Mapping Co-Exhibition Networks

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Abstract. This study investigates the evolution of pre-columbian exhibition networks and narratives from 1930s to 2020s through computational topic modeling of exhibition titles. Using BERT (bidirectional encoder representations from transformers), we analyzed 416 exhibitions across Europe, North America, and Latin America to understand how exhibition themes evolved over time and varied across regions. The results reveal a clear transformation from collector-centric presentations to more diverse thematic approaches, with increasing emphasis on regional and indigenous perspectives.

1. Introduction

Pre-columbian art exhibitions serve as vital records of how cultural institutions have interpreted and presented indigenous American heritage over time. These exhibitions not only showcase artifacts but also reflect changing academic perspectives, cultural attitudes, and institutional priorities. While traditional exhibition analysis often relies on manual categorization, computational approaches using natural language processing can reveal patterns across larger datasets.

This research applies BERTopic to analyze how pre-columbian exhibition

networks and narratives have evolved from the 1930s to the 2020s across different geographical regions. By examining exhibition data from the Dumbarton Oaks Library collection, a Harvard University research institute and premier resource for Byzantine and Pre-Columbian art research, we identify patterns in thematic focus, regional variations, and temporal shifts in exhibition approaches. Our work contributes to both museum studies and digital humanities by demonstrating how computational tools can enhance our understanding of cultural heritage presentation practices, while providing quantitative evidence for the evolution of curatorial approaches to pre-columbian art.

2. Related work

2.1 Digital Methods in Art History

In the article *The Growing Pains of Digital Art History*, Wasielewski provides an overview of the limitations of the implementation of digital methods in art historical research. These digital methods include image recognition, data mining, machine learning, and mapping. The text also discusses network analysis, highlighting its advantages and drawbacks. Network analysis helps reveal patterns between several actors in the art world, such as art, artists, institutions, and exhibitions. Analyzing data from correspondence or exhibition histories helps detect influences and relationships that remain hidden with analog analysis. However, this method remains flawed as it struggles with biased and incomplete data, reduction of complexity, and a lack of answers. Network analysis does not provide direct answers; instead, its deliverables need to be further analyzed. Additionally, there is the cost and effort barrier of creating useful datasets.

2.2 Pre-Columbian Art Exhibition History

Martin E. Berger's text, *Collecting, Buying, and Dealing 'Pre-Columbian Art' in Europe*, discusses a brief historical overview of the cultural exchange between the Americas and Europe since the 15th century. Initially, colonial civil servants, missionaries, and travelers collected objects, often through excessive violence. These objects were obtained for their scholarly value and were displayed as artifacts and curiosities. By the 19th century, interest in Pre-Columbian artifacts had grown enough to support an international

commercial market. The consensus changed as interest in pre-Columbian artifacts, especially among modern artists, increased. These objects were more frequently considered art. By the mid-20th century, laws were passed that limited the trade of cultural heritage objects. The text emphasizes the importance of investigating the provenance of objects and calls for ethical museum practices that respect the rights of Indigenous communities

2.3 Language

Finally, João Feres Jr. (2009), in Representing Latin America through Pre-Columbian Art: Political Correctness and the Semantics of Othering, researched the role of Pre-Columbian art in representations of Latin America.Feres describes how Pre-Columbian imagery, everyday language, and scientific discourse often reinforce othering in Latin American studies, for example, in textbooks. These forms of othering can be communicated along cultural, temporal, or racial lines, which force Latin America into the role of an asymmetrical counter-concept to, in this case, the United States. Our research project borrows this focus on language and applies it to exhibition catalogs, as these can also be considered alternative sites of knowledge production.

3. Dataset description

3.1 Data Source and Scope

The dataset based on the Dumbarton Oaks Library's Pre-Columbian collection reveals a comprehensive picture of exhibition patterns from 1937 to 2023. We analyzed 416 exhibition catalogs distributed across five continents: Europe led with 147 exhibitions, followed by Latin America (131), North America (124), with additional presence in Asia (13) and Oceania (1). The collection includes multilingual materials in English, Spanish, German, and French, encompassing various formats from printed catalogs to exhibition guides. Exhibition activity notably peaked during the 1980s-1990s, representing a crucial period of cultural exchange and academic focus on Pre-Columbian studies.

3.2 Humanities and Social Science Challenges

The research faced several key challenges in analyzing cultural interpretation patterns. The primary focus was understanding how exhibitions were presented across different cultural contexts, particularly tracking the evolution from collector-centric to more diverse curatorial approaches. The analysis required careful consideration of how historical events and institutional networks influenced exhibition practices, while also examining shifts in academic perspectives and cultural attitudes over time.

3.3 Computational Challenges

The technical implementation came with multiple challenges. First, standardizing multilingual data requires careful translation while preserving cultural nuances. Second, we needed to normalize geographic and temporal data to enable meaningful visualizations across different regions and time periods. Finally, implementing topic modeling across multiple languages while maintaining semantic accuracy posed significant computational challenges, particularly in creating visualizations that could effectively represent both temporal and spatial dimensions of the exhibition network.

4. Method/approach

4.1 Dataset Preprocessing

The preprocessing phase involved three essential steps to prepare the exhibition catalog data for analysis. First, non-English exhibition titles were translated to English to ensure consistency across the dataset. Second, all data were standardized to a consistent format to facilitate temporal analysis. Finally, exhibition locations were mapped to continents and assigned geographic coordinates to enable spatial analysis of exhibition patterns.

4.2 Solution approach and design

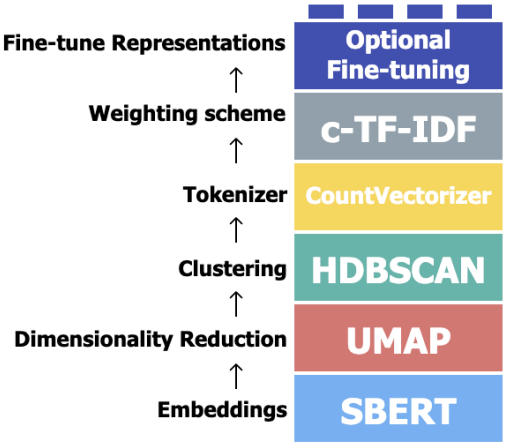

Figure 1. BERTopic

Our analytical framework implements BERTopic, which processes text bidirectionally to better understand context through a sequence of five main steps:

1. Document Embedding: We used the Sentence Transformer model 'all-MiniLM-L6-v2' to convert exhibition titles into numerical representations, optimized for semantic similarity tasks.
2. Dimensionality Reduction: UMAP (Uniform Manifold Approximation and Projection) was employed to reduce the high-dimensional embeddings while preserving both local and global data structure.

3. Document Clustering: HDBSCAN (Hierarchical Density-Based Spatial Clustering of Applications with Noise) was implemented to identify clusters of semantically similar exhibitions, allowing for the natural emergence of thematic groups.
4. Topic Creation: We applied a bag-of-words representation with n_gram_range=(1, 4) to capture complex phrases and individual words, enabling more nuanced topic extraction.
5. Topic Representation: We implemented Maximal Marginal Relevance (MMR) to generate topic keywords. MMR helps reduce redundancy in topic representations by balancing between keyword relevance and diversity. It selects keywords that are not only relevant to the topic but also sufficiently different from each other,

The network analysis component maps exhibition connections across continents, enabling visualization of institutional collaborations and their evolution over time. This dual approach allows us to examine both the thematic content of exhibitions and their institutional relationships simultaneously.

4.3 Evaluation setup

The evaluation process was designed to assess the quality of the results from both qualitative and quantitative perspectives. The qualitative analysis focused on the coherence of the identified topics, which involved a critical examination of the keywords associated with each topic to confirm their semantic meaningfulness. Quantitative evaluation was primarily concerned with the distribution of topics across different regions and time periods. To that end, the percentage of exhibitions attributed to each topic in each region and decade was calculated to allow for analysis of the data. Visualizations were employed to create a clear picture of the results and improve the interpretability of the dataset.

5. Results

5.1 Exhibition network

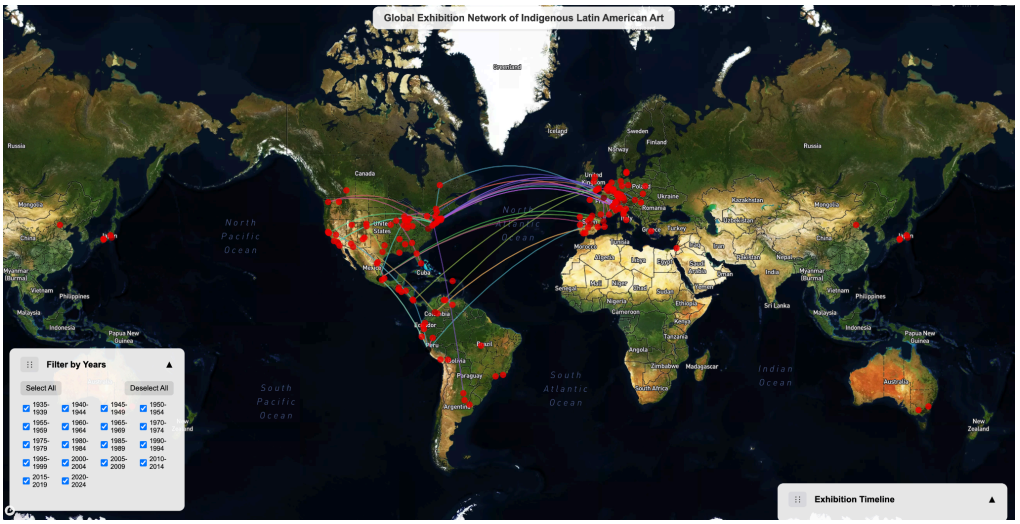

Figure 2. Screenshot of Exhibition Network Visualization

The exhibition network visualization(please download the file to check the interactive visualization) reveals extensive connections between European institutions and Latin American exhibition sites, with particularly strong links across the Atlantic. The colored lines, each representing publications from the same institution, show that many European museums and galleries actively organized Pre-Columbian art exhibitions in multiple locations across Latin America. The network is densest between major cultural centers in Western Europe and regions rich in Pre-Columbian heritage. This pattern suggests strong institutional relationships and consistent curatorial exchange between these regions, with the timeline filter showing how these networks evolved over different periods.

5.2 Exhibition narratives

The application of the BERTopic algorithm resulted in 11 distinct topics. Topic -1 represents non-clustered documents that the algorithm couldn't confidently assign to any specific thematic cluster, though in this dataset these documents appear to share common elements related to ceramics and general Pre-Columbian treasures (appearing in 94 exhibitions).

Figure 3. Exhibition Narratives

5.2.1 Temporal Evolution:

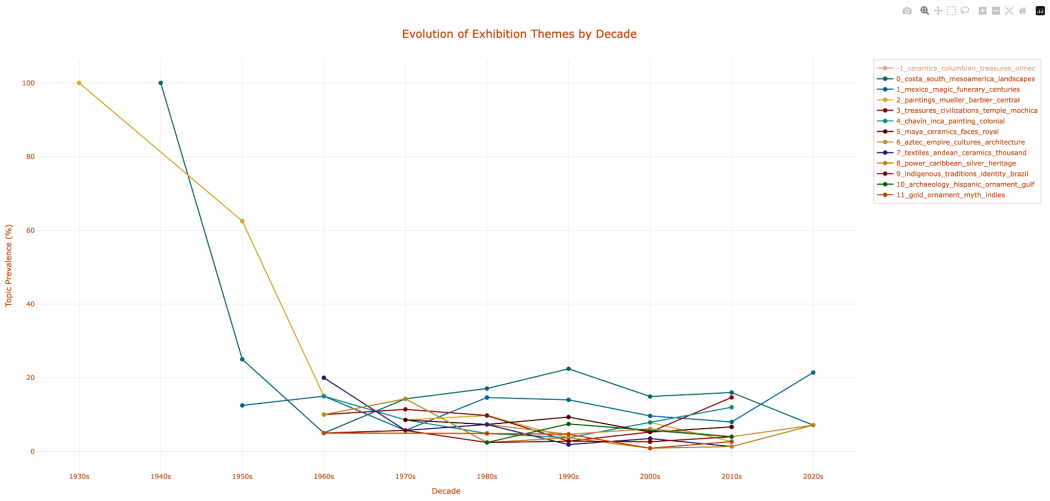

Figure 4. Screenshot of Temporal Evolution Visualization

Please download the file to check the interactive visualization

While data from the 1930s and 1940s is limited (one exhibition each), significant trends emerge from the 1950s onward.

The 1950s show a strong focus on paintings and museum collections (Topic 2, 62.5%), particularly centered around the Barbier-Mueller collections. This suggests an early emphasis on aesthetic and collector-centric presentations.

A notable diversification occurs in the 1960s, with exhibitions distributed across nine different themes. The strongest representation comes from textile-focused exhibitions (Topic 7, 20%), indicating growing interest in material culture studies. This decade also marks the emergence of indigenous and regional perspectives (Topics 9 and 11).

The 1970s show further thematic expansion, with ceramic-focused exhibitions gaining prominence (17.1%). The decade also sees increased attention to regional heritage (Topic 8, 14.3%) and landscape contexts (Topic 0, 14.3%).

The 1980s and 1990s represent peak diversification periods. The 1990s, with 107 exhibitions, showed strong interest in Mesoamerican landscapes (Topic 0, 22.4%) and continued focus on ceramics (18.7%). This period also sees increased attention to Maya studies (Topic 5, 9.3%) and archaeological perspectives (Topic 10, 7.5%).

5.2.2 Regional Distribution

Figure 5. Screenshot of Regional Distribution Visualization

Please download the file to check the interactive visualization.

European institutions (147 exhibitions) demonstrate a balanced thematic approach with particular emphasis on ceramics (26.5%) and Chavín/Inca artifacts (12.9%). The distribution suggests a comprehensive curatorial strategy that attempts to cover multiple aspects of Pre-Columbian culture.

North American institutions (124 exhibitions) show strong focus on ceramics (29.8%) and Mesoamerican landscapes (19.4%). Notably, they place less emphasis on Chavín/Inca themes (0.8%) compared to European institutions, suggesting a regional preference for Mesoamerican studies.

Latin American institutions (131 exhibitions) show the strongest focus on ceramics (40.5%) among all regions. They also demonstrate significant interest in Mesoamerican landscapes (13.7%) and Mexican themes (13.0%). Archaeological perspectives receive more attention here (6.9%) compared to other regions.

6. Discussion and Conclusion

First, exhibition narratives transformed from collector-centric presentations to more diverse thematic approaches, incorporating increased emphasis on regional and indigenous perspectives. Second, regional analysis shows distinct institutional priorities: European institutions maintained broad thematic coverage, North American institutions focused on Mesoamerican studies, and Latin American institutions emphasized material culture and archaeological contexts. Third, while ceramics remained consistently important across regions and time periods, architectural themes gained prominence in later decades, indicating growing interest in broader cultural contexts.

For limitations, the analysis primarily relied on exhibition titles, which provides only a limited perspective of exhibition content and may not capture the full complexity of curatorial narratives. While titles were translated into English for consistent analysis, this process potentially sacrificed important linguistic nuances that could carry cultural significance. At the same time, the dataset's quality and comprehensiveness are also constrained by the available exhibition catalogs in the Dumbarton Oaks Library collection, which may not represent the complete landscape of Pre-Columbian exhibitions during this period.

From a technical perspective, the BERTopic modeling approach, while

powerful for thematic analysis, has inherent limitations in capturing complex cultural narratives and may oversimplify multifaceted exhibition themes. Although the use of Maximal Marginal Relevance (MMR) helped address this, further parameter tuning could potentially yield more granular or coherent topics.

Future research could address these limitations by expanding the dataset to include exhibition catalogs from additional institutions and regions. Incorporating multilingual analysis could preserve important cultural nuances lost in translation. Additionally, developing more sophisticated natural language processing methods specifically tailored to museum contexts could enhance our understanding of exhibition narratives.

References

1. Berger, M. E. (2024). *Collecting, buying, and dealing "pre-Columbian art" in Europe: A short history.* In E. Seidl (Ed.), *Kunst und Kult – Die Altamerikasammlung der Universität Tübingen aus dem Nachlass Pelling Zarnitz*.

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Appendix:

For all the data, visualizations, codes and related results please check our Github Repository