Galileo's Library at the Intersection of Digital Humanities and Italian Studies

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The construction of a digital laboratory and archive for the texts in Galileo Galilei's personal library offers an opportunity for evaluating the relationship between Digital Humanities and Italian Studies (DHIS). Most importantly, the case study of digital work on Galileo addresses certain larger questions that rest at this intellectual intersection: What new knowledge does the field of Italian Studies stand to gain by allowing entry to the digital? More urgently (for the digital), can the needs of scholars of Italian, the nuances of Italian objects of study, and the sophistication of Italian modes of inquiry shape the practice of Digital Humanities (DH)? Certain aspects of these interventions translate easily to the concerns of cultural studies outside Italy, which underscores the importance of the humanistic materials and methodologies that drive the development of computational tools and theorization about digital work. This reversal of the standard questions about the role of DH in relation to other fields intentionally is meant to emphasize the authority of Italian Studies as an established discipline for interrogating cultural expression.

Using Galileo's library as an example, this reflection argues that Italian Studies is a rich domain for staging a meaningful and provocative intervention into digital and computational practices. Galileo was very aware of straddling different disciplines in his practice as a natural philosopher, to the point where he was frequently accused of trespassing into intellectual areas where his approaches were not welcome. That tension is not lost in the project's design rationale. Two examples from this developing project on early modern European texts will demonstrate the ways in which Italian-inflected digital humanities can not only resist, but also imagine alternatives to, the frequent criticisms of DH as positivistic, techno-capitalistic, and banausic.

Currently "Galileo's Library" exists only as a website, not the digital humanities project it will become.[1] The ideal project will offer users an opportunity to explore the relationships between what Galileo wrote and the textual tradition by which he was surrounded. Importantly, "Galileo's Library" is being designed as a laboratory, a site of experimentation, an interactive space, and a space for unexpected discovery. This *modus operandi* is built upon the hermeneutics of DH and also the spirt of Galilean epistemology. The interface and infrastructure will emphasize the potential of digital humanities tools to indicate pathways through the library that prompt new questions and lines of research. Alongside this approach to text analysis and cultural studies users will still be able to access materials through standard identifiers: author, title, subject, year of publication, keyword search, and even the physical dimensions of a volume where available.

The project exists as a website now because "Galileo's Library" will be more than an archive based on those features, which means that its innovative infrastructure is under development. That infrastructure, the planned database, is one example that I can offer for how Italian Studies can shape digital practices. In addition, it has been important to understand what kind of user experience the early modern Italian texts could enable, rather than construct

[1] The URL is https://research.bowdoin.edu/galileos-library/ (Accessed November 22, 2016).

a site with a pre-conceived notion of what was necessary. This exploration of Italian texts as data informs the other example that I will discuss.

Galileo's Library as a Collection of Book Isotopes

Current research on primary and secondary sources related to the library can pinpoint over 340 specific volumes that Galileo owned, including author, title, publisher, and year of the edition.[2] Marginalia, correspondence, quotations and the secondary sources written within decades after Galileo's death provide ample data for standard digital and computational visualizations that summarize overall trends in the collection. Yet, while they are informative, the visualizations also obscure the fact that, aside from the marginalia, the sources also provide partial information for a further 350 books in the collection. Partial information typically is not suitable for computational analysis because it is incomplete, although early modern readers found these short-hand indications entirely sufficient for conveying information about books.

Early modern lists of books tend to express those volumes in terms of an idealized text with general properties that a contemporary audience was expected to know: Juvenal's *Satires*, Virgil's *Aeneid*, Dante's *Comedia*, etc. were entries with densely-communicated information for the readers of the inventory. Nevertheless, historians, literary critics, material culture scholars, and anyone working in digital or computational studies all seek out, insist upon determining, and, in some cases, require the specific characteristics of a book in order to carry out their analyses. Without those details, essentially the metadata for the edition, some scholars might feel that they are left with incomplete data that must be discarded or omitted from a comprehensive presentation of their research question. Yet, having just the title or the author is already a substantial amount of information for any humanist familiar with the successes and frustrations of working with early modern archival materials.

"Galileo's Library" is testing the hypothesis that chemistry offers the humanities a way to conceptualize, measure, and represent the general properties of the early modern book element in a way that recognizes the complexity and richness of its various iterations.[3] Isotope, meaning "same place" in Greek, is a term typically reserved for descriptions of atoms that have the same number of protons but different numbers of neutrons. For example, chemists speak of the general properties of the idealized element carbon, which has six protons, but isotopes of carbon, with six or more neutrons, interact differently with other atoms in highly specific ways due to their unique masses. As such, an isotope can be a useful heuristic for considering the nature of an early modern book, especially when quantification and translation into data alone simply do not account for the variability and uncertainty inherent in their identities as they were understood at the time.

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[2] Current details on Galileo's library can be found in the methods paper for data collection for this project: Crystal Hall, "Galileo's Library Reconsidered," *Galileaena* XII (2015): 25-78; bibliographic information and a partially searchable database can be found at the website of the Galileo Museum in Florence: http://www.museogalileo.it/en/explore/libraries/library/galileolibrary.html (Accessed Nov. 22, 2016).

[3] Please see https://research.bowdoin.edu/galileos-library/book-isotopes/ (Accessed Nov. 28, 2016).

Even though most digital and computational tools prioritize complete entries, we humanists know that our materials, our data as it were, are seldom precise, or we challenge ourselves to identify and contextualize their imprecisions. This cumulative identity of a book, which to a computational pessimist could also be seen as a lack of specific metadata, is essential to understanding how early modern readers conceptualized their libraries. It can help answer new questions: When Galileo started annotating his copy of Boccaccio was it because it was the first to be published in Florence in his lifetime or did he seek out an older, more philological, or less-censored edition? In the list of books that Galileo's son inherited, when the notary indicates "Lucretius," what possible geographic information does that information carry with it? How long were ideas percolating in printed Italian intellectual culture prior to reaching Galileo? Using the book isotope as a means to think through questions of print and even manuscript culture offers an approach to how computation can represent the complexity of an edition's publication history.

By identifying this point of resistance between the materials and the current tools, new directions for research in both Italian Studies and Digital Humanities have emerged. To what data do researchers need access in order to understand a book in this way? What new visualization techniques would facilitate comparison, contextualization, and analysis of these isotopes? Importantly for DH, this includes designing processes to account for ambiguity and multiplicity. The next example will suggest how the DHIS intersection could have epistemic consequences.

Galileo's Library as a Database Model

The early modern period in which Galileo lived can be defined by the problems of classification brought about by what we now refer to as information overload. Transatlantic exploration and technological developments brought Europeans new information and objects that frequently conflicted with long-held beliefs about the natural world and cultural practices. Although a certain historical parallel exists with our own data-saturated moment, the cultural priorities that provoked and mitigated the influx of information were not the same. Consequently, my concern is that today's standard digital tool for sorting and storing information, the database, maps current intellectual paradigms anachronistically onto the earlier materials. I am approaching with great skepticism and great hope the question of this database design as an intellectual problem: can a tool typically built according to 21st-century principles help us to *understand* rather than to *represent* written culture, scientific practice, and literary inspiration in the early modern period? Framed differently, the guiding question is: can a database recreate the categories, organizing principles, affinities, disparities, patterns, and outliers in written materials from seventeenth century Italy?

Galileo described two competing methodologies for sorting, evaluating, and studying the wealth of information that he and his peers confronted about the natural world. He best expresses these methods metaphorically while describing his experiences reading Ariosto's *Orlando furioso* and Tasso's *Gerusalemme liberata*.[4] Galileo identifies different mechanisms for

[4] See *Le opere di Galileo Galilei. Edizione nazionale sotto gli auspici di Sua Maestà il Re d'Italia*, ed. Antonio Favaro and Isidoro del Lungo (Florence: G. Barbèra, 1890-1909; reprinted 1929-39, 1963-66) vol. IX, 69.

making meaning in these literary texts, which offers rich metaphors for exploring how digital technologies might be designed to facilitate a comparison of these processes. In disparaging tones, he compares reading Tasso's chivalric poem to perusing a cluttered and immature study, typically referred to by the German term *wunderkammer*, or cabinet of curiosities, an assortment of bizarre pieces that lack the individual cohesion to suggest a coherent collection: insects in amber, petrified sea creatures, sketches, common objects that he deems of trifling importance, and works by second-tier artists. By contrast, for Galileo, reading Ariosto is similar to touring a well-organized Renaissance gallery or *studiolo* filled with examples of the refined objects of classical and contemporary culture: ancient sculptures, illustrious paintings, precious stones, and other artifacts of refined taste and exquisite craftsmanship. Both the *studiolo* and the *wunderkammer* were sites of knowledge production during Galileo's lifetime but they represent very different epistemologies, the former based on juxtaposition to reveal differences or surprising similarities, the latter built upon established relationships of timeless exemplars.

The primary problem with designing a database to reflect these early modern ways of making meaning is that current technology is well-suited to recreating the *studiolo*, but Galileo and other intellectuals of the time proposed new ideas based on the *wunderkammer* approach. Fortunately, this means that methods have already been determined for documenting half of the attributes that will create the database. For example, canonicity and hierarchy can be measured by persistence through time and named entities in the texts. Galileo's contemporary, Gabriel Naude, published advice for building a princely library (1627) that could be a preliminary filter of what counts as authoritative or curated content for this gallery. Stylometric analysis highlights the most common stylistic features among texts and clusters of similar documents. A search for commonplaces would show authors who were borrowing from the old tradition and those excerpts can be analyzed in terms of frequency, persistence, and substance.

Yet, Galileo did not advise his own readers to focus on these characteristics in his books. The resolution of the competing apparent truths about the structure of the universe was not achieved through this kind of epistemology. This *studiolo* data representation does not embrace the complexities of reading in the early modern period as we have been able to understand them with traditional, non-computational means of analysis.[5] Galileo's mode of inspiration, inquiry, and argumentation does not rely so much on pre-existing relationships as it does on intense focus on seemingly unique, rare, or exotic phenomena. The guiding question for this design phase is: can the organization of a database as a text-driven *wunderkammer* be useful for identifying signposts for early modern readers who were sensitive to these qualities in their texts? The design will need to allow for search and retrieval functions that are determined by apparent lack of relevance, by inconsistency, or limited connections to the traditions highlighted in the *studiolo*.

The project responds to a call in the field of Digital Humanities to imagine the digital tools that could be built to better reflect humanistic questions, rather than trying to adapt our

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[5] For recent examples see Elizabeth Spiller, *Reading and the history of race in the Renaissance* (Cambridge: Cambridge University Press, 2011) and Evelyn Lincoln, *Brilliant discourse: Pictures and readers in early modern Rome* (New Haven: Yale University Press, 2014).

questions to the current tools. More importantly, the project asks how new knowledge is made: through a pattern or through an outlier, from hierarchical order or from juxtaposition. Patterns and hierarchy would seem to be the defining characteristics of analytics and data science, while outliers and juxtapositions are integral to a humanist's analysis of experience and expression (as they are perhaps to other scholars as well). Merging the two approaches creates an opportunity to evaluate a potential epistemic shift with consequences beyond Italian Studies.

Conclusions

Even at a preliminary stage "Galileo's Library" seems to suggest that DHIS as a subfield of two disciplines represents encounter, conversation, exchange, and inspiration. The agency and authority of the original materials are essential to making meaningful contributions in either intellectual space. The priorities of Italian Studies, here primarily seen as literature and history, are shaping tool development and theorization of Digital Humanities practices. The awareness of the criticisms of DH is shaping new questions and directions for research in Italian Studies. As mechanisms for training and collaboration develop, hopefully each field will find further new ways to benefit from DHIS.