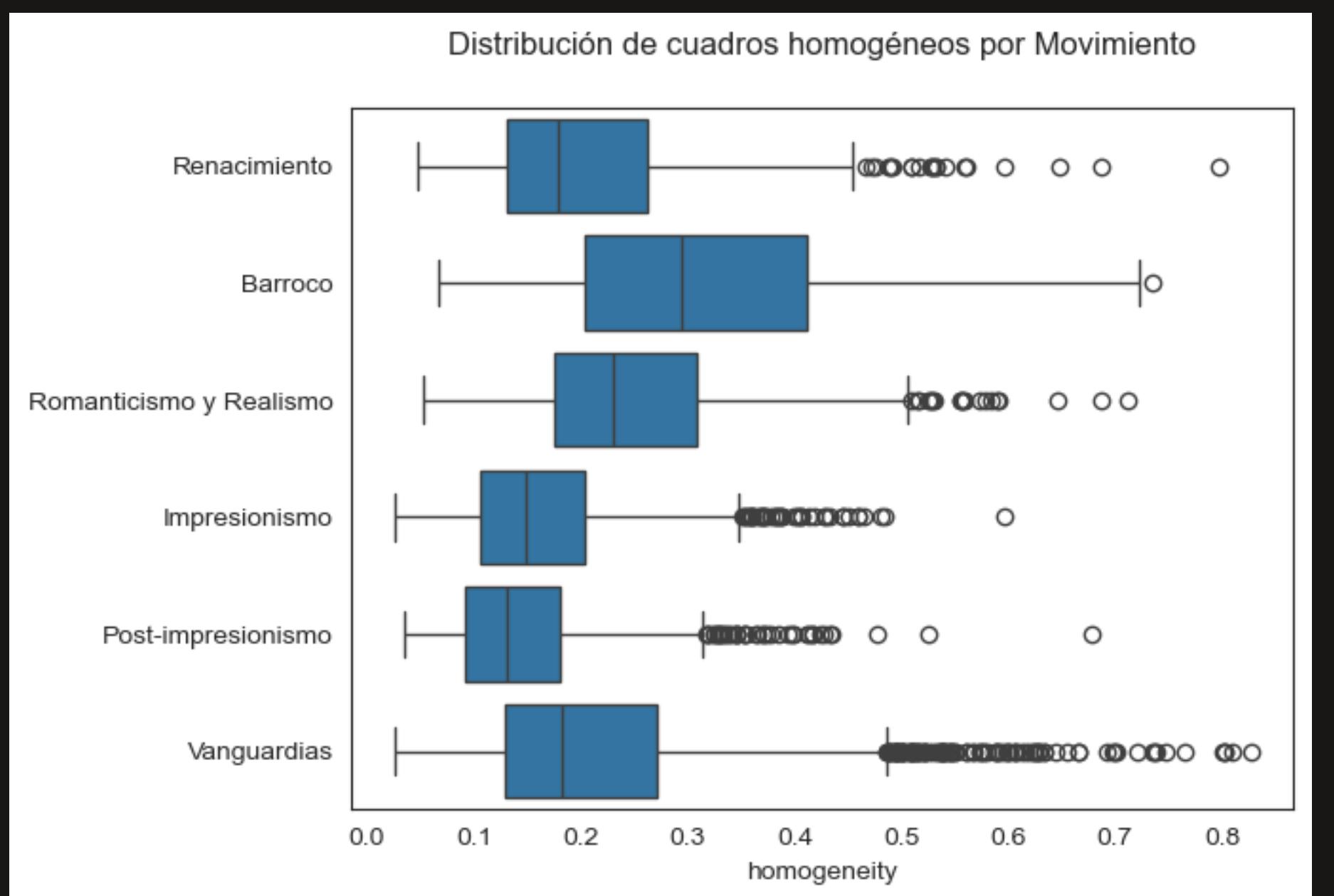
Evolución hacia la LUZ

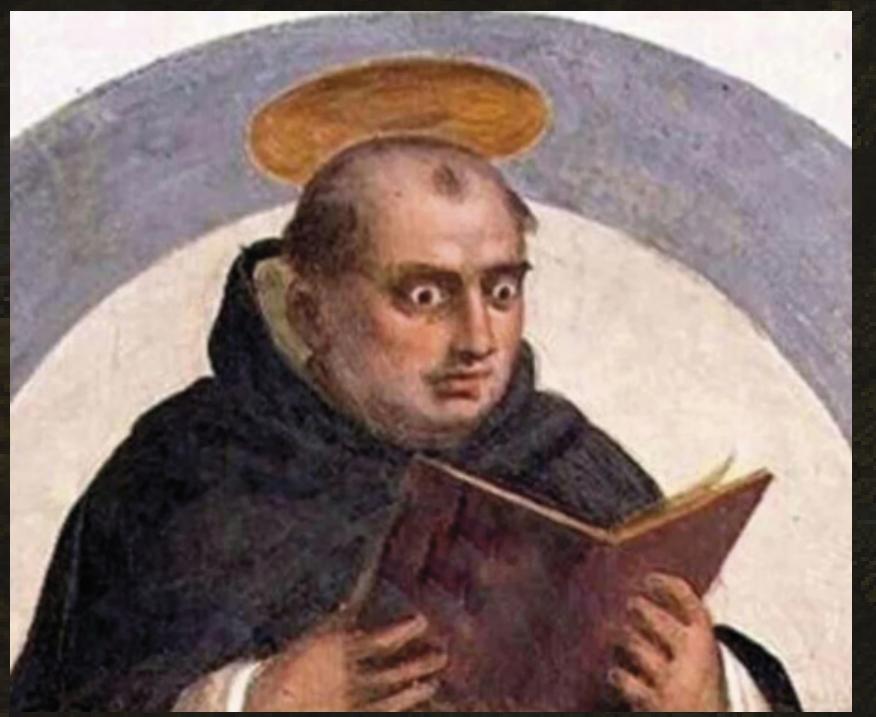


# Análisis de los ejes principales (Estructura)



Evolución hacia el CAOS





# Clasificación automatizada (Random Forest)

# Random forest

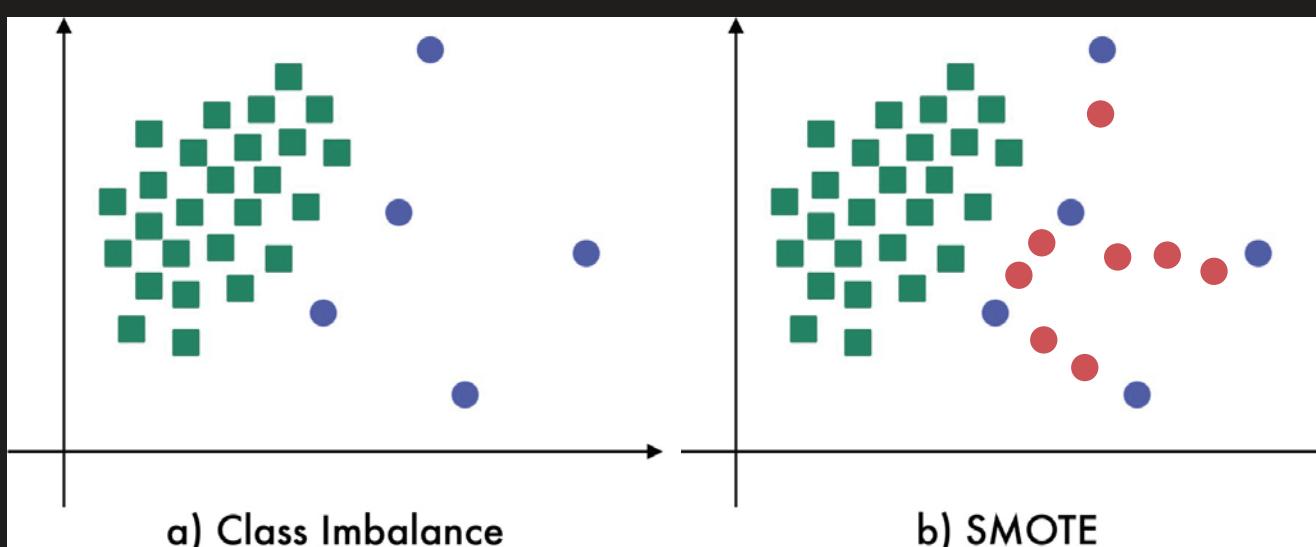
ML Supervisado -> Clasificación

- Variables: X, y

```
1 X = df[['mean_r',  
2     'mean_g',  
3     'mean_b',  
4     'saturation',  
5     'brightness',  
6     'entropy',  
7     'contrast',  
8     'homogeneity',  
9     'edge_density']]  
10  
11 y = df['movement']
```

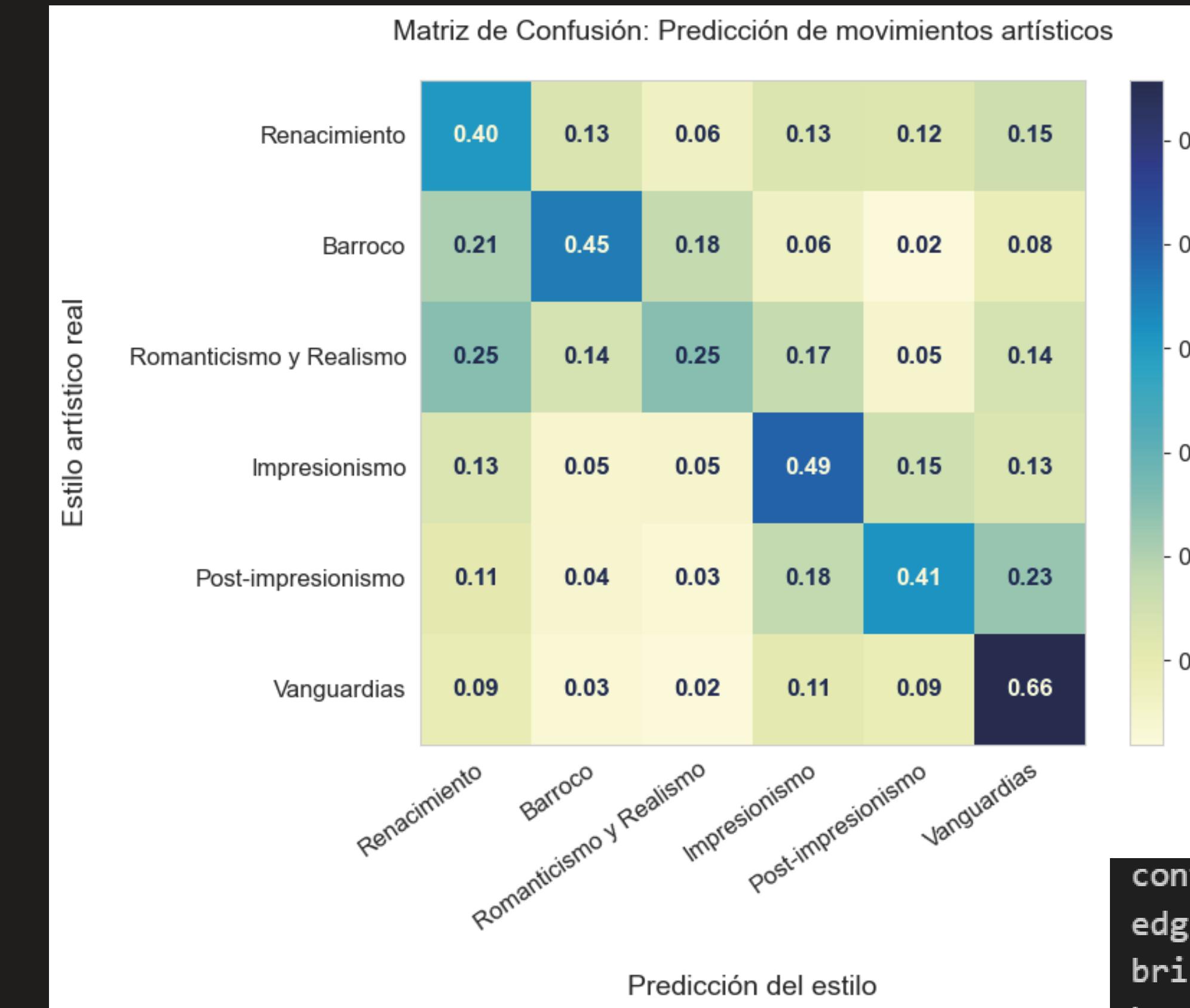
- Train / Test split

- SMOTE (sólo para Train)



- Accuracy

0.5125523012552301



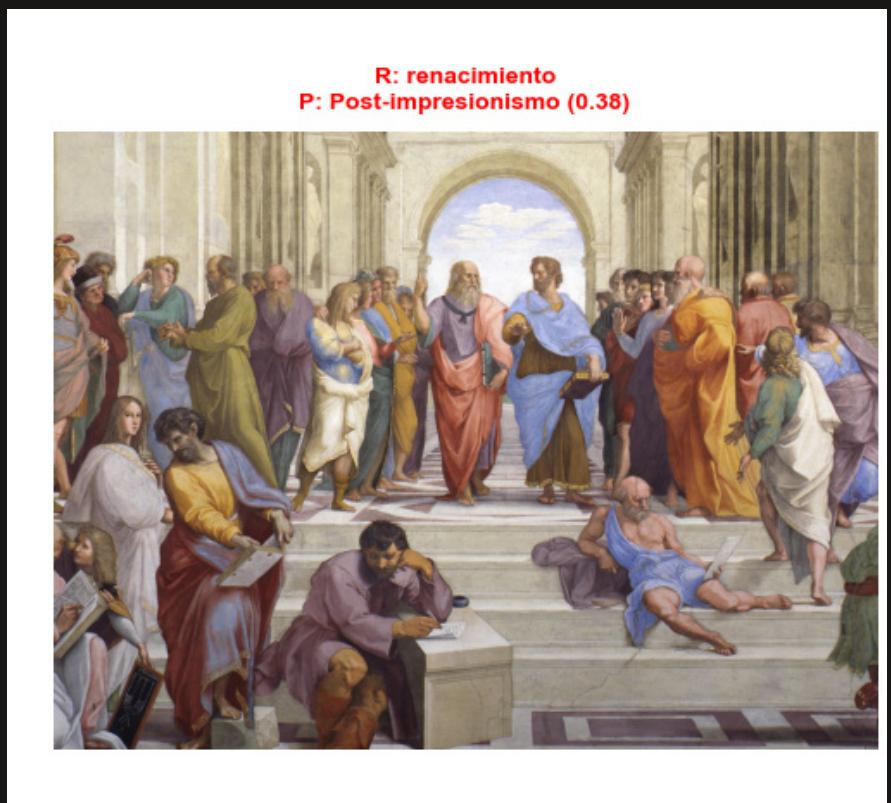
# Test

--- RESULTADOS DEL MINI-TEST ---  
Precisión total: 50.00%

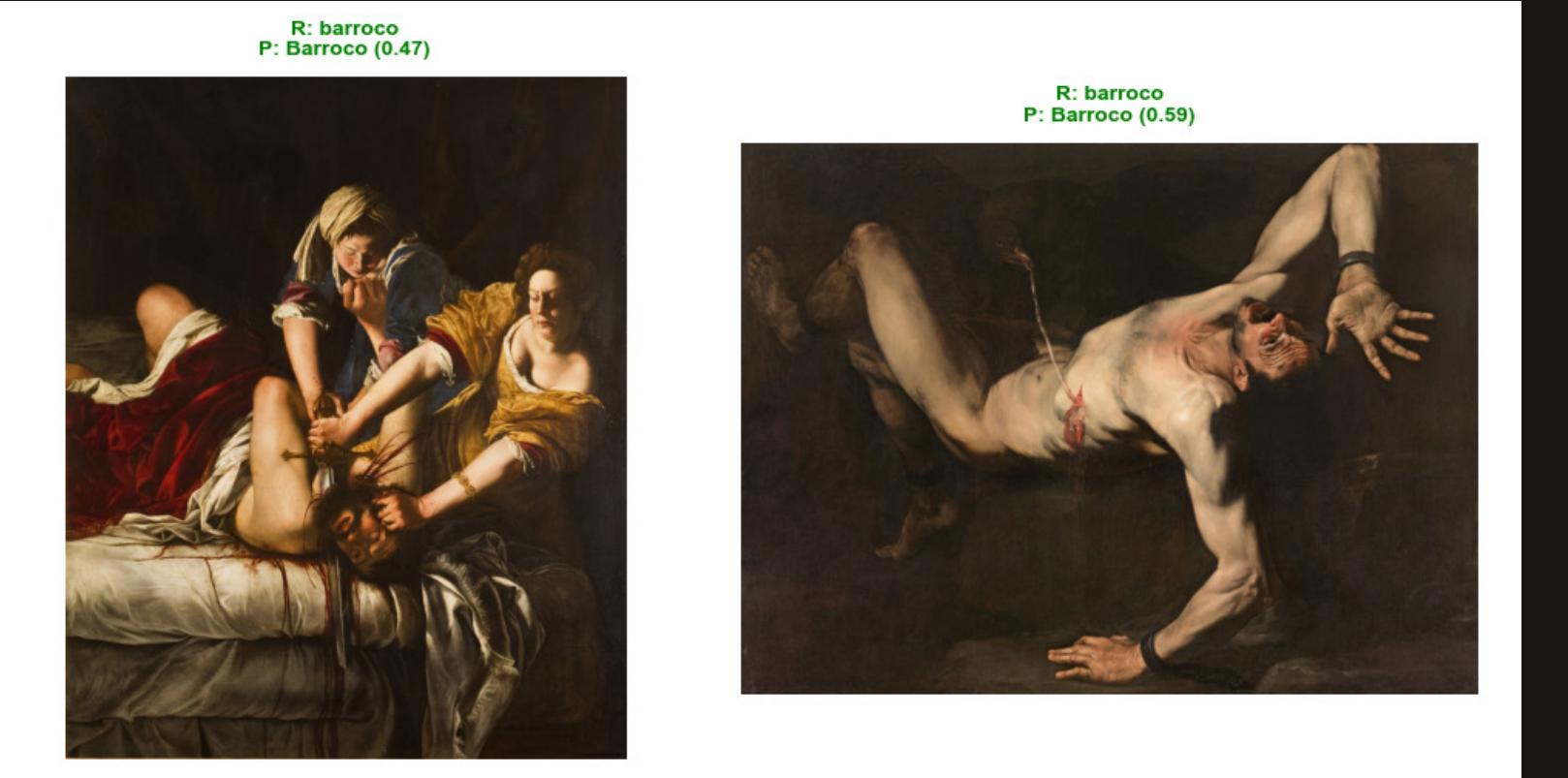
4 obras de cada movimiento de pintores no presentes en el dataset (es capaz de predecir el estilo)

Clase mayoritaria (Vanguardias = 35%). Hemos mejorado el azar (% de acierto ahora es de 51%).

Renacimiento : 50%



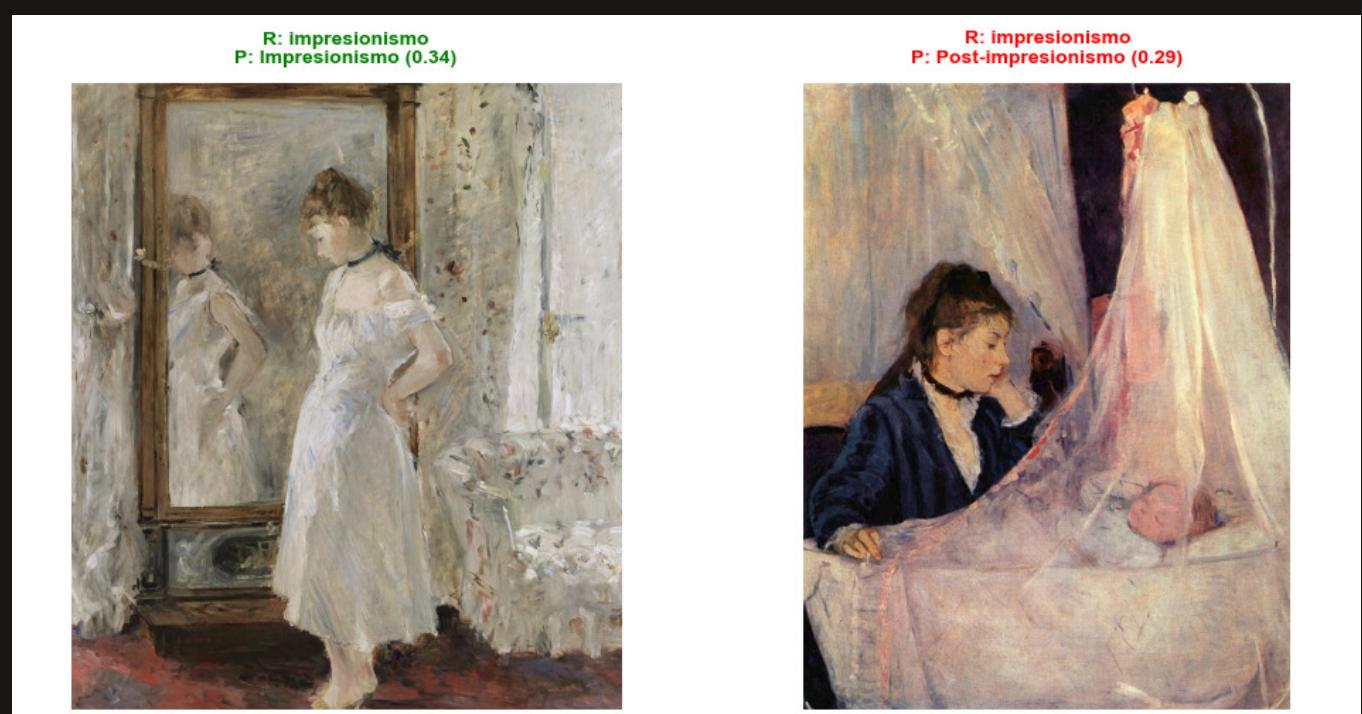
Barroco : 75%



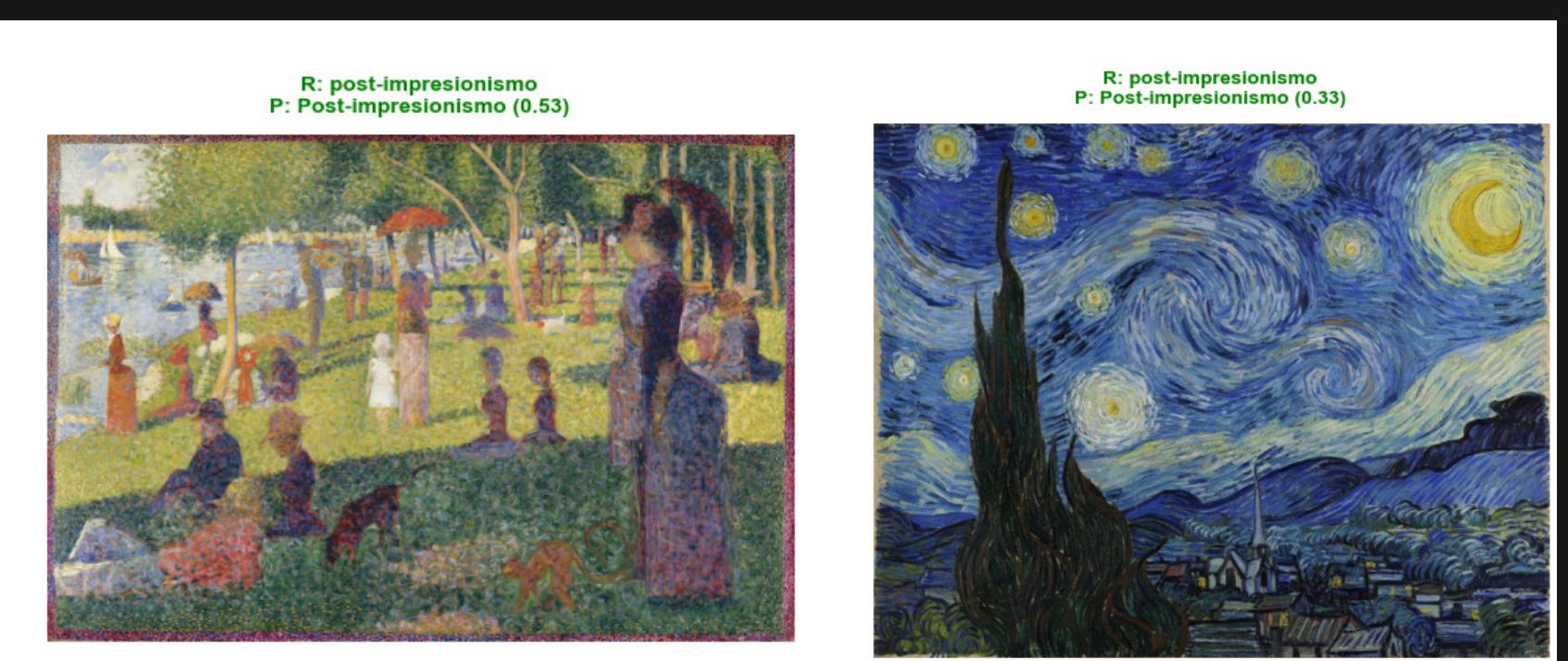
Romanticismo / Realismo: 25%



Impresionismo : 50%



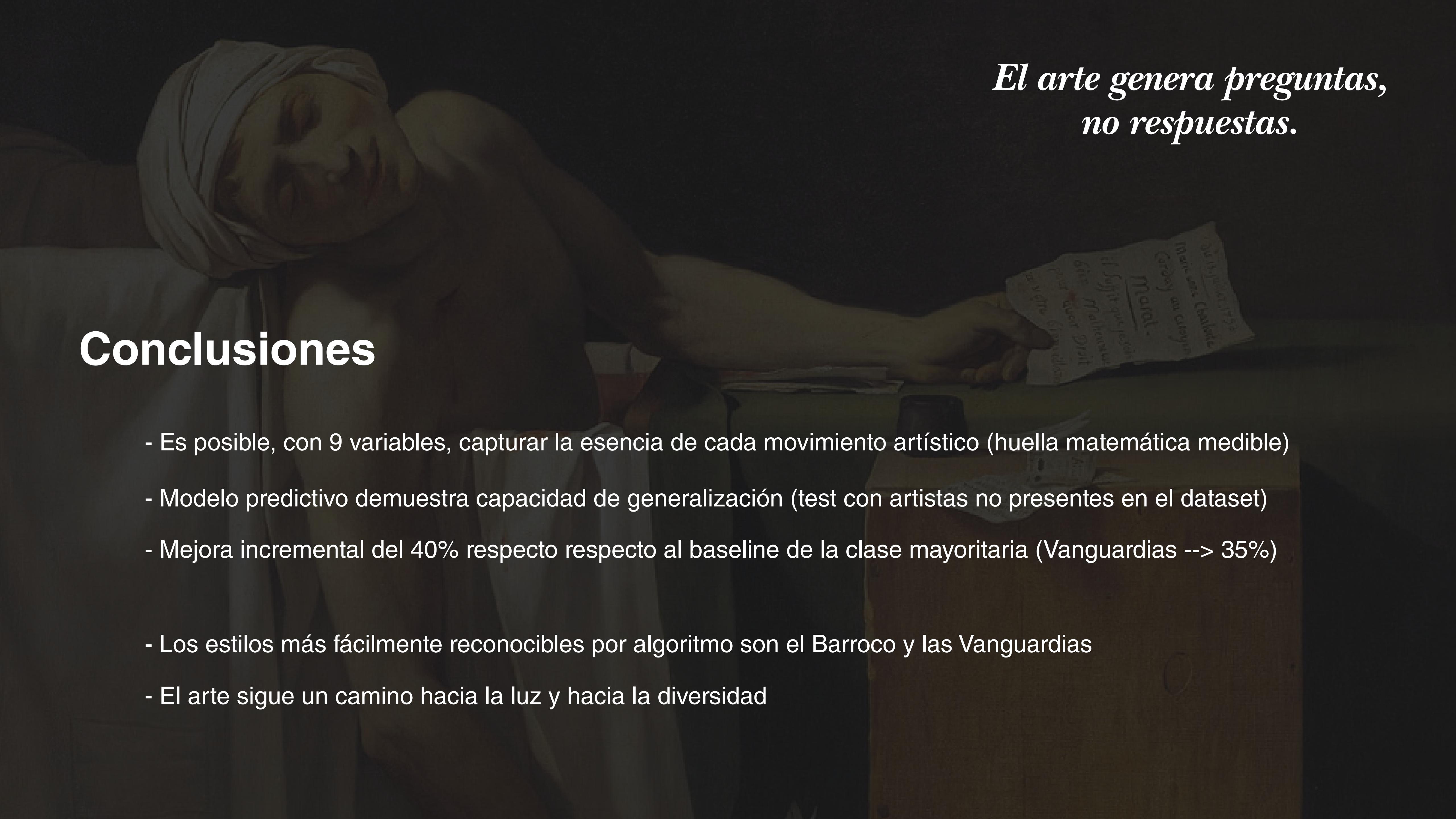
Post-impresionismo : 50%



Vanguardias : 75%



*"No sé quién es  
este señor, pero veo que usa  
la luz y la entropía como lo  
hacían en el Barroco"*



*El arte genera preguntas,  
no respuestas.*

## Conclusiones

- Es posible, con 9 variables, capturar la esencia de cada movimiento artístico (huella matemática medible)
- Modelo predictivo demuestra capacidad de generalización (test con artistas no presentes en el dataset)
- Mejora incremental del 40% respecto respecto al baseline de la clase mayoritaria (Vanguardias --> 35%)
- Los estilos más fácilmente reconocibles por algoritmo son el Barroco y las Vanguardias
- El arte sigue un camino hacia la luz y hacia la diversidad



## Limitaciones:

- Imágenes en low-quality
- Soporte (pared / relleno)
- Evolución autores
- Naturaleza del arte (solapamiento)
- Bocetos
- Variables limitadas

## Horizontes:

- Posibilidades más allá, redes neuronales CNN
- Análisis por artistas o sub-estilos
- Incluir más variables relevantes

A dark, atmospheric scene of a shipwreck at night. The foreground is filled with dark, jagged metal debris and twisted wreckage. In the background, a lighthouse stands on a rocky cliff, its light visible through the haze. The overall mood is somber and mysterious.

*Thanks!*