

Metadata as a Site for Critical Inquiry

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Abstract

As a key element of digital infrastructures that shapes the use and reuse of digital information objects, metadata is a rich source for critique. This paper argues for metadata as a focal area for critical inquiry on information systems and characterizes the landscape of research that examines the social and cultural impacts of metadata. Critical information studies needs methods that bridge between analysis of the social impacts of information systems and examination of the technical realities of those systems. Critical data modeling bridges that gap by using data modeling and systems analysis techniques to create critical readings of information systems. The paper concludes with a discussion of future directions for critical metadata research, arguing for relationality and radical empathy as core metadata principles.

Keywords: metadata research; critical inquiry; data modeling; metadata principles; metadata for DEIA

1. Introduction

As information systems have become more central to how we live our lives and build our communities, a wide range of scholars have pointed to the ways that these systems reinforce racism, sexism, ableism and other forms of injustice. For a handful of the many example of these studies, see Adler, Huber & Nix (2017); Angwin, Larson, Mattu & Kirchner (2016); Eubanks (2018) Obermeyer, Powers, Vogeli & Mullainathan (2019). In her book *Race After Technology*, Ruha Benjamin shows how the widespread adoption of these systems and their integration into our everyday lives has created a system of oppression where the technical nature of the systems obfuscates their oppressive nature (Benjamin, 2019). Scholars of information organization and metadata are now called to interrogate the information systems we use to do our work, in order to reveal the ways that bias and injustice are concretized through representational and system design choices.

Researchers in critical information studies have brought to bear insights and methods from critical geography (Jefferson, 2020), ethnic studies (Villa-Nicholas, 2019), feminist theory (Noble, 2018), policy studies (Obermeyer et al., 2019), infrastructure studies (Acker and Donovan, 2019) and media studies (Brock, 2018). As this area of inquiry matures, we need methods that open dialogues between social concerns and information system design choices. In the context of metadata systems, this means examining how our metadata design choices interact with broader social power dynamics and structural inequalities. These methods will forge insights from socio-cultural critiques together with detailed grounding and awareness of the technical materialities and design choices that shape information organization systems.

This paper positions metadata as a focal area for critical inquiry on information systems using the lens of critical data modeling. The next section motivates and defines critical data modeling and is followed by a discussion of relevant data modeling tools and frameworks. The following section describes the landscape of research on metadata, knowledge organization and archival representation. The final section describes some future directions for critical metadata research, and argues for relationality and radical empathy as core metadata principles.

2. Motivations for Critical Data Modeling

While data science initiatives and machine learning systems offer the promise of guiding decision-making through objective means, researchers in information studies are keenly aware of the human decision-making at play in the development of any information system. From recording or identifying data, through data processing and visualization; data modeling choices are being enacted. Those choices are a key part of how information systems function. Therefore they are also a key part of how information systems enact oppressive social forces upon communities. While it may be the case that no one intended to build an oppressive information system, and each choice may have seemed neutral to the system designers, the resulting system may have serious and inequitable impacts on human lives. Startling examples of these impacts can be found in Virginia Eubanks' *Automating Inequality* (Eubanks, 2018) and in the analysis of the racially biased results of the risk assessment algorithms used in courtroom sentencing conducted by ProPublica (Angwin et al., 2016). Untangling representational choices will clarify the role of information systems in societal oppression by revealing the ways that seemingly mundane data modeling choices are part of how systemic racism and other structural inequalities are enacted in our society.

Metadata research is poised to further contribute to the critical interrogation of information systems by identifying methods and tools from systems analysis and design, and developing them as part of a critical lens on information systems. Using data modeling techniques will let us trace the construction and influence of data models in computational systems. This “under the hood” work will provide a view that integrates internal system structures and operations with the external impacts of an information system. In their landmark book, *Sorting Things Out*, Bowker and Star (2000) demonstrated the usefulness of a technically-aware, detailed, and critical lens in investigating the role of classification systems in modern life. They argued for a “a new kind of science, a new set of metaphors, linking traditional social science and information science”, which “will draw on the best empirical studies of work-arounds, information use, and mundane tools” and “will also use the best of object-oriented programming and other areas of computer science to describe this territory” (Bowker and Star, 2000, p.31). Critical data modeling meets this call to foster new conversations and deepen existing dialogues around how scholars of information can offer their expertise in inquiry around the impacts of information systems on communities.

The classifications that were the focus of Bowker and Star's work are one element of the data models that shape information systems and their impacts on people. Further elements of data modeling include schemas for databases, metadata elements that structure API responses, and controlled vocabularies that shape browsing experiences. While the term ‘data modeling’ suggests a declarative orientation, procedural aspects of code also interact with and instantiate data models. Critical data modeling therefore overlaps with critical code studies (Marino, 2020) and is concerned with how algorithms and data structures interact in an information systems. Critical data modeling also has features in common with critical design as defined by Bardzell and Bardzell (2013). While critical design is oriented around the creation of products or systems that draw attention to and problematize modern-day life, critical data modeling is intended primarily as an analytical toolset. That is, the product of critical data modeling is a technically-informed critical reading of an information object, not a new information object.

3. Tools for Critical Data Modeling

Critical data modeling uses detailed examination of data models via data documentation, close reading of data structures in digital objects, and critical design exercises. This section describes these methods and provides examples of critical information studies that use them. The following section describes critical information research that leverages metadata.

Critical data modeling is an approach to the study of information systems and objects that is designed to expose the assumptions and commitments that are “baked into” those things. The aim is to create readings of individual objects and systems that can be connected to broader analyses of relevant societal and political forces. This is a deliberate push back against a kind of technological exceptionalism that paints computer systems as natural and neutral. In a similar vein

to Dourish (2017), critical data modeling takes the position that information representation decisions in all their forms are productive sites of analysis for a full understanding of the influences on and impacts of information systems. Critical data modeling does not commit to any particular social theory for creating readings of information systems, but aims to create evidence that can be used to bring critical approaches to the methods and practices of information representation (Wickett, 2023). Technical details of metadata, data models and data processing are relevant to how information systems shape our reality, and critical data modeling aims to interrogate those details.

Data modeling is a process where conceptual and computational structures are created in order to represent some aspect of the real world in an information system. The conceptual process consists of creating categories, determining the properties of the things that will be represented, and assigning regularized labels for those entities and properties. These conceptual arrangements are documented with visual languages such as UML and Entity-Relationship diagrams. In cases where explicit documentation of a data model is not given, data models can be inferred from examination of data objects or algorithmic code. Computational aspects of data modeling include definition of data structures, the assignment of standardized data types, and the creation of algorithmic processing routines. These computational design choices are shaped by the technical requirements of the information system in conjunction with end-user requirements and constraints arising from data governance concerns. Data modeling for a relational database system will result in a database schema, which consists of table definitions and datatypes assignments, along with a set of queries and views that express the kind of retrieval requests that are anticipated for the database. Data modeling for digital library or archival repository systems consists of the development of metadata schemas to regularize the attributes of objects that will be available for searching and specify syntactic rules for expressing descriptive metadata.

For an example of using UML diagrams to build technical close readings of digital objects through their metadata, see Thomer and Wickett (2020). This study used UML diagramming to examine the data modeling choices in “scientific ‘databases’ that do not use traditional database technology but rather rely on spreadsheets, plain text files, and programming languages such as R” (Thomer and Wickett, 2020, p.2). Although the datasets used in the analysis are CSV files, the examination of the dataset metadata reveals complex relational data constraints that align with relational database design. For an analysis of the data modeling choices in a predictive algorithm, see Obermeyer et al (2019), which interrogates the racial bias in an algorithm that leverages previous health care costs as a proxy to predict which patients will benefit from enrollment in health management programs. The choice of proxy is fundamental to the data model of the algorithm, but given the disparities in health-care spending across racial groups in the United States, the algorithm under-predicts negative health outcomes for Black patients, thus excluding them from enrollment in potentially life-saving programs Obermeyer et al (2019).

The use of structured queries to examine the realization of a data model in a corresponding dataset is another technique for critical data modeling. This approach provides insights on points of friction in a data model by showing where data conforms to a documented data model and where it departs from it. The degree of conformance or departure is evidence of how the creators and maintainers of a dataset are positioning their work or responding to social or cultural factors in their domain. Thomer and Wickett (2020) used structured queries to examine the degree of commitment to relational database practice in “non-conventional” databases, finding that while the digital objects were not realized in relational database systems, they held to many of the constraints for relational database design. This finding speaks to the social and cultural roles of relational design in modern scientific practice. A recent study by the author used structured queries of a police arrest record dataset that demonstrated the emphasis on geographic information and showed how conformance to datatypes took precedent over accuracy in the dataset (Wickett, 2023).

Critical design uses design as a research methodology “that foregrounds the ethics of design practice, reveals, potentially hidden agendas and values, and explores alternative design values” (Bardzell and Bardzell, 2013, p.3297). Since data modeling is a technically-embedded form of design, critical design is a natural approach for investigating data models with a critical lens. In

the context of critical information studies, critical design methods focus on data infrastructures and interaction design. For example, Feinberg, Carter & Bullard (2014) used critical design of a digital library collection to interrogate database interaction and classification. By intentionally creating re-classified versions of a digital library, the authors demonstrated how residual categories (containing objects that don't fit cleanly into classification systems) can reveal the impact of digital infrastructures on user perceptions and goals. Along similar lines, Clarke & Schoonmaker (2020) used critical design methods to create a prototype library catalog that "raises questions about normativity, positionality, and forms of social justice". As information scholars and professionals work to not just critique information organization systems, but to repair them to address social inequalities, we will need to integrate methods like critical design into our research and practice.

4. Critical Information Studies on Metadata

Scholars from a range of fields have undertaken critical information research that uses metadata as a site of critique. Research areas include the political and legal status of metadata, the role of metadata in social media platforms and search, the social impact of information organization systems, knowledge organization and classification, and archival representation. The discussion here is not a comprehensive review, but serves to contextualize critical data modeling research that focuses on metadata.

4.1 Communication and social media metadata

Siva Vaidhyanathan (2006) proposed critical information studies as a "field that considers the ways in which culture and information are regulated, and thus the relationships among regulation and commerce, creativity, science, technology, politics, and other human affairs" (p.293). Vaidhyanathan's conception includes "the relationship among information control, property rights, technologies, and social norms," and although he does not mention metadata explicitly in this manifesto, developments since have demonstrated how consideration of metadata fits into these concerns. While discussions of metadata in library and information science typically foreground metadata created to describe resources and managed externally from those resources, communication metadata and embedded document metadata arise as concerns in law and policy. For example, Sinha (2010) provides a detailed analysis of the ethical and legal dimensions of mining embedded document metadata in legal proceedings.

The role of metadata in global politics and surveillance regimes came to prominence in 2013 after Edward Snowden released documents that revealed the ways the US National Security Agency (NSA) used metadata from phone calls to conduct a wide-ranging surveillance program (Pomerantz, 2015). Scholars since have investigated the legal nature of communications metadata as a source of private information (Mayer et al., 2016), described the "sociotechnical characteristics of metadata within digital networks" (Mayernik and Acker, 2018), and explored metadata in the context of human rights and constitutional law (Newell, 2014). These studies show how issues of metadata design and use have societal impacts on a global scale.

Social media platforms use metadata to track content and users and to create suggestions based on algorithmic processing. The prominence of these platforms has led researchers to study privacy concerns that stem from the ability to infer identity of users via metadata (Perez et al, 2018). The widespread dissemination of misinformation on social media platforms has motivated research to leverage metadata in social media platforms to assess trustworthiness of medical information (Albalawi et al., 2019) and to detect data manipulation in political information shared online (Acker and Donovan, 2019). User-contributed tagging systems blend elements of social media into online content hosting environments. Recently researchers have used these systems to build cultural critiques of the ways modern information systems shape culture by investigating genre as constructed through tagging (Andresen, 2022) and arguing that tagging systems "destabilise

meaning” in a way that reflects broader post-structuralist views of culture (Murphy and Rafferty, 2015).

4.2 Cataloging and digital collections

Critical cataloging views cataloging practice as potential site for social and cultural transformation by recognizing how library descriptive practices reinforce social inequities, and advocating for remediation and better representation of marginalized groups. Olson (2000) argues that the Library of Congress Subject Headings (LCSH) is a device of cultural authority and that librarianship can therefore leverage it as an agent of social change. Analyses of metadata in critical cataloging have focused on the impact of library metadata practices on a range of issues connected to broader social patterns of inequity and oppression. These studies include attention to race in library cataloging practice (Snow and Dunbar, 2022), the representation of Indigenous communities (Bone and Loughheed, 2018), the inclusive accounts of gender (Billey, Drabinski & Roberto 2014, and Wagner, 2022), and the allowances for transgender identities in library catalog data (Roberto, 2011). Clarke & Schoonmaker used library metadata as “design material for social justice” in a research through design project that sought to interrogate catalog interfaces and potential for leveraging existing library metadata in the creation of retrieval methods that foreground authors and identities from marginalized groups.

As digital library metadata development has shifted from the definition of schemas for the description of digital resources into the design of cultural heritage ontologies and data models to aggregate descriptions from a multitude institutional sources, digital library infrastructures have become a focus for critique. Scholars have examined the role of technical infrastructures and metadata in cultural perceptions of archival research (Montoya, 2016) and the organizational impacts of digital repository platforms (Plantin and Thomer, 2023). Research on the Europeana Data Model has drawn connections from the technical aspects of the model development to the goals of the Europeana project and broader political trends in Europe (Bettivia and Stainforth, 2017). In terms of social impact of metadata, librarians have pointed to the potential for digital library infrastructures that use linked data to improve discoverability of digital resources for more diverse sets of users who are more likely to use mobile technologies outside traditional library environments (Boczar et al., 2021).

4.3 Archives

The archival field is directly concerned with the representation of people, organizations and events; and has a tradition of critical reflection on the role of archives and the activities of archivists. Scholars of archival studies have brought postmodern, post-colonial and critical lenses to their work, exploring the nature of archival records and the relationship of records and truth (MacNeil, 2001), and the colonial nature of metadata (Frenandez, 2018). Critical scholarship in archival studies addresses the role of archival record-keeping in political life, for example, showing how regimes use language to maintain their power (Guberek and Hedstrom, 2017) and the role of archival selection in the erasure of Indigenous perspectives from the historical record (Ghaddar, 2016). These analyses demonstrate how archival practice is part of the construction of the historical record and scholars have therefore critiqued archival practice and argued for the adoption of feminist theory to guide future archival practice (Caswell and Cifor, 2016).

The needs of contemporary archival metadata to support identity, memory and repatriation have driven arguments to reshape approaches to metadata. Cifor (2016) argues for “hatred as an organizing principle” in LGBTQ archival arrangement as a mechanism for engagement with the political realities of queer identity and experience. In the context of repatriation of Aboriginal sound recordings, Toner (2003) points to the orientation of Dublin Core metadata around Western principles of organization and argues “for an expanded notion of metadata which includes a whole range of layered commentaries by traditional owners about the significance of the recordings in the present cultural context.” Christen (2011) describes the development of “an integrated metadata scheme that allowed for Native knowledge to be viewed side-by-side with the academic voice.”

More recently, archivists have argued for practices that remediate oppressive archival description (Hughes-Watkins, 2018) and created recommendations for metadata practices advance “anti-oppressive archival description” (Antracoli, et. al, 2020). The emerging role of community archives in decolonizing archival description and centering the experiences of marginalized groups () highlights the need to democratize description and create opportunities for community members to build their own metadata with their own priorities. Current technical infrastructures have the capacity to deliver metadata that supports new kinds of engagement with archival material, and metadata researchers have the opportunity to contribute our expertise through critical reflection and design.

4.3. Knowledge organization

Knowledge organization systems—encompassing library classifications, subject headings, authority files, taxonomies and ontologies—provide vocabularies and structure for metadata systems. The essential relationships between culture, social power, and knowledge have brought many researchers to critique knowledge organization systems and highlight their relationships to broader social and cultural movements and to their potential to reinforce social inequities. Subject headings have been analyzed in terms of shifting social perception of topics (Tennis, 2012) and the impact of hierarchical organization of terms on the perception of marginalized groups (Adler et al., 2017). The biased representation of racialized groups in library classification has been connected to critical race theory (Furner, 2007), racial exclusion (Higgins, 2016) and violence (Adler, 2017). In terms of the broader social impact of knowledge organization systems, Honma (2005) analyzed the role of librarianship and library classification in the “construction and maintenance of a white American citizenry”. The research literature on knowledge organization systems demonstrates how bias and inequities that are observed in knowledge organization systems both arise from social inequities and serve to reinforce those inequities.

The suppression of Indigenous culture and traditional knowledge through Western knowledge organization systems is a form of epistemicide—defined by Patin, Sebastian, Yeon, Bertolini, & Grimm (2021) as “the killing, silencing, annihilation, or devaluing of a knowledge system. Scholars have shown that the challenges in knowledge organization around representation of Native American materials are direct evidence of colonialism, and further argued that “decolonization is knowledge work” (Duarte and Belarde-Lewis, 2015). To address the devaluing of Indigenous knowledge, Littletree et al. (2018) argue for the inclusion of Indigenous knowledge organization systems, practices, and ways of knowing into the field, which “allows Indigenous ontologies to emerge in otherwise colonial institutions”. Knowledge organization research has consequences for communities and for library and information studies that go beyond system design. We can extend the argument from Littletree, et al. (2018), which highlights relationality and relational accountability in knowledge organization as a guiding principle for the field writ large.

5. Research Directions

Metadata has narrative force. The metadata about an object tells a story and therefore contributes substantially to “belief and belonging” (McDowell, 2022) as it is conveyed by an information organization system. Snow and Dunbar (2022), in their discussion of bringing together critical race theory and critical cataloging argue that “Counter-storytelling is a necessary part of de-centering whiteness in cataloging.” Metadata research is poised to weave counter-storytelling into metadata by exploring methods for incorporating counter-stories into metadata records. This approach departs from positions that view metadata as reflecting a single objective truths about an object. Data models like the Europeana Data Model give us the opportunity to represent multiple views of an object, but the implementation of these models has been primarily to manage contribution of metadata from distinct institutions. Metadata researchers can explore more radical approaches to metadata (Lapp, 2023) based on techniques like critical fabulation as developed Hartman (2008) in her efforts to address absence of Black women in early American archives on

without “reiterating violent speech and depicting again rituals of torture”. Critical inquiry into metadata requires new views of metadata and leveraging methods that draw from history and cultural critique. We have the opportunity to use our expertise in data modeling to create and expand approaches to metadata that center communities and foster new forms of engagement with digital collections and archives.

Littletree, et al. (2018) describe relationality (following Wilson (2008)) as “the acknowledgement that we all exist in relationship to each other, the natural world, ideas, the cosmos, objects, ancestors, and future generations, and furthermore, that we are accountable to those relationships.” Framing metadata design and specification as a focal area of critique grounded in Indigenous knowledge organization immediately suggests a number of research questions and design provocations. The trends in metadata design to accommodate linked data and large-scale aggregation have emphasized atomizing records into individual statements, with an end-goal of fully semantically independent statements that can move between contexts. However, if we seek to answer Littletree, et al.’s call to “center relationality”, we must ask whether atomization and disaggregation of descriptive records is the best approach for all cases. Relationality highly contextual and calls for designs that can weave together context and content through descriptive infrastructure. There is an opportunity here to explore how data models for metadata support relationality. Similarly, there are a number of research questions we can ask about metadata design that bring reciprocity as a core principle into metadata design and practice (Punzalan and Marsh, 2022).

Caswell and Cifor (2016) call for “radical empathy in the archives”, and their arguments apply a feminist ethics of care to archival practice extends naturally to metadata for digital collections. This orientation to metadata design opens questions about respect and care for the people and communities represented in metadata. Following this call, Han and Han (2021) explored issues of representation of Chinese students are represented in university archives, arguing that “[name] variations related to Chinese “courtesy names” and hyphenations can lead to challenges in creating descriptive metadata.” Getting names right is a basic form respect, but metadata practice does not always accommodate accurate encoding and representation of names. While character encodings provide the technical infrastructure to encode names in their original forms and data models may allow multiple values, practice does not always support the accurate expression of a name. Metadata researchers have an opportunity to design and advocate for expressions of names that convey respect to the people represented in collections.

6. Conclusion

Metadata is a rich source for critical inquiry. By contextualizing critical data modeling in existing research on metadata, this paper has characterized the landscape of critical metadata research that focuses on communication metadata, social media, cataloging, knowledge organization and archives. Critical metadata research is an evolving area that bridges social critiques and technical analysis of information systems. Future research areas include relationality and radical empathy as core principles for metadata design and data models that support counter-storytelling in digital collections.

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