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One view is not enough

High-level visualizations of a large cultural collection

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As cultural institutions are digitizing their artifacts and interlinking their collections, new opportunities emerge to engage with cultural heritage. However, it is the often comprehensive and complex nature of collections that can make it difficult to grasp their distribution and extent across a variety of dimensions. After a brief introduction to the research area of collection visualizations, this paper presents a design study visualizing an aggregated collection from diverse cultural institutions in Germany. We detail our iterative design process leading to prototypical implementations of four stylistically and functionally coordinated visualizations, each one focusing on different facets of the collection.

1. Background

One major promise connected with the digitization efforts carried out by many heritage institutions is increased levels of access to our cultural heritage (Smith 2002: 7). Aggregators, such as the Digital Public Library of America[1] and Europeana,[2] expand this ambition by integrating contents from many collecting institutions so as to let people search through millions of artifacts of varied origins. Due to the size and diversity of such composite collections it can be difficult to get a sense of the patterns and relationships hidden in the aggregated data and the overall extent of the collection.

While there has been an increased research interest in personal collecting practices (e.g. Watkins et al. 2015), we are more interested in the growing body of work devoted to the visualization of collections maintained by cultural institutions. Some of this research uses existing visualization techniques to help collection owners analyze their own data. For example, the Viewshare tool developed at the U.S. Library of Congress allows for rapid creation of visual interfaces that can be used to explore and share patterns in the collection data (Algee et al., 2012). While timelines can be used to reveal temporal trends in such collections, they also allow for engaging formats of visual storytelling (Kräutli 2016).

Additional research has been motivated by the unease with search-only access, which may impede discoveries, as it requires people to translate a possibly vague interest into a specific query. Explicitly designed to encourage serendipitous exploration, the Bohemian Bookshelf offers a playful display of a set of books as interconnected views representing different aspects of the collection (Thudt et al. 2012). Considering the austere aura of many search interfaces greeting visitors with a

search box, Whitelaw (2015) argues for more 'generosity' in the display of artifacts and their distribution in the collection. An example of a generous display of artifacts is the one showing the entirety of public-domain images owned by the New York Public Library. These images are shown in a grid-based visualization[3] grouped by time, genre, collection, or color, resulting in a view that is truly a bird's-eye perspective on the NYPL's collections. While arrangements in grids follow a linear order, image plots can position items along two dimensions, for example, the time a photo was taken and its average hue (Hochman & Manovich 2013).

Other common representations are network diagrams of artifacts or artists depicting various relationships in cultural collections. In general, network visualizations tend to be analytical, such as in the project examining the European art trade in the 19th century.[4] Network graphs can also be used for casual exploration of collections, enabling closer inspection of artifacts. For example, the Städel Museum provides access to their digital collection[5] along linear network arrangements of paintings based on similar motif, era, style, and other less conventional associations such as mood.

Besides plots, grids, timelines, and networks, there are also hybrids that juxtapose and connect multiple visualizations. For example, a visualization of a prints collection couples a grid of thumbnails with a timeline, thus conveying the visual richness of the works as well as its temporal extent (Whitelaw 2015: para. 26). A multifaceted visualization of a poetry anthology provides multiple perspectives on the data, which are coordinated and act as alternative entry points into the same collection (Hinrichs et al., 2016).

These examples show how the visualization of collections can operate at various scales, from overview to detail (Shneiderman 1996), as a continuum between the synoptic representation of an entire collection, and the literal presentation of individual artifacts (Greene et al. 2000). However, the collections that have so far been visualized are mostly small to mid-sized, and relatively homogenous in the types of artifacts they contain. This design study explores the potential of high-level visualizations for comprehensive collections that aggregate data of diverse artifacts and diverse sources.

The study was commissioned by the Deutsche Digitale Bibliothek[6] (German Digital Library), DDB, which is an aggregator of collections from museums, archives, libraries, and research institutions across Germany. Akin to similar efforts at the European level (Europeana) and the United States (Digital Public Library of America), the aim of the DDB is to promote the digital distribution of cultural heritage by connecting a multitude of digital libraries and allowing this aggregation to be queried in a faceted search interface.

2. Methodology

This case study was carried out over the course of five months in the lead-up to a multi-year project on visualizing cultural collections (Glinka & Dörk, 2015). The original brief by our partners was to conceive multiple visualizations that could reveal the extent of their collection. The team working on the project comprised three junior interface designers and one senior visualization researcher. Our partners at the DDB had backgrounds in physics, computer science, and information science. All exchanges with the partners and within the team—whether in person, by telephone or email—were recorded in brief form in a shared Google document.

The first step involved consideration of the data facets that were already in use in the search interface of the DDB: time, location, person/organization, keyword, and sector. Based on these facets, early conversations with our partners at the DDB, and our own interest in the data, we made a few simple low-fidelity sketches of

visualizations of these facets as well as combinations of them. The exchanges with the DDB around these early sketches helped us to decide which selection of visualizations should be implemented as prototypes. The verbal and written feedback on the early visualization sketches enabled us to estimate the feasibility and usefulness of the representations before they were actually implemented.

Once the most promising visualizations were selected, our focus shifted to building working prototypes. The process was of an iterative nature with weekly to bi-weekly meetings (in person and by telephone) to review progress and refine the designs. After the initial ideation phase, we carried out the aesthetic and functional development as an intertwined process. To evaluate the quality of the visualizations, we had two dedicated feedback sessions on the actual prototypes before publishing the visualizations as part of an integrated website. Toward the launch of the visualizations the focus shifted from individual visualizations to the overall experience of the site.

3. The problem

At the time of the study (April-August 2014), the DDB contained over 7 million digital artifacts across a broad spectrum of institutions. While trying to grasp the extent of the comprehensive aggregations of artifacts, a difficult question arose: How can we meaningfully visualize these large and diverse collections to reveal patterns and relationships, while also providing access to the individual artifacts? To approach this question for the DDB collection, we considered four unique characteristics of aggregated collections as challenges for the visualization design.

- Aggregated collections, such as the DDB, contain a large number of items. The challenge is thus to convey the extent of such large datasets along the most meaningful and consistently used facets.
- Digitized cultural artefacts contained in the DDB can vary greatly depending on the cultural sector, collection type, and how much is known about the objects. Given such diversity, the challenge is to devise visualizations that provide multiple perspectives on the data.
- Visualizations of large datasets tend to use highly abstract representations. Consequently, the resulting distance from the underlying artifacts can be difficult to connect with.
- Considering that aggregated collections are mainly created for the public good, the challenge is for visualizations to represent the diversity of cultural artifacts in such a way that it is inviting to a broad audience.

4. The solution

To address the above challenges, we carried out an iterative design process in close collaboration with our partners at DDB. This process led to four views, each one focusing on a main facet relation: time, keywords, places, and networks of people and organizations.

The *timeline* view serves as an overview visualization that features a time series chart for the different sectors, as well as small coordinated facet visualizations (see Figure 1). The timeline received a prominent position due to the observation that time is the facet most broadly associated with cultural artifacts. When opened, the visualization slowly builds itself up, allowing the viewer to gradually make sense of its components. The horizontal axis spans a timeframe from −4000 BC to the present days, with a nonlinear scale based on the time epochs used by the DDB. Considering that the relative number of artifacts across epochs and sectors varies considerably, we developed a dual-scale timeline visualization that

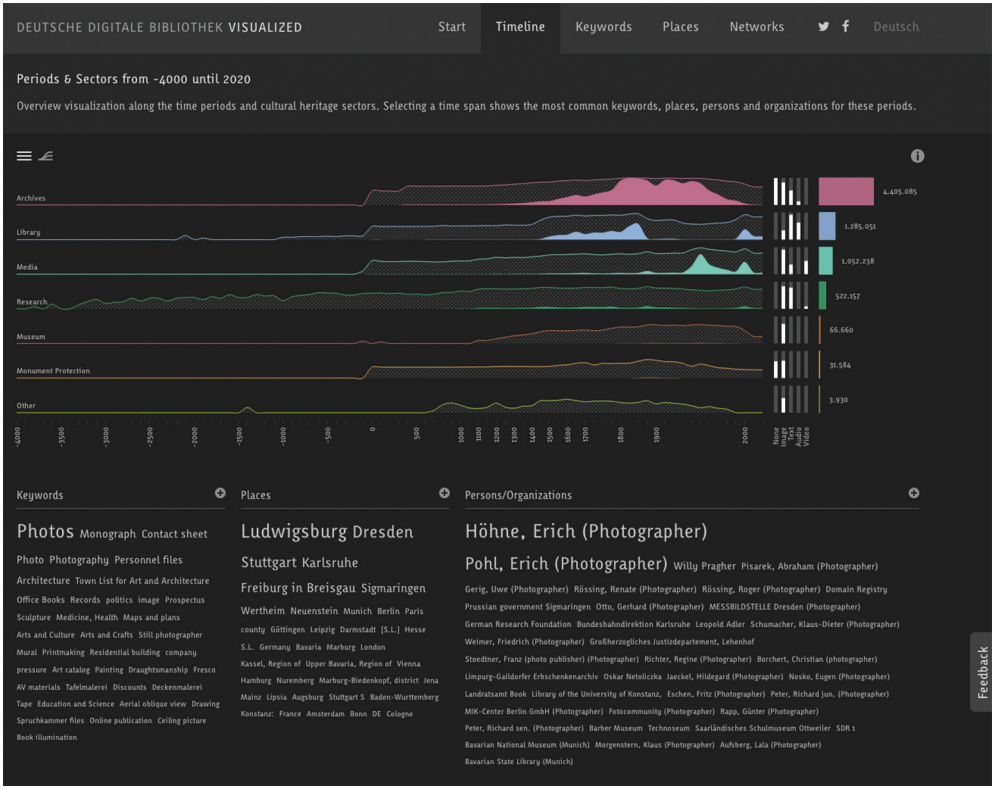

Figure 1. The timeline view is the densest visualization as it brings together all the main facets of the DDB collection and integrates the facet values (bottom) with the filterable stacked timeline (top) in a multi-view visualization.

employs at the same time a linear and logarithmic scaling for the vertical axis. The linear scaling has a more salient visual presence, while the shapes for the logarithmic scaling are displayed only with a contour and dark gray crosshatching pattern. The benefit of the dual scale is that both lower and higher ranges remain readable and comparable across time within each sector. The timeline can be used to select time spans as filters that inform the selection of keywords, places, and persons/organizations displayed in the facet views. The respective font sizes in the tag clouds for these facets are immediately adjusted when the time window is resized or moved, providing direct feedback on the filtering.

Compared to the timeline, the next two visualizations are based on conventional representations that are likely to be more familiar to viewers (see Figure 2). The *keyword* view is a visualization of the 500 most common keywords as a tag cloud, in which variation of font size

Figure 2. A tag cloud displays the top 500 keywords associated across the entire DDB database (left). Donut charts represent the most prolific places and the distribution of artifacts across the main sector types (right).

represents relative differences in frequency. By selecting a keyword, the other keywords that have the most artifacts in common become more salient (brighter) than those that share fewer (darker) items. The *place* visualization shows a small-multiple arrangement of donut charts, each visualizing the distribution of sector types across the most common locations in the DDB. Hovering over segments of a given donut chart highlights the same sector in the other charts. The main intention behind the design of the *keyword* and *place* views was to provide both visitors and creators of the DDB with comprehensible visualizations that focus on a given facet.

The fourth view is the *network* view, which represents the connections between people and organizations via the artifacts that link them in the metadata (see Figure 3). Organizations are displayed as bright gray circles whereas people are displayed as red circles. Nodes are positioned using a force-directed algorithm, and node sizes correspond to the relative number of items associated with them. The network represents data provided by the time period selected by the user. Differently from the timeline visualization in the first view, due to performance issues only individual time epochs can be selected. When switching between time periods the difference and overlap is calculated to enable smooth transitions between the different network states. Viewers can zoom and pan into the graph, allowing close examination of sections of the network.

Common interaction concepts that are intended to facilitate exploration by novices have been reused across the different views. For example, all four views contain direct links to the DDB search interface providing access to the underlying artifacts. The links in turn can contain multiple search criteria, which means that clicking on a tag below the timeline visualization will trigger a search query with both the currently selected time window and the selected tag. Similarly, selecting a

Figure 3. The network view shows the connections among people (red) and organizations (gray) based on their associations with the same artifacts within the selected epoch (top).

link between two nodes in the network view will result in a list of all items linked to these two entities. Each view provides a unified help function available via an info icon on the top right in each view; after selecting it small tooltips briefly explain the components of the views. We also placed particular emphasis on the flexibility of each visualization, to enable alternative views on the same topic. For example, in the timeline view, charts for each sector can be integrated into a stacked graph; and in the place view, viewers can sort elements by switching between frequency and name. The network view features an alternative to the force-directed layout, i.e. a scatterplot that arranges nodes by number of connections and entries. The design is consistent throughout the site,[7] as can be seen in the landing page, which displays previews of the other visualizations in addition to a detailed background about the project (see Figure 4).

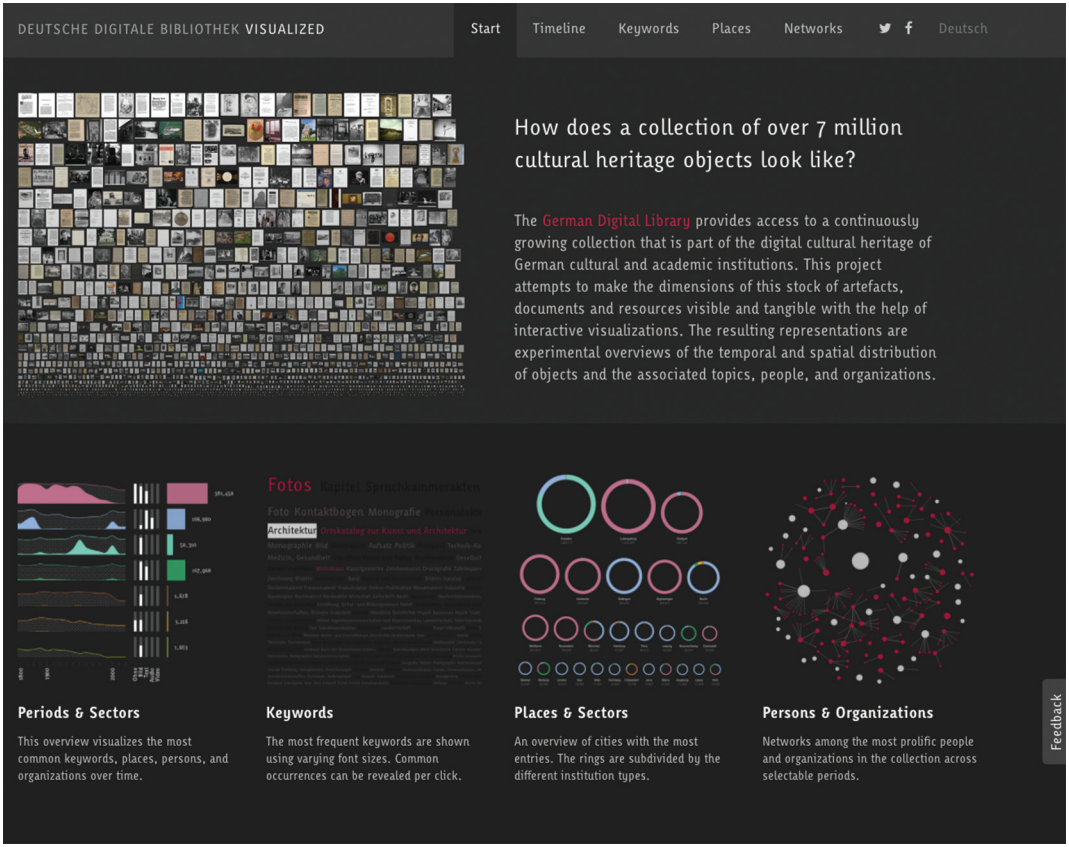

Figure 4. The initial page introduces the project and links to the four visualizations.

5. Conclusions

Over the course of the project design patters emerged. These were confirmed by feedback from our collaborators as well as by comments left by the website visitors.

– *Multiple perspectives*. Overall, the premise that the complexity of a cultural collection cannot be distilled into one singular visualization was confirmed by our partners throughout the study. Our multi-view approach enabled multiple interpretations and analyses to be carried out on the same collection data.
– *Coordination across views*. While the interface has separate views, these are coordinated by functional and aesthetic consistency, and by offering faceted previews in the timeline view as gateways to the respective other views. This solution illustrates how

multiple views do not need to appear disjointed, but can be integrated in various ways.
– *Primacy of time*. While time was only considered in two of the four views, the feedback indicated that it is a dimension that could be expanded across all views. In a follow-up project we are currently exploring how a timeline visualization can welcome visitors and be reused as a widget to provide a common method of filtering subsets of a collection.

One major limitation of this work relates to the extraordinary distance and dislocation caused by high-level visualizations that aim to represent thousands and millions of artifacts. The highly aggregated nature of composite collections arguably results in a form of display that does not take into account particular preferences for the specific mediating practices of different cultural communities (Hennessy 2012). Furthermore, the highly abstract nature of the visualization itself necessarily neglects the local data practices involved in the creation and evolution of the collections (Loukissas 2017). One possible way to address these justified critiques is to consider the use of site-specific visualizations embedded within the respective collections (Legrady & Forbes 2016). Such situated visualizations, however, can hardly be aggregated across multiple locales. Although the presented visualizations may be able to convey the extent of the collections at the metadata level, they fail to reveal the depth, richness, and significance of the underlying artifacts. Thus one challenging question remains: How can we do justice to the particular aesthetics and ethical issues of cultural collections?

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Notes

1. Digital Public Library of America: http://dp.la

2. Europeana: http://www.europeana.eu

3. New York Public Library public-domain images: http://publicdomain.nypl.org/pd-visualization

4. Network diagram of agents connecting the British, Belgian, Dutch, and French auction markets from 1801–20: http://www.getty.edu/research/tools/provenance/zoomify/

5. Städel Museum, Digitale Sammlung [Digital collection]: http://digitalesammlung.staedelmuseum.de

6. Deutsche Digitale Bibliothek [German Digital Library]: https://www.deutsche-digitale-bibliothek.de/

7. Deutsche Digitale Bibliothek Visualized: https://uclab.fh-potsdam.de/ddb/

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