

Dissecting the Canon: Visual Subject Co-Popularity Networks in Art Research

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Introduction

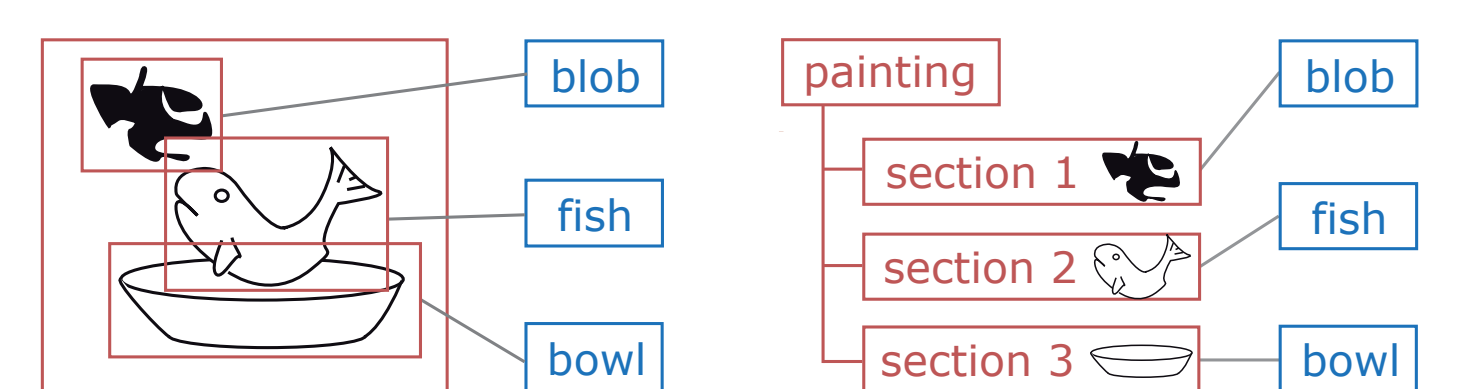
In Art History and Archaeology scholars use documents to study objects together with their meaning, related people, locations, times and events. Within this effort Art History has been defined as the 'history of all man-made things' (Kubler, 1962), which implies a focus on the dynamics of interrelated objects – the growth of what can be seen as the 'coral reef of culture' (Gombrich, 1979).

An important question in this domain is the definition or emergence of 'canon', i.e. the set of most popular objects, which everybody knows or supposedly should know in a given area – like for e.g. Da Vinci's 'Mona Lisa' and Botticelli's 'Venus' in painting or the Colosseum and the Pantheon in architecture.

In this poster we show that canons are identical with the most popular items over a distribution of popularity, which happens to be highly heterogeneous. As a consequence we can explore the meaning of canon by looking at co-popularity of visual objects in general, no matter if the objects belong to the head or the tail of the popularity distribution.

New research in the area of co-popularity has been facilitated recently with the emergence of relevant datasets, in which tags and other classifications have been used to classify a large number of images and image segments. The work in these projects is either done manually by human editors (Russell 2008, Schich 2007), automatically with the help of pattern recognition algorithms (e.g. <http://www.definiens.com>) or by human computation, i.e. in a collaborative effort in the form of games such as Peekaboom (Ahn 2006).

The data produced by these efforts can be understood as bi-partite networks connecting image documents and classification criteria. Moreover image documents as well as the classification criteria may feature additional information in the form of trees or ontologies. The figure below shows a simple example, where paintings and their classified segments are represented as simple trees, which are connected to classification criteria via the classification link:

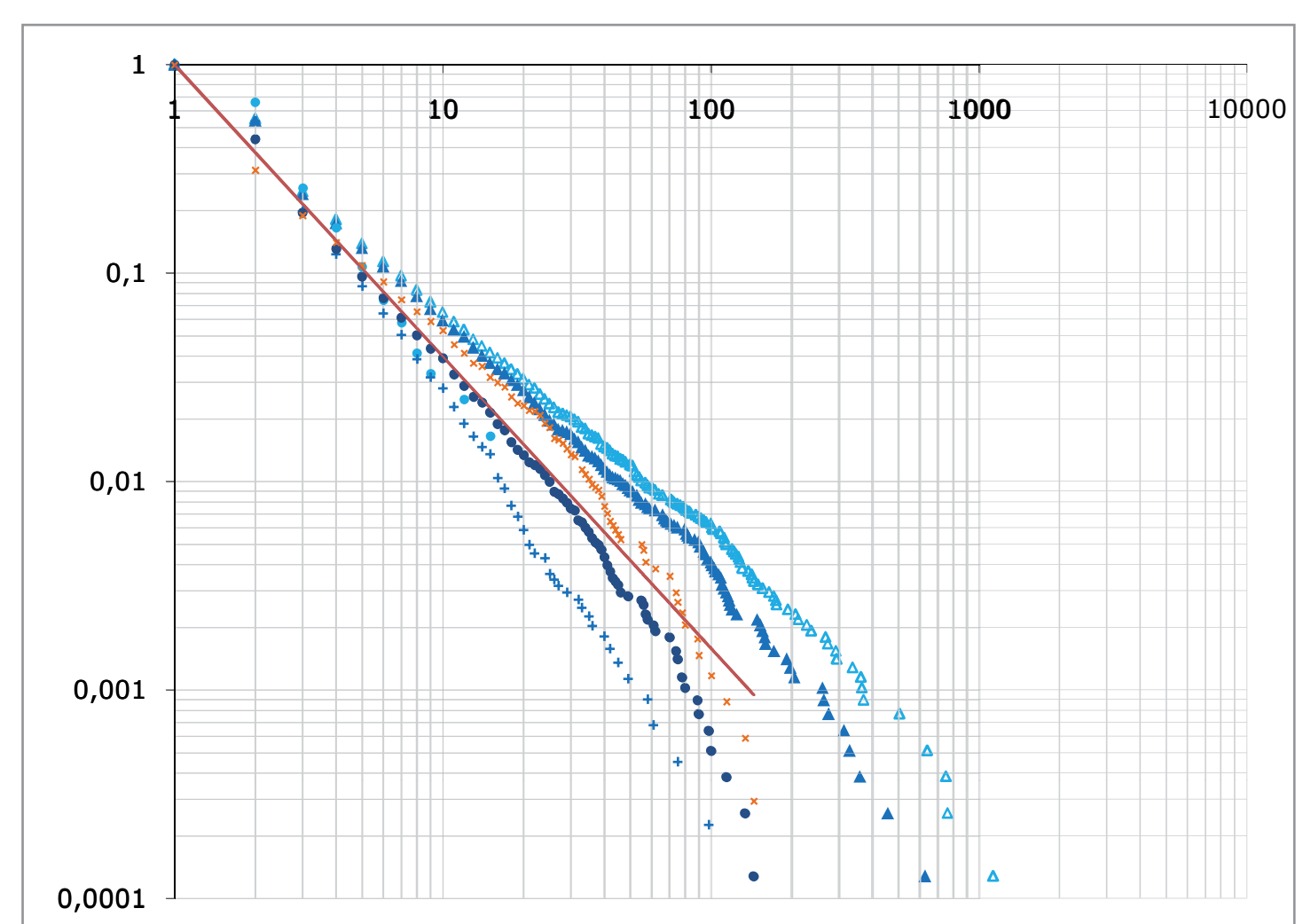


As shown in at least two studies (Russell 2008, Schich 2007), such bi-partite classification networks usually belong to the scale-free class of networks, characterized by a highly heterogeneous connectivity distribution. Hence methods developed in network science can be used to process art research data in search for better definitions of a canon.

In this poster we analyze a classic dataset of art research collecting ancient art and architecture and their Western Renaissance documentation since 1947 (CENSUS 2005):

As we can see in the plot below, there is a clear long tail of monument popularity, no matter if we look at the Number of Renaissance Documents ●, the Number of Depictions/Descriptions in the Documents ▲ or the Total Number of Links Including Overpopulation ▲ (where single depictions are linked to multiple monument parts).

In addition the long tail emerging from the Number of Documents can be dissected into tails of different character, such as Non-Architectural Sculpture + and Everything Else x. The hitlist below gives a clear idea how Non-Architectural Sculpture, Architecture and Sculptural Architecture combine to the general canon of ancient monuments in Western Renaissance.



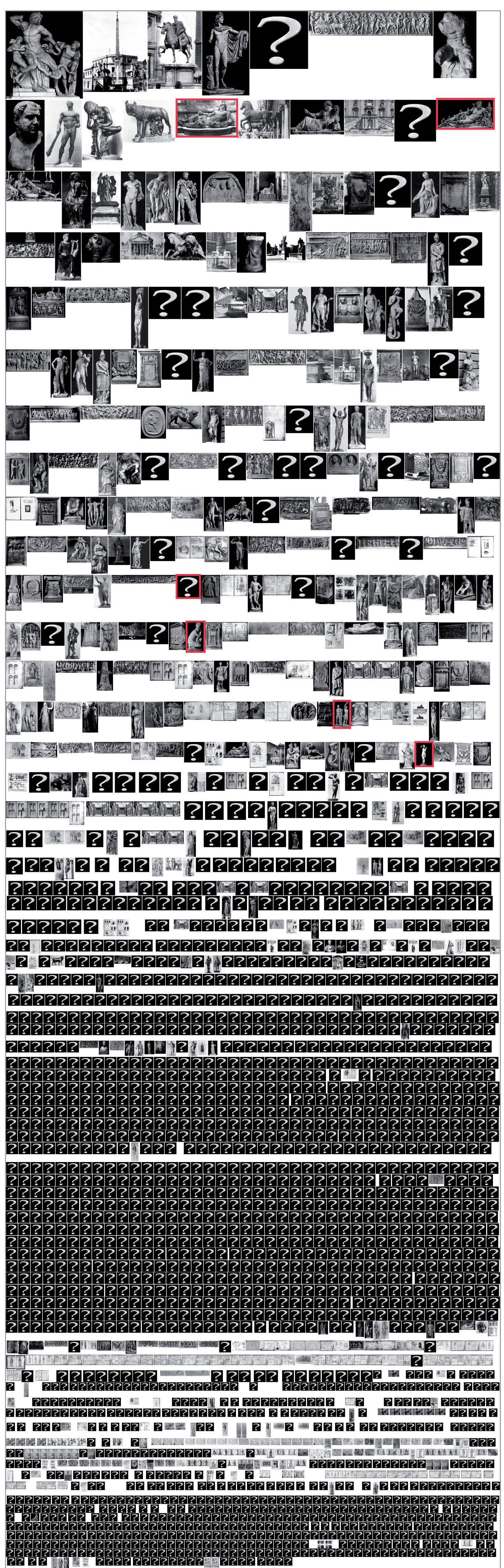
NodeID	Ancient Monument	Renaissance documents	Depictions in documents	Total links including overpopulation	
150908	Arch of Constantine (triumphal arch)	144	360	764	112%
150770	Pantheon (temple)	134	629	1131	80%
150940	Arch of Septimius Severus (triumphal arch)	114	329	754	129%
150792	Colosseum (amphitheatre)	100	457	642	40%
219823	Laocoon (group of statues)	98	156	156	0%
151057	Column of Trajan (honorary column)	90	261	363	39%
150958	Arch of Titus (triumphal arch)	89	264	372	41%
150812	Baths of Diocletian (thermae)	80	314	506	61%
150826	Basilica of Constantine (basilica)	78	198	268	35%
150784	Temple of Mars Ultor (temple)	75	159	238	113%
150776	Horsetamers (group of statues)	75	107	108	1%
151227	Forum of Nerva (forum)	74	172	273	59%
150844	Baths of Caracalla (thermae)	70	275	506	84%
150890	Theatre of Marcellus (theatre)	70	205	366	79%
151328	Temple of Antoninus and Faustina (temple)	62	160	228	43%
151697	Equestrian Statue of Marcus Aurelius (equestrian statue)	61	94	94	0%
150779	Apollo Belvedere (statue)	58	66	66	0%
151029	Mausoleum of Hadrian (sepulchral monument)	57	125	142	14%
151930	Temple of Minerva (temple)	56	149	212	42%
150806	Septizonium (facade)	56	118	124	5%
151038	Temple of Castor and Pollux (temple)	55	153	207	35%
234323	Regiole (equestrian statue)	49	80	80	0%
151320	Temple of Saturn (temple)	46	110	145	32%
151322	Curia Julia (curia)	45	95	112	18%
151625	Bacchic Sarcophagus (sarcophagus)	45	75	75	0%
151065	Temple of Serapis (temple)	44	120	175	46%
150785	Forum Augustum (forum)	43	90	129	43%
151046	Forum of Trajan (forum)	42	82	90	10%
151526	Torso Belvedere (statue)	42	53	53	0%
151143	Basilica Aemilia (basilica)	41	117	176	59%

Canons are tails within tails!

Extrapolating from this result the general canon of art history can be seen as the head of the long tail distribution of object popularity, where the sub-canon of given specialized areas appears as the head of a self-similar sub-tail of the whole distribution.

In the examples below we size object images according to their documentation frequency, which provides us with a limiting condition of what objects are contained in various canons emerging from the documents:

The first example shows the long tail of Non-Architectural Sculpture in analogy to the + plot and the blue entries in the hitlist on the left:



The second example presents the top 30 monuments of the sub-tail of Statues Identified as Venus or Aphrodite at some point in history. Again the long tail appears in the + plot on the left:



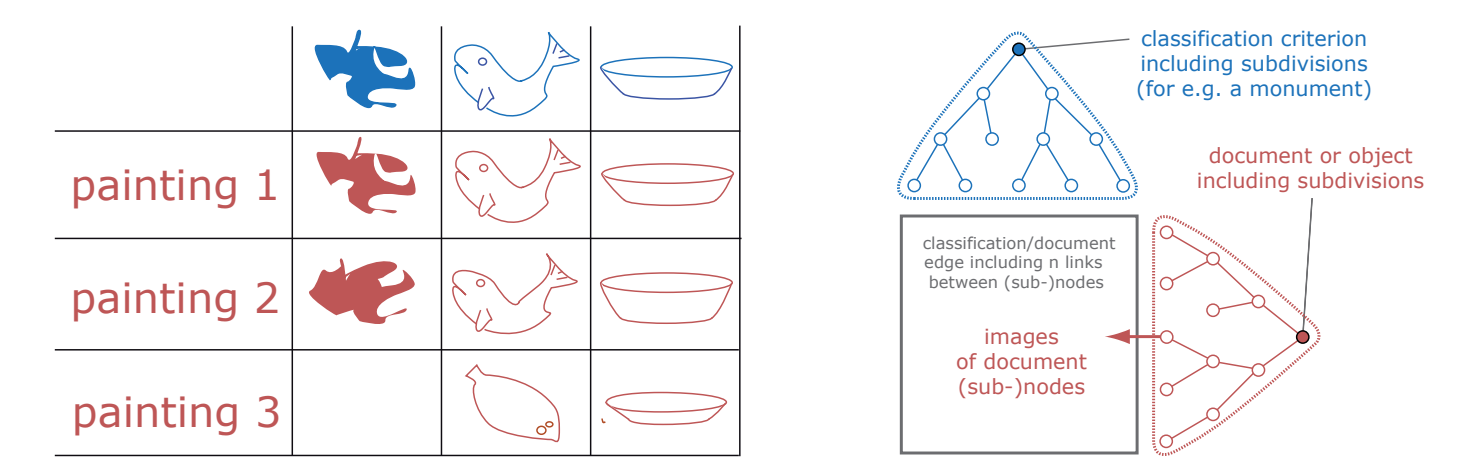
Note: In both cases above for each monument we show a directly attached photo or an image of the first document. Question marks either indicate that the monument is untraced, i.e. lost since the Renaissance, only verbally documented or without image information at the first document in the database.

Visual Subject Co-Popularity

Extending from the question of popularity and canon, we present a new way to explore the related phenomenon of visual subject co-popularity. Starting from a classified/annotated image dataset, we propose a method, which combines a bipartite community finding algorithm and a method for the production of scalable image matrices in order to construct 2-dimensional overviews.

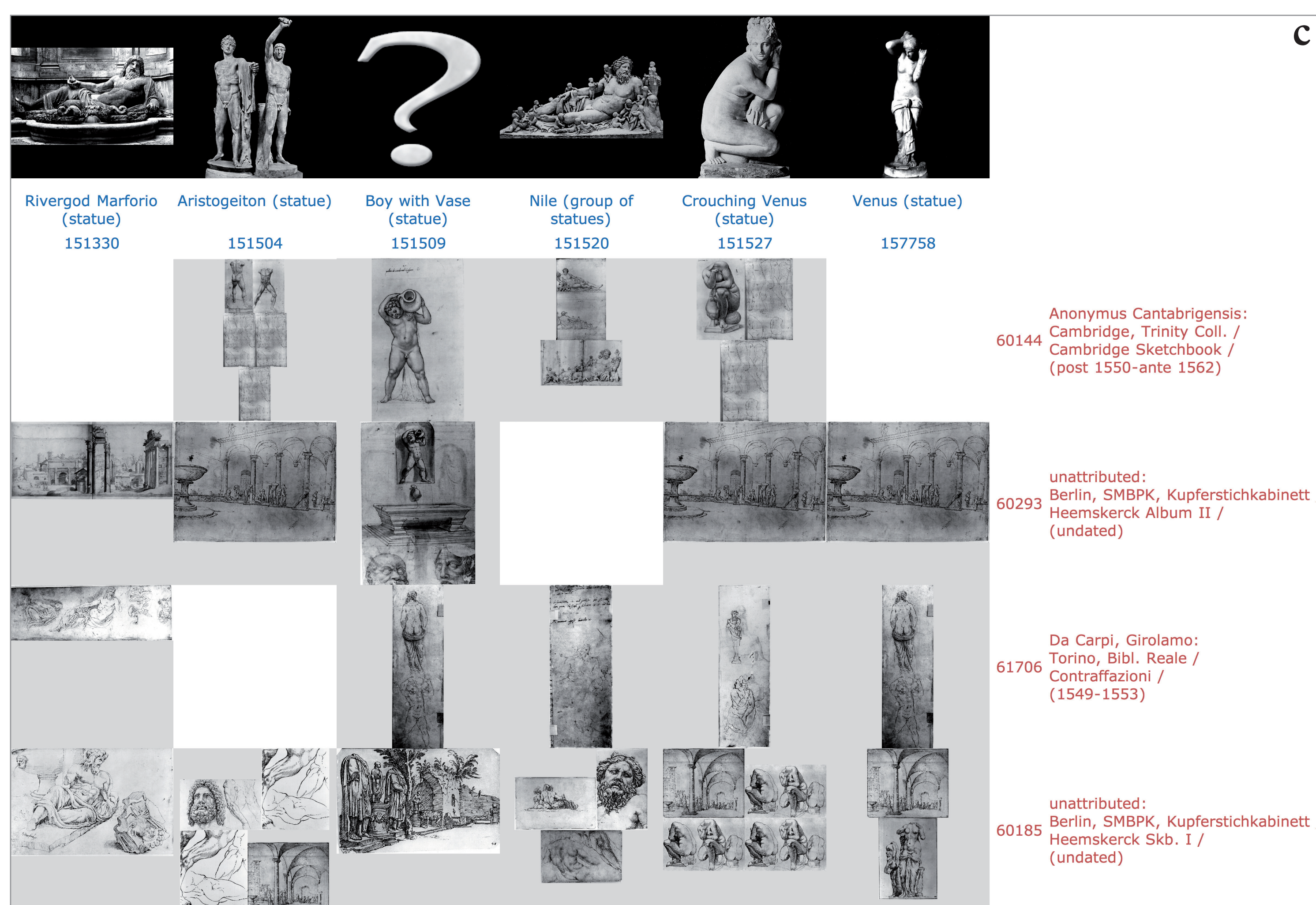
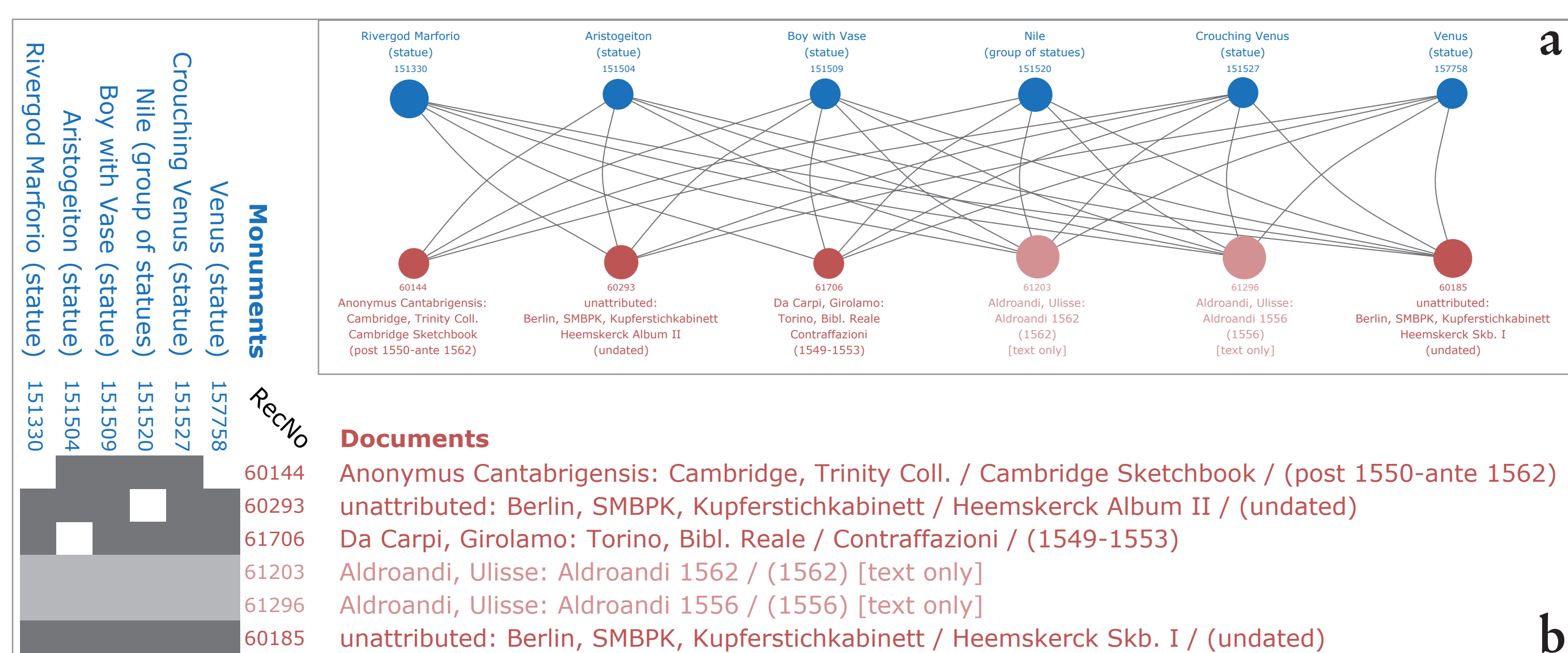
In order to find interesting areas in the whole network we apply a community detection algorithm for overlapping bi-cliques introduced by Lehmann et al. (2008), which generalizes on the k-clique community finding algorithm for one-mode networks by Palla et al. (2005).

In a second step these communities are then visualized using a method for the production of scalable image matrices introduced by Schich (2008). Here, node information of a bi-partite classification network is placed in the location of the links in the adjacency matrix of the network, as shown below for our simple paintings example and the monument-document network in the CENSUS dataset:



The figures a-c provide a proof of concept for our method: First a community of monuments and documents as found by the bi-clique community finder a is visualized much clearer as an adjacency matrix b. After permutation and filtering, the images of subordinate document nodes are finally placed in the location of the links c.

The resulting image matrix obviously indicates some reasons of co-popularity of otherwise unrelated monuments - in our case all monuments except for the two superprominent river gods were located in close topographical proximity around 1550.



Acknowledgements

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