Nodes, Edges, and Artistic Wedges: A Survey on Network Visualization in Art History

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EuroVis 2025 STARs

EUROVIS 2025
LUXEMBOURG

Content

- Introduction
- Related Work
- Motivation
- Scope and Methodology
- Categorization
- Digital Resources and Databases
- Discussion
- Conclusion

Art History (AH)

- Visually oriented discipline
- Increasing availability of digitized archives
- Major research focus of AH: analyzing relationships and their attributes
- Existing databases without visualizations or only simple ones
  - ➤ Hard to see relationships / patterns

The Last Supper, Leonardo da Vinci. Wikimedia Commons

Mona Lisa, Leonardo da Vinci. Wikimedia Commons
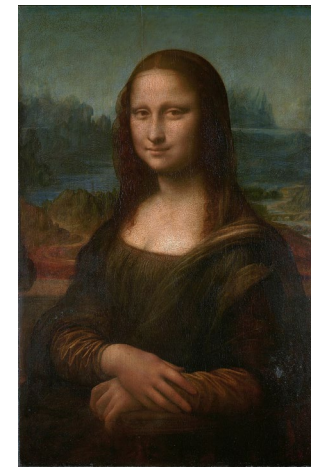
4
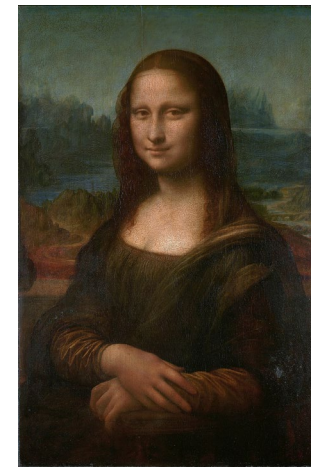
Network Visualization

- Visual Analytics (VA) gains popularity in AH research
  - ➢ **Network visualization and analysis**

- Great to show relationships in data
- Different types, e.g., node-link diagrams, arc diagrams, trees

Same artist

The Last Supper, Leonardo da Vinci. Wikimedia Commons

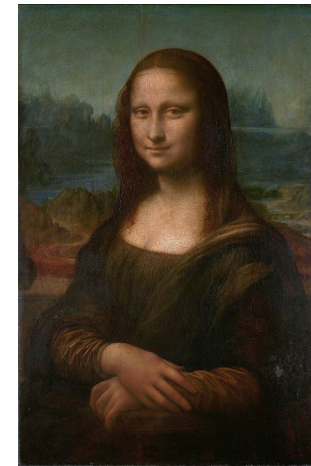*Mona Lisa*, Leonardo da Vinci. Wikimedia Commons

Nodes, Edges, and Artistic Wedges

- Nodes: e.g., artists, artworks, art styles

The Last Supper, Leonardo da Vinci. Wikimedia Commons

Mona Lisa, Leonardo da Vinci. Wikimedia Commons

Nodes, Edges, and Artistic Wedges

- Nodes: e.g., artists, artworks, art styles
- Edges: relationships between them (e.g., influences, similarities)

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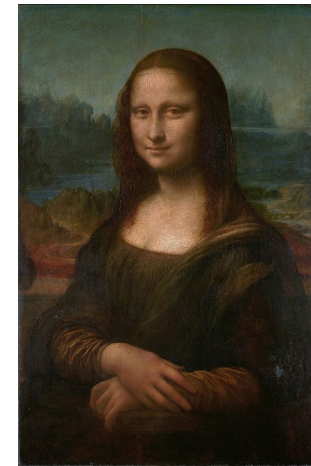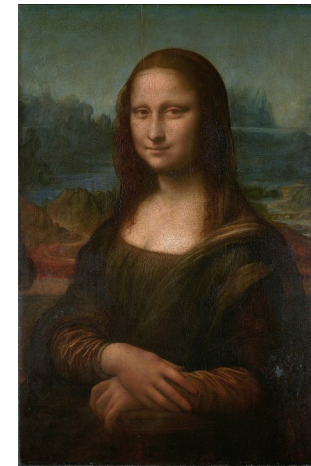
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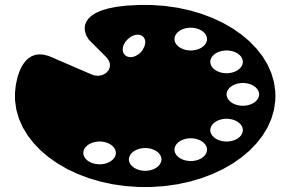- Wedges: stories from AH domain that provide insights

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The Last Supper, Leonardo da Vinci. Wikimedia Commons

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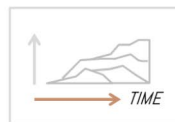- Discussion
- Conclusion

Related Work

- Visualization of cultural heritage collection data [Windhager et al. 2018]
- Multiple surveys on website of Historical Network Research Community (HNR) https://historicalnetworkresearch.org/hnr-bibliographycategories [HNR 2021]
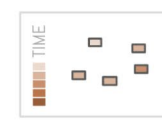
WINDHAGER F., FEDERICO P., SCHREDER G., GLINKA K., DÖRK M., MIKSCH S., MAYR E.: Visualization of cultural heritage collection data: State of the art and future challenges. IEEE Transactions on Visualization and Computer Graphics 25, 6 (2018), 2311–2330.
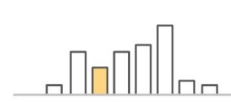
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Motivation

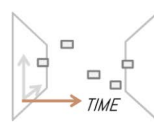- None of the surveys from related work focus on art history
- Working together with art historians on ArtVis (https://artvis.cvast.tuwien.ac.at/)

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Scope & Methodology

Scope
- **Network visualization**
- **Painters, paintings, and their relationships**

Method
- Systematic literature review according to PRISMA statement [Page et al. 2021]

Exclusion of
- Contemporary Art (1970 and later)
- Resources without visualizations
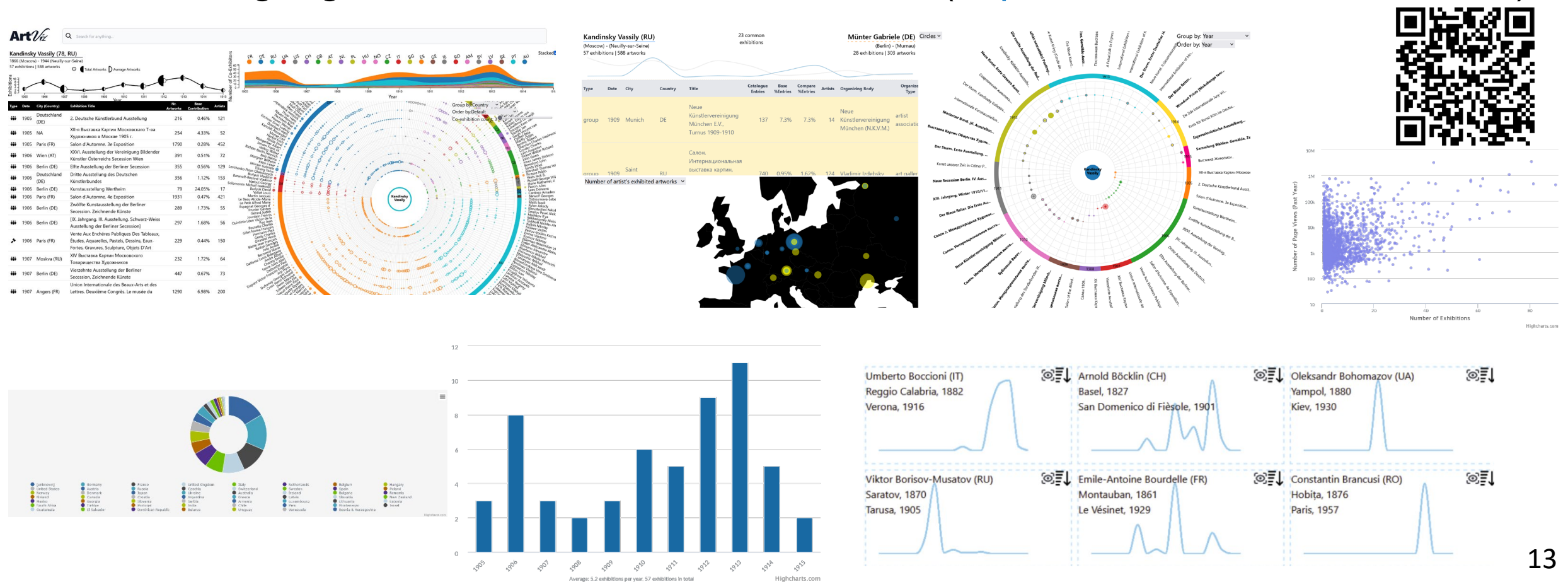- Other visualization types (e.g., scatter plots, bar charts)

Inclusion of
- Journal papers, books, conference proceedings
- Online resources (websites, blogs, etc.) in supplementary material
- Visualizations that include other people/art forms, where painters/paintings in focus

Methodology

- Selection of papers according to scope, inclusion -, and exclusion criteria

- Multiple academic search engines, including Google Scholar, Elsevier, Springer, ResearchGate, Scopus, IEEE Xplore, ACM, SAGE, and Kubikat

- Keyword combinations
  ("Art History" | "Painter" | "Painting" | "Artist" | "Artwork")
  &
  ("Graph" | "Graph Visualization" | "Network" | "Network Analysis" | "Network Visualization")
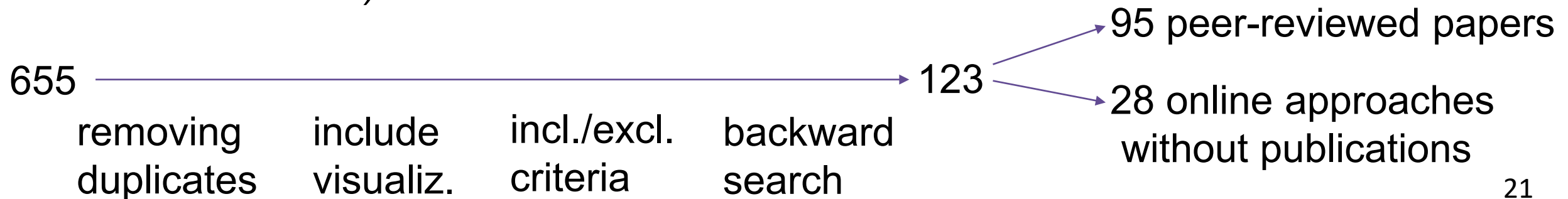
95 peer-reviewed papers

655 → 123

28 online approaches without publications

removing duplicates   include visualiz.   incl./excl. criteria   backward search

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Categorization

- **Main**: nodes and edges (i.e., persons/objects and their relationships)

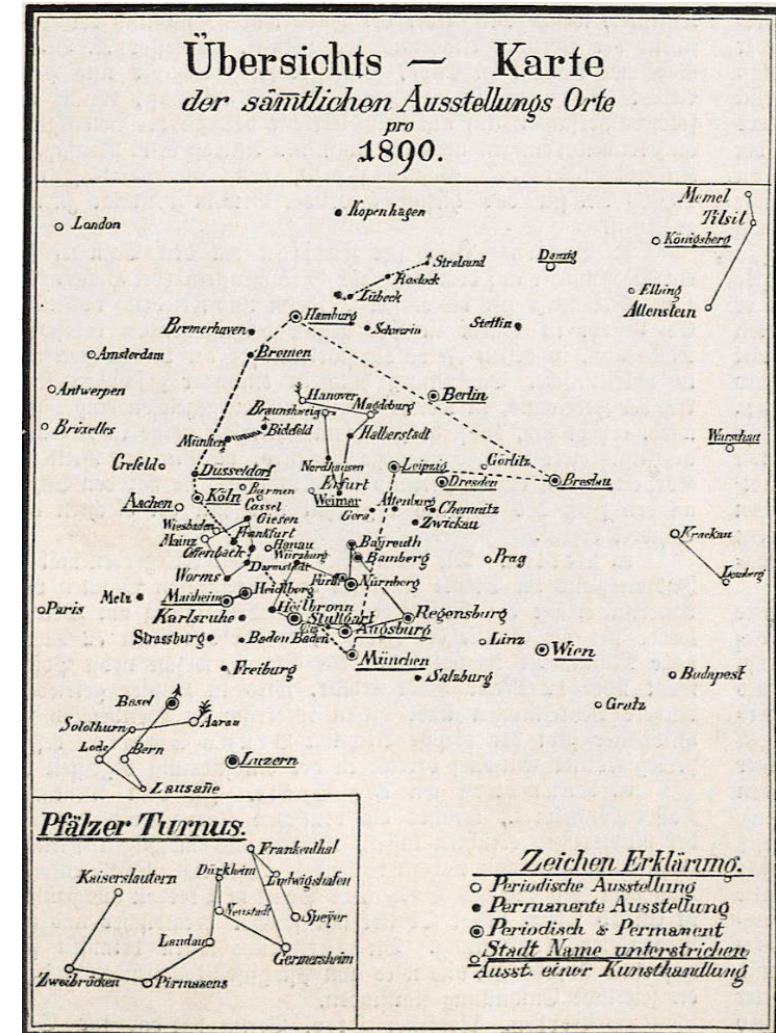| Influences	Similarities			Travels		Exhibitions + Art Market		Social Relationships	
	Artists	Artworks	Art Styles	Artists	Artworks	Exhibitions	Art Market	Work Related	Others

- *Sub*: visualization techniques, interactivity, temporal visualization, spatial visualization

| Visualization Techniques																Interactivity		Time Vis					Space Vis									
Node-link	Tree / hierarchy	Bipartite	Arc diagram	Radial	Chord diagram	Map with edges	(Colored) adjacency matrix	Colored adjacency matrix	+ dendrogram mix	Multiple coordinated views	Timeline with links	Information landscape	Other / experimental	Ego network	Treemap	Yes	No	None	Multiple vis	Edges on map	Animation / video	Implicit	Timeline	None	Nodeshape	Nodeproperty	Nodecolor	Edge (from same country)	Different vis per country	Node	Position (rows)	Clusters	Map

Hand-drawn

- Network visualizations in AH existed long before computers
- First attempts to visualize relationships in art world
- Earliest from 1890

PECHT F.:. Die Kunst für Alle 5 (1889 - 1890), 144. URL: https://digi.ub.uni-heidelberg.de/diglit/kfa1889_1890/0196/image,info,thumbs

Hand-drawn

- **Tree visualizations** very popular

- Other famous visualizations:

  - Covarrubia's "**Tree of Modern Art**" [Cov. 1933] showing evolutions of art movements

  - 1936 Alfred H. Barr, Jr.'s **genealogy of art** [Barr 1936] showing origins of art movements
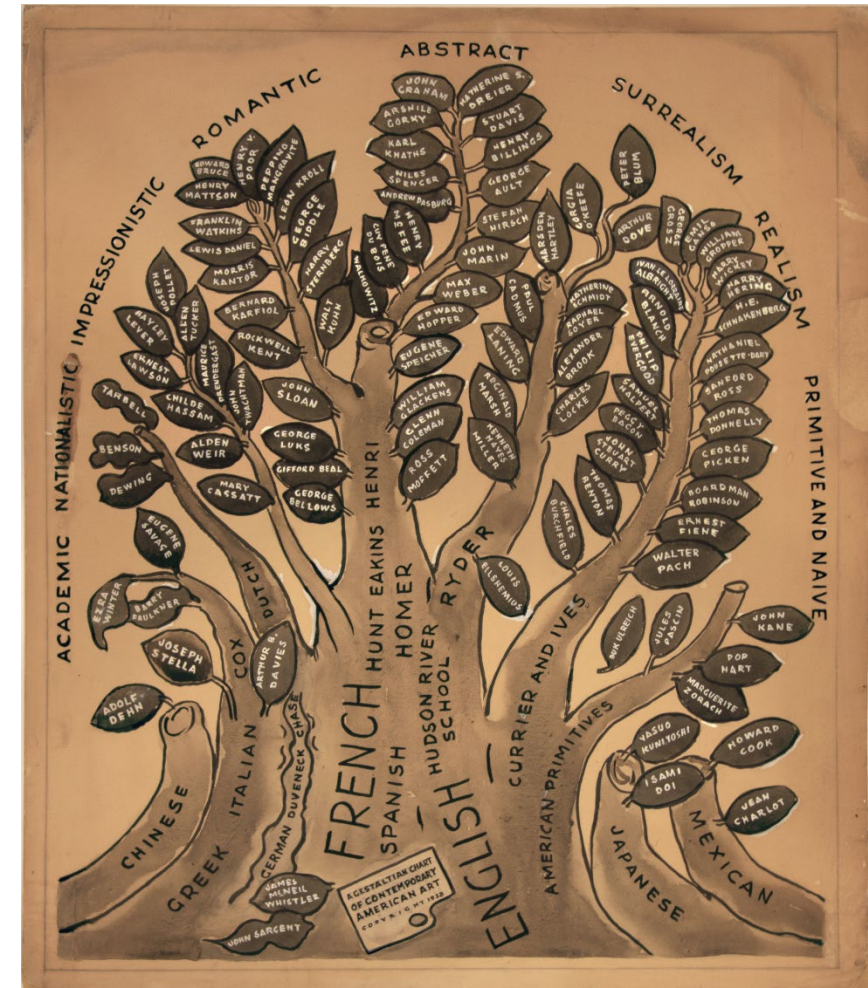
POUSETTE-DART N. J.: Original drawing for "A Gestaltian Chart of Contemporary American Art". Art and Artists of Today Vol. 1, no. 6, p. 2 (June - July, New York 1938). Pen, ink and graphite on board, 61 x 53 cm. The Nathaniel Pousette-Dart Papers. The Richard Pousette-Dart Foundation, New York. Courtesy of The Richard Pousette-Dart Foundation, New York.

Raphael and Perugino –

a student and his teacher

The Marriage of the Virgin, Raphael, 1504.
Wikimedia Commons

The Marriage of the Virgin, Pietro Perugino,
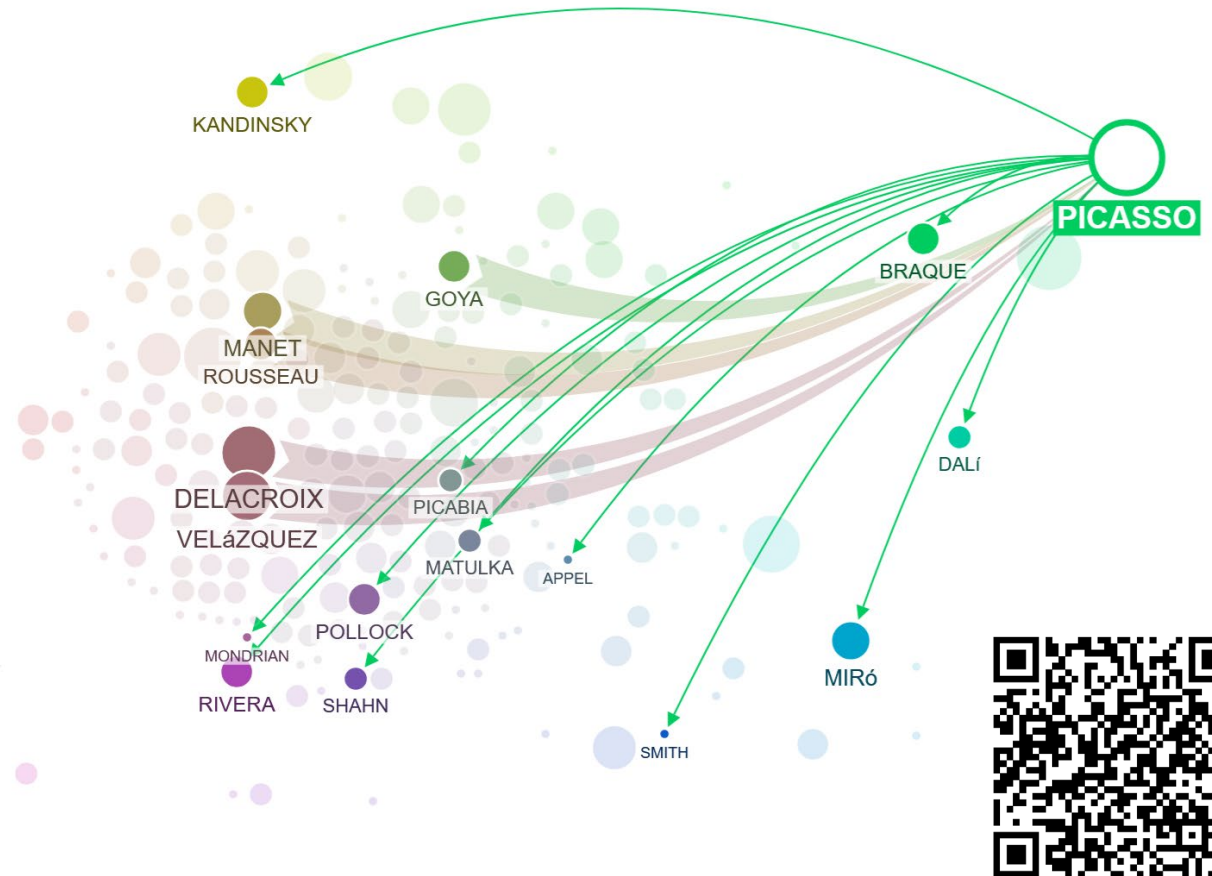1500-1504. Wikimedia Commons

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Influences

Some remodeled hand-drawn ones

Types:

Temporal aspects:

Spatial aspects:

Interactive:
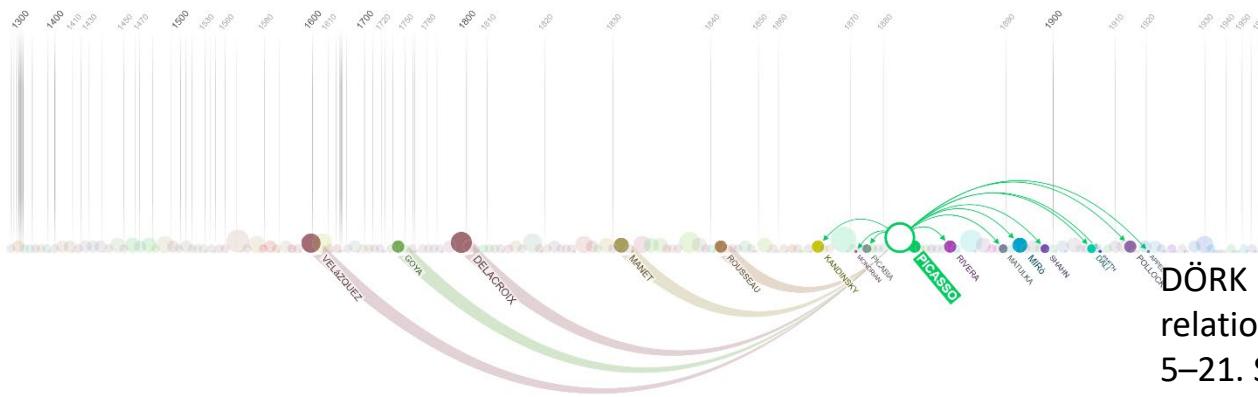
DÖRK M., CARPENDALE S., WILLIAMSON C.: Visualizing explicit and implicit relations of complex information spaces. Information Visualization 11, 1 (2012), 5–21. Screenshots taken from https://mariandoerk.de/edgemaps/demo/

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Similarities – Wedges

Manet – from rejection to success

Le Dejeuner sur l'herbe, Edouard Manet, 1863. Wikimedia Commons

Detail of Le Dejeuner sur l'herbe, Claude Monet, 1865. Wikimedia Commons

Le Dejeuner sur l'herbe, Paul Cezanne, 1876-1877. Wikimedia Commons

Similarities

Especially used colored adjacency matrices, dendrograms, phylogenetic trees

Types:

Temporal aspects: ➡
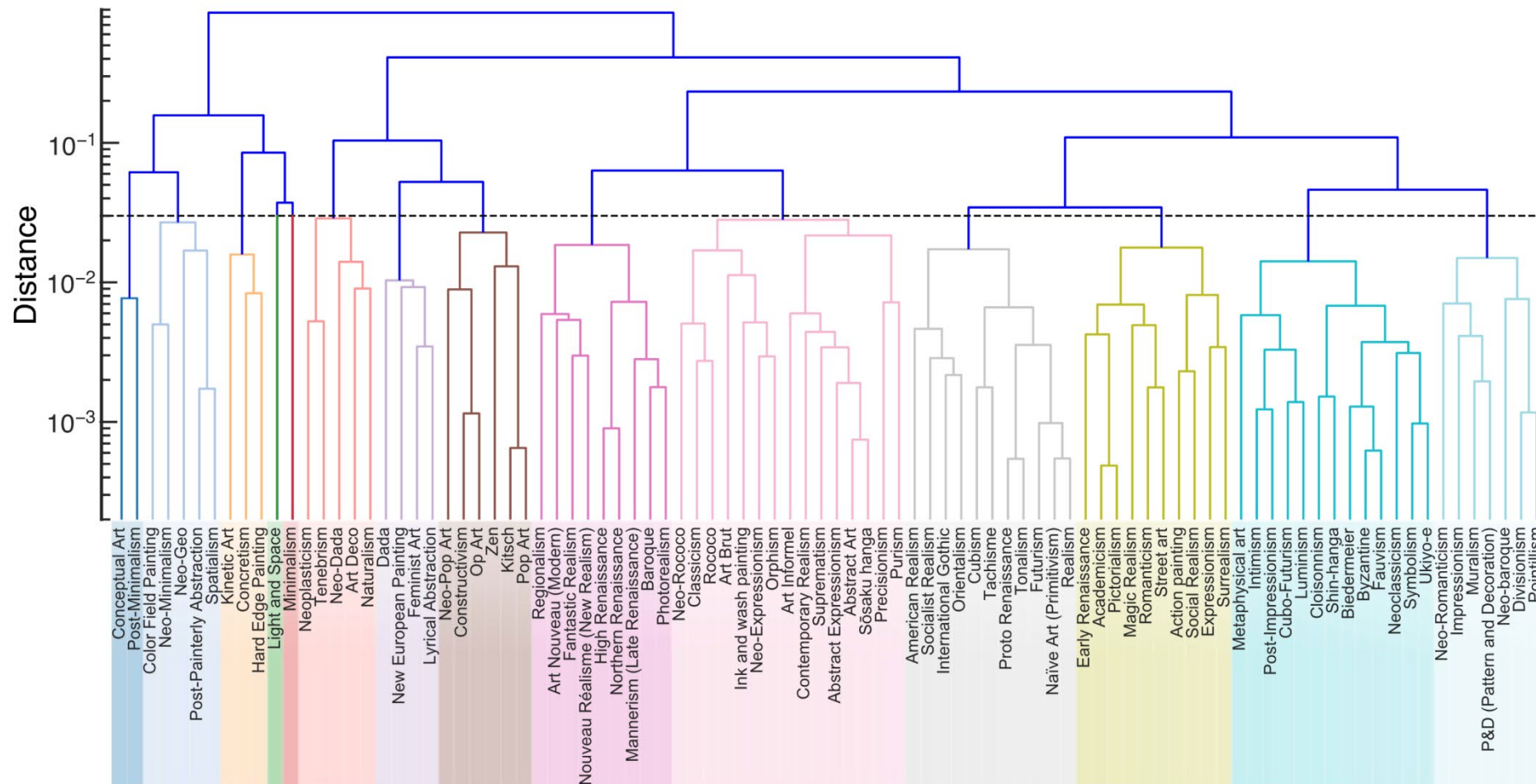
Spatial aspects: ●

Interactive: ◔

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Picasso – the travels of "Guernica"
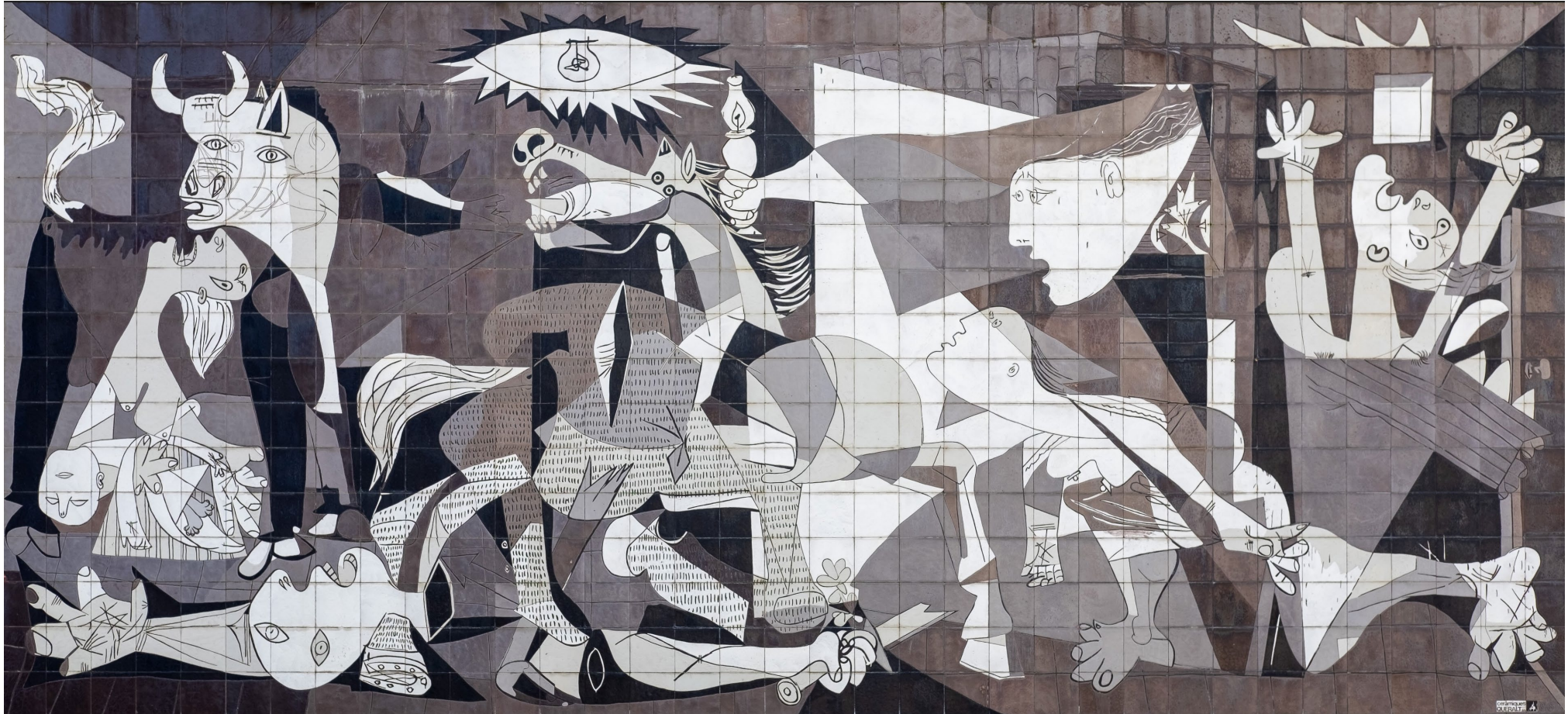
Mural reproduction of the painting "Guernica" by Picasso made in tiles on a wall in the city of Guernica y Luno. Photographer: Jules Verne Times Two / julesvernex2.com / CC-BY-SA-4.0

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Travels

Mostly papers from AH domain

Types:

Temporal aspects:

Spatial aspects:

Interactive:
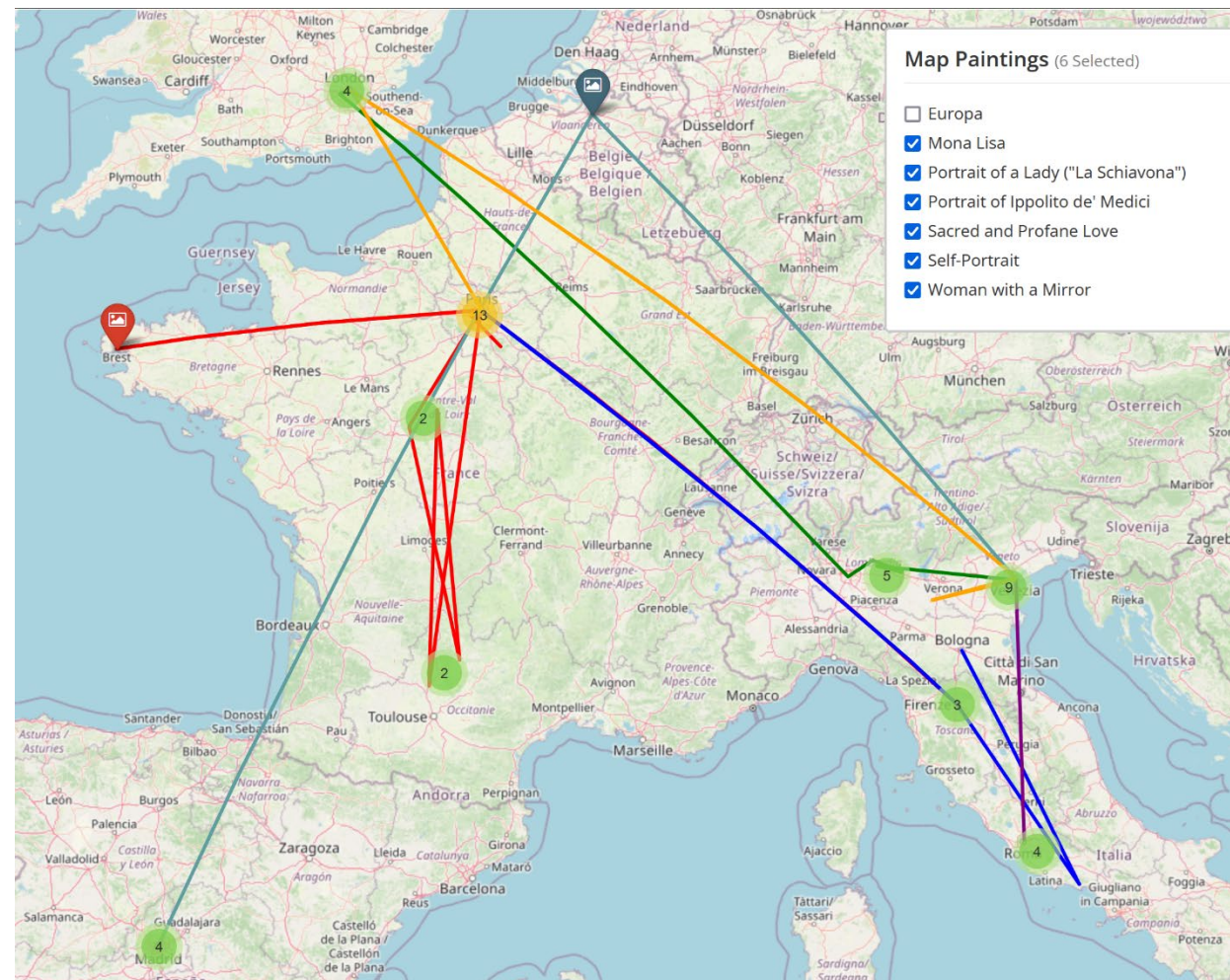
CRANSTON J.: Mapping paintings, or how to breathe life into provenance. In The Routledge Companion to Digital Humanities and Art History. Routledge, 2020, pp. 109–119. Screenshot from: https://www.mappingpaintings.org/

Davies and Kuhn - the creation of the "Armory Show"
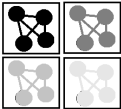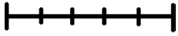
69th Regiment Armory in New York. Photographer: Dmadeo
https://de.wikipedia.org/wiki/Benutzer:Dmadeo. CC BY-SA 3.0
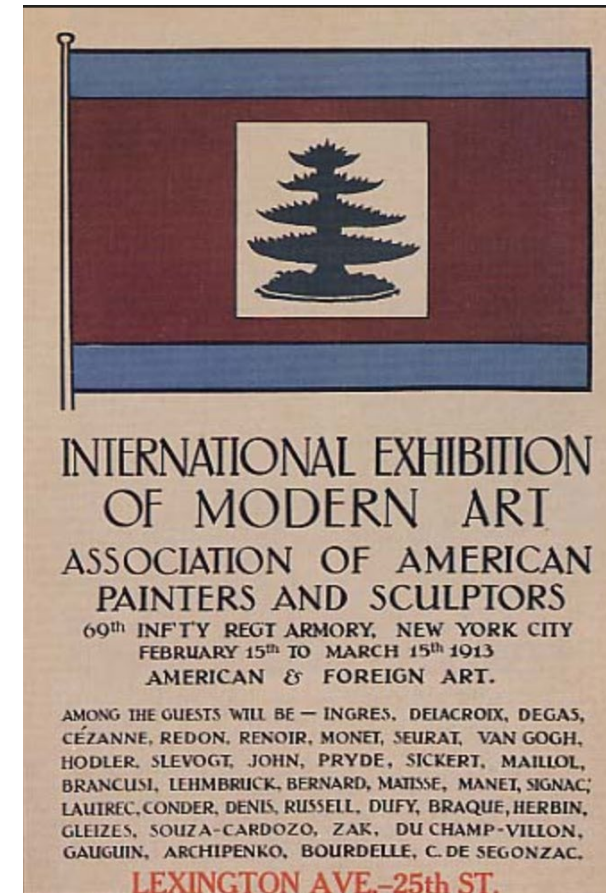
Armory Show poster, 1913.
Wikimedia Commons

Exhibition and Art Market Relationships

Types:
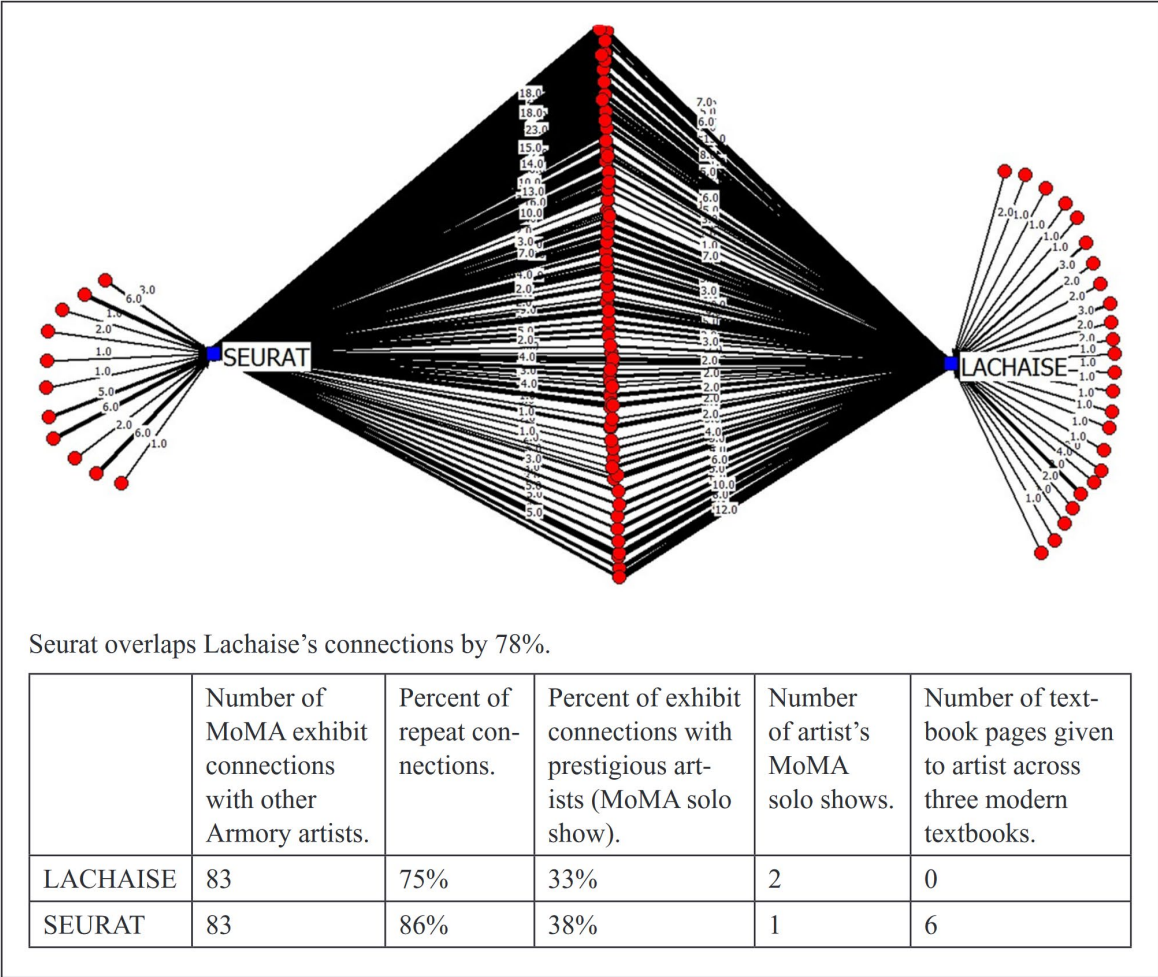
Temporal aspects:

Spatial aspects:

Interactive:

Seurat overlaps Lachaise's connections by 78%.

	Number of MoMA exhibit connections with other Armory artists.	Percent of repeat connections.	Percent of exhibit connections with prestigious artists (MoMA solo show).	Number of artist's MoMA solo shows.	Number of textbook pages given to artist across three modern textbooks.
LACHAISE	83	75%	33%	2	0
SEURAT	83	86%	38%	1	6

Van Gogh and Gauguin – an intimate friendship

Gauguin's Armchair, Vincent Van Gogh, 1888. Wikimedia Commons
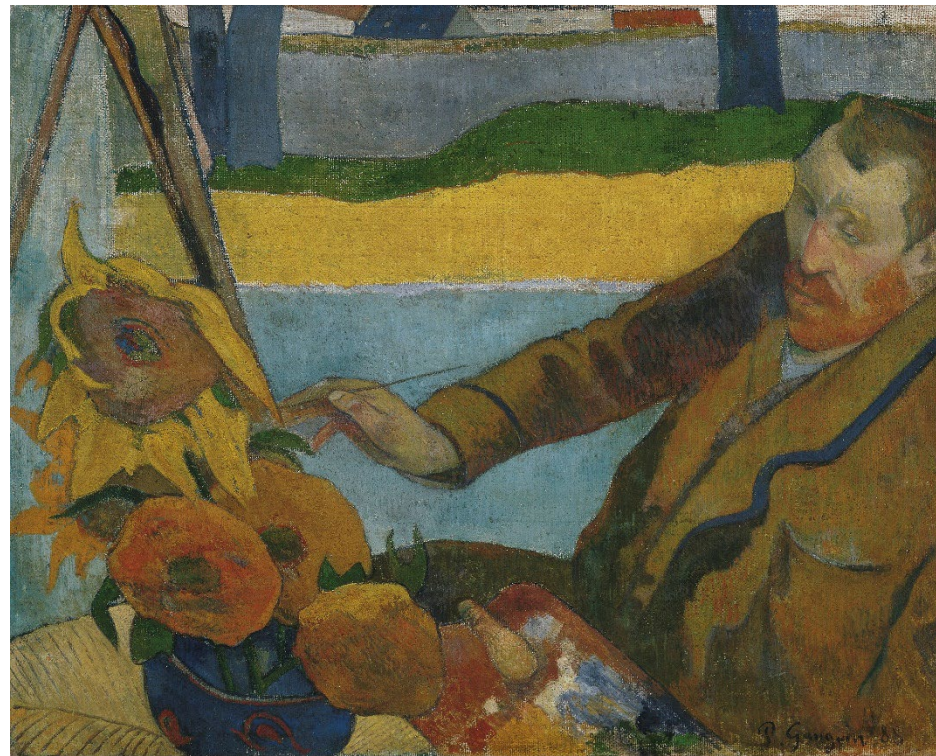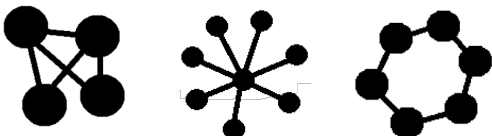
Vincent Van Gogh Painting Sunflowers, Paul Gauguin, 1888. Wikimedia Commons
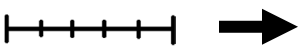
Still Life with Sunflowers, Paul Gauguin, 1901. Wikimedia Commons

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Social Relationships

Types:

Temporal aspects:

Spatial aspects:

Interactive:
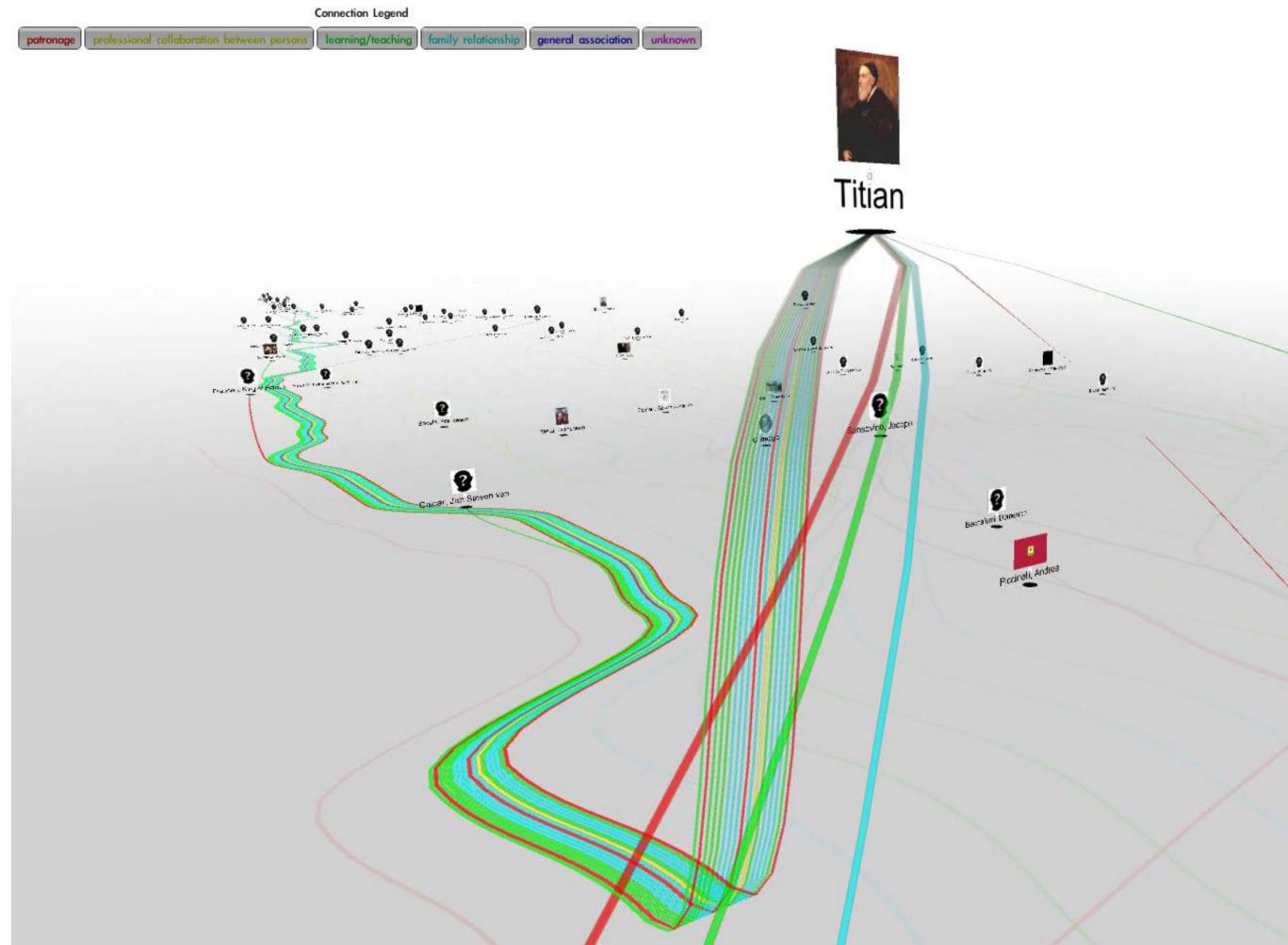
GOLDFARB D., ARENDS M., FROSCHAUER J., MERKL D.: Revisiting 3d information landscapes for the display of art historical web content. In Proceedings of the 8th International Conference on Advances in Computer Entertainment Technology (2011), ACM, pp. 1–8. Courtesy of Goldfarb.

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Digital Resources and Databases

Across 95 papers and 28 online approaches

- > 70 different **data sources**, 56 available online

- On average 1.8 **data sources per approach**

- **Most often used**: Getty Union List of Artist Names (ULAN), Wikipedia, Wikidata, DBPedia

- Many of available **online sources** are catalogs of museum collections

  - Majority of these focus on **artworks** and provide images

- Also some websites with **online biographies or norm data**

- Several cases where **same source was used for multiple papers** by the same authors

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Discussion

- **Beauty or Clarity**: balancing visual appeal and clarity

- **Shades of Truth**: including uncertainty

- **The Art of the Story**: encourage users to explore storylines (transform graphs into visual narratives)

- **Computational Frontiers**: develop sophisticated algorithms to uncover relationships, including techniques like machine learning, LLMs, generative AI, or text mining to get new insights

- **Best of Both Worlds**: interdisciplinary exchange between AH and VA important

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95 peer-reviewed papers

- Most popular **visualization techniques**: Node-link diagrams (83%), trees (18%)
- Most often used **tool**: Gephi (22%)
- **Subjects**: Artists (83%), artworks (25%)
- **Interactive**: 28%, most often used for social relationships (many online)
- **Dimensionality**: huge majority 2D (97%), 3D (5%), 1D (2%)
- **Additional visualizations**: 23% of papers only showed networks, 21% bar charts
- **Temporal aspects**: 53% of papers
- **Spatial aspects**: 44% of papers
- **Comparisons**: most popular topic: time periods (17%) in multiple vis (46%)

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Limitations

Other papers…
	…about other visualizations than networks
	…about other art forms
	…about contemporary art
	…that might only be available in printed form

Content

- Introduction
- Related Work
- Motivation
- Scope and Methodology
- Categorization
- Digital Resources and Databases
- Discussion
- **Conclusion**

Conclusions

- Five relationships especially interesting for art historians (influences, similarities, travels, exhibitions + art market relationships, social relationships)

- Mostly static 2D approaches and node-link diagrams

- Challenges in effectively visualizing ambiguity, uncertainty, incompleteness, and temporal evolution

Future Work:

- Bridging the gap between AH and VA

  - Visualizations that help domain experts

  - Including algorithms from machine learning for further insights

- Surveys about other AH subdomains/visualizations, comparisons to our STAR

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Thank you!

Nodes, Edges, and Artistic Wedges:
A Survey on Network Visualization in Art History

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EUROVIS 2025
LUXEMBOURG

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