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### Exploring the Role of Repertoire in Library Cataloging

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  - To examine catalogers' use of repertoire, this study employed a juxtaposition of field observations of professional library catalogers' work processes with elements of “think-aloud” protocols.
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library cataloging, repertoire, design, cataloger's judgement, think-aloud, observation

### Disciplines

Art and Design | Library and Information Science

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Rachel Ivy Clarke and Brian Dobreski

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Paper type: Research paper

## Introduction

Recent years have seen a surge of interest in the relationship of design to librarianship. For many years, discussions of design in librarianship focused on architecture and space planning (e.g. Morehart, 2015; Bradburn, 2013; Bradigan and Rodman 2008). In addition to this emphasis on architecture, discussions and discourse of design in library and information science literature often reflect technology (such as “web design”) and printed material formats (such as the design of book jackets) (Clarke, 2015). But design in librarianship is much more than physical spaces and webpages. Increasingly, design approaches are being used to better understand a range of work in librarianship, from teen services

(Subramaniam *et al.*, 2013a; Subramaniam *et al.*, 2013b) to library storytimes (Mills *et al.*, 2016). Yet these investigations still focus on more public-facing programs and services. What about the technical aspects of librarianship?

Library cataloging—the creation and maintenance of metadata for information resources—has often been considered a formalized process of rule-following. However, cataloging involves the negotiation of complex standards and procedures in attempt to create useful descriptions for a variety of materials, and thus may be considered a creative problem solving activity that also reflects design aspects. Lambe (2015) argues that catalogers are designers, while Snow (2017) highlights the need for design thinking in cataloging. Still, little work has actively explored specific aspects of design as they relate to library cataloging.

This study seeks to dive deeper into the relationship between library cataloging and design by exploring a specific aspect of design—the concept of repertoire. In design, repertoire is the name given to previous experiences and bodies of knowledge. Designers create new knowledge by drawing on repertoire both to guide current choices and to evaluate decisions and artifacts. Schön (1983) describes repertoire as the “capacity to see unfamiliar situations as familiar ones, and to do in the former as we have done in the latter, which enables us to bring our past experiences to bear on the unique case” (p. 68). Designers develop their repertoire over time by confronting problems and attempting to integrate design components into new solutions; the knowledge that comes from these attempts forms a repertory knowledge that designers may draw on in future projects (Goldschmidt and Porter, 2010).

In the course of their work, catalogers create descriptions intended to “solve” representation and access problems for end users, and in doing so, must be capable of drawing on previous experiences and “solutions.” This suggests repertoire as a particularly fitting design concept through which to view this area of work. This exploratory study thus aims to answer the following research questions:

- In what ways and during which tasks or specific aspects of work do catalogers draw on repertory knowledge?
- What is the scope and diversity of catalogers’ repertory knowledge?
- In what ways, if any, do catalogers develop their repertoire?

## Related literature

### *Cataloging as design*

Although librarianship is traditionally conceptualized as a social science, recent investigations have explored the field’s parallels with design. While science and design often function symbiotically, scholars from the 1960s through the present have articulated the ways in which design is a distinct discipline from science (e.g. Lawson 1990, 1994; Cross 2011). The major distinction between science and design stems from the idea that science concerns itself with observing and describing the existing natural world with the goal of replicability and prediction. Design, on the other hand, centers on the artificial world: objects created by humans to institute change and solve problems. The objectives of design are to “create things people want” (Konsorski-Lang and Hampe, 2010) by “addressing problems or ideas in a situated context” (Binder *et al.*, 2011). Thus the discipline of design is one based in the creation of things that solve problems.

Within libraries, cataloging is a kind of knowledge organization work entailing the creation and maintenance of metadata for information resources such as books, magazines, or sound recordings. Early library catalogs were created to solve simple inventory problems before evolving into finding tools that helped solve problems of location within a library in addition to existence within a collection (Norris 1939; Lerner 2009). But as libraries evolved, so too did the problems that catalogs were intended to solve. Fons (2016) describes the evolution of library catalog from a focus on user convenience to a focus on library convenience through standardization, automation, and workflow efficiency. New problems arose, such as how to develop library catalogs that met users' new, internet-inspired expectations of full-text search, complex keyword, phrase, and natural language queries, relevance ranking, and immediate access. Contemporary cataloging practitioners have raised many multifaceted problem-based research questions which they would like to see addressed (Clarke 2018). Even Patrick Wilson (1968) wrote that library catalogs are not faulty because of poor workmanship or outmoded organizational schemes, but rather a deeper inherent complexity.

Such complex problems in cataloging reflect many of the characteristics of "wicked problems": problems that are unique, interconnected, and ill-defined problems that cannot be definitively described (Rittel and Webber, 1973) and are made complex in the need to serve multiple stakeholders with conflicting values (Buchanan, 1995; in Wahl and Baxter, 2008). Because these wicked problems cannot be solved through traditional scientific means, creative approaches like design are necessary (Conklin *et al.*, 2007; Wieringa, 2010). As a creative, problem solving activity, cataloging exhibits many design traits, though as with most library work, it is not typically considered as such (Clarke, 2018). The products of contemporary cataloging include bibliographic records, which act as surrogate representations of library resources. Such products of the cataloging process may be viewed as design artifacts created to address wicked problems related to managing and navigating a collection. Indeed, contemporary conceptualizations of knowledge organization work have been evolving more toward a form of design. For instance, in exploring the creation of metadata standards, Long et al. (2017) specifically argue that metadata designers tackle wicked problems.

Work such as Lambe's (2015) argument that catalogers are designers and Snow's (2017) call to include more design thinking in cataloging lend credence to this perspective. Because this view is relatively recent, little work has actively explored specific aspects of design as they relate to library cataloging.

### *Repertoire in design*

One specific aspect of design arguably worth exploring in relation to library cataloging is repertoire. The metaphor of repertoire, drawn from theatre and the performing arts, recurs throughout the design literature (Gulari 2015). Similar to a stock of pieces that a company is prepared to perform, a designer's repertoire is the accumulation of previous knowledge and experiences they bring to bear when confronting new projects. Gulari notes that such repertory knowledge is different than a mere repository of knowledge: repertory knowledge is implicit, personal, and dynamic knowledge that has undergone digestion by an individual making it difficult to share with others.

Empirical studies of designers' decision-making processes show that repertoire is a key factor influencing decision-making. Schön (1983) frames repertoire within the design decision-making process. He points out that a designer's ability to create increasingly better solutions hinges on the scope and

diversity of his or her repertoire: the more past experiences a designer has, the more familiar situations he or she can draw upon, and thus then be more informed in making decisions in uncertain situations. Stolterman (1992) shows that knowledge from previous experiences has a large influence on the ability of information technology designers to make early formative judgements. Almendra and Christiaans (2009) show that “capitalized knowledge reuse, i.e. the reuse of any knowledge capitalized from the same project or other projects” (p. 15) is one of three key factors influencing design decisions. Tan & Melles (2010) also show that designers rely on past design experience to inform their strategic decisions. These experiences may be further in the past, such as prior client discussions, or the immediate recent past, such as the use of knowledge from temporary sketching to inform newly sketched ideas. Wahl & Baxter (2008) argue that better design decisions are made when designers can draw from a broader knowledge base, either a designer’s own large personal repertoire, or (even better, in their argument) multiple people’s repertoires and worldviews. Lloyd and Snelders (2003) highlight the idea that repertoire need not be limited solely to previous design experiences, but may extend to other external factors such as passive information reception. Their case study of Phillippe Starck’s *Juicy Salif*—a lemon squeezer shaped like a squid after Starck partook in a lunch of calamari—showed that a designer’s ability to create analogies between present problems and external ideas also shaped decision making. Salmon and Gritzer (1992) argue that broadening repertoire beyond traditional design knowledge, such as including social science topics in designers’ professional education, “expand[s] the basis of the future designer’s professional expertise” (p. 78).

Repertoire guides not only decision-making during the design process, but evaluative decisions regarding design outcomes. Design evaluation may seem like arbitrary subjectivity to those unfamiliar with design, but evaluation is actually based on an extensive repertoire of personal knowledge (Snodgrass and Coyne, 2013). The lack of pre-established and explicitly defined criteria does not automatically mean that an evaluator’s subjective opinion comes arbitrarily from thin air. Understanding of values and norms of evaluative criteria have built up over time, from a designer’s first critique through all subsequent design evaluations and experiences. It is conformance to—not deviance from—these values that demonstrates and reifies an evaluator’s authoritative role. Anyone who attempted to arbitrarily assess a design according to their own personal criteria would lose their community status as a reliable and expert evaluator. Greenberg and Buxton (2008) point out that repertoire is a crucial aspect that separates rigorous design evaluation from mere personal opinion, as designers draw on extensive repertoires to evaluate new artifacts. Nelson and Stolterman (2003a) note that it is the accumulation of a designer’s experience making choices and addressing consequences that guides design judgment. Designers with large, well-developed repertoires, whom Eisner (1998) calls “connoisseurs,” are able to discern complex and subtle qualities and characteristics of a design and make fine-grained discriminations that others may not be able to express (Nelson and Stolterman 2003b).

Dooren *et al.* (2014) identify repertory knowledge as one of five elements necessary for teaching design, including patterns, rules of thumb, and previous design solutions that are stored, often implicitly, in the designer’s mind. How does this repertory knowledge develop? In addition to participation in multiple design projects, and exposure to examples of existing design artifacts, the development of repertoire also requires reflective thinking (Lowgren and Stolterman 1998). While design instruction often consists of designing an artifact, what the student has engaged during the creation process to increase knowledge is more important than the artifact itself (Léglise 2001). The implication is then that it is the

explicit attention paid to internalization of this knowledge that creates design repertoire (Gulari 2015). Such explicit attention and reflection contributes to Schön's (1987) conceptualization of designers as reflective practitioners.

### *Repertoire in cataloging*

Among the types of library work, cataloging has typically been seen as a specialized set of skills and knowledge, and is often considered a distinct area of focus (Bair, 2005). Indeed, in many libraries, cataloging is performed by specialized staff members. Far from rote work, cataloging involves the negotiation of complex standards and procedures in attempting to create useful descriptions for a variety of materials. Technical services positions in libraries, including cataloging, tend to emphasize independent problem solving as a common job duty (Gerolimos et al. 2015). Typically, the cataloging process requires a number of decisions concerning what information about a resource is relevant, what formal cataloging rules must be consulted, and how such rules may be interpreted. This decision-making process, as well as the aptitude for making these decisions, has often been framed and studied as "cataloger's judgment" (Hasenyager, 2015). This judgment is derived from education, training, and experience; it is not what anyone would do in a situation, rather, it is what one who has learned to think like a cataloger would do (Santamauro and Adams, 2006). Recent advances in library technologies and standards have seen an increasing emphasis on cataloger's judgment within the profession (Paiste, 2003; Hitchens and Symons, 2009; Parent, 2014). As a skill, judgment has even been formally recognized as an important area of training for modern catalogers (Association for Library Collections and Technical Services, 2007). Even so, this concept has been criticized as a simplification of the processes and protocols catalogers negotiate in the course of their work (Intner, 2006). Recent research has challenged the monolithic conception of cataloger's judgment, arguing it to be a complex, multifaceted array of factors (Diao, 2017).

Within design, the concept of repertoire represents an alternative route of exploration for catalogers' problem-solving activities beyond the often considered cataloger's judgment. Though not framed in terms of repertoire, previous works have examined the kinds of resources and knowledge that catalogers draw upon during their work. Through a combination of surveys, interviews, and focus groups with catalogers in North Texas, Miksa (2008) found that though these catalogers had a variety of resources and tools available for their everyday work, their usage of these was relatively low overall. Terrill (2014) surveyed catalogers about their use of resources for professional development, both conventional resources and those associated with social media, and found catalogers continued to rely most on conventional sources such as articles and listservs. In a comparative study of Slovenian and American catalogers, Sauperl (2005) highlighted the importance of existing records as support resources as well as working from memory. These works suggest that catalogers do rely on a defined set of resources and knowledges that may be better understood through the concept of repertoire.

## Methods

To examine catalogers' use of repertoire, this study employed a juxtaposition of field observations of catalogers' work processes with elements of "think-aloud" protocols. In employing observations, this study took inspiration from the growing use of ethnographic observations in library research (Khoo,

Rozaklis, & Hall, 2012), though due to its initial, exploratory nature, the present work is more limited in scope than traditional ethnography work. Nevertheless, observations allow researchers to see first-hand how participants work, and collect rich, detailed data to understand participants' natural behaviors in the context of their everyday environment (Courage and Baxter, 2005). While field observations place actions and behaviors in context, observations alone cannot offer reasons or motivations for catalogers' behaviors. Therefore, observations were supplemented with a "think-aloud" protocol to elicit information from participants about decision-making processes and sources of knowledge. This entails having participants speak what they are thinking as they complete a task, and is known for its use in gathering data on more covert, decision-making processes (Nielsen *et al.*, 2002). Combined, the two methods represent a useful means of providing an initial, exploratory look at repertoire in cataloging.

The population of interest was professional catalogers working in library environments. Due to the exploratory nature of this study, purposive sampling was utilized. For inclusion in the study, participants were required to meet the following criteria: 1) be at least 18 years of age, 2) speak English, 3) work half- to full-time in a library where 50% or more of their job involves cataloging of library materials. Catalogers with any level of education, training, experience, or professional status were eligible. Potential participants were identified through the personal and professional networks of the researchers, as well as snowball sampling, and were recruited directly via email invitation.

Researchers traveled to the participants' work settings, and observations were conducted in the participants' normal work environments. During the sessions, researchers sat alongside participants in their workspaces. Participants were asked to conduct whatever cataloging tasks they would regularly be performing at the time, at their normal pace of work. For all participants, this included a mix of original cataloging and modification of existing records. During the observations, participants were instructed to constantly narrate their activities, reasons, and motivations where possible as they worked. Researchers audio recorded, observed, took notes, and only asked questions or offered prompts in the event that a participant ceased speaking aloud about a task. Sessions were conducted for approximately one hour, at which point the researchers left participants to continue their normal activities.

Observations sessions were conducted with eight catalogers who were employed full-time in institutions in upstate New York. While all participants performed library cataloging as the majority of their work, they varied in terms of setting and specific responsibilities (Table 1).

	<b>Library Type</b>	<b>Focus</b>	<b>Experience</b>	<b>Position</b>	<b>Gender</b>
<b>P1</b>	Public	general, special collections	35 years	librarian	M
<b>P2</b>	Academic	special collections	40 years	librarian	M
<b>P3</b>	School	general	20 years	paraprofessional	F
<b>P4</b>	Academic	music	1 year	paraprofessional	F
<b>P5</b>	Academic	music	10 years	paraprofessional	F
<b>P6</b>	Public	general	unknown	paraprofessional	F
<b>P7</b>	Government	law	7 years	librarian	F



Table 1. Participant information.

Following the sessions, researchers transcribed and de-identified the audio recordings from each session. Researchers then worked together on an inductive analysis of the audio transcripts as well as their own researcher notes. In their analysis, researchers were guided by repertoire and other design concepts, and coded qualitatively for aspects of interest, including sources of information consulted, tools and software utilized, rationales for decisions, and use of personal memory and knowledge. The two researchers first independently coded a small sample of materials; the coding process was inductive and took place in a shared set of Microsoft Excel documents. Next, researchers reviewed their initial coding results together and performed thematic coding to develop broader themes of interest from these codes, including what was used by catalogers, why, and for what purposes. Researchers then independently coded the remaining materials using these themes. Coding results from both researchers were then brought together to further develop major themes of interest and devise an initial framework representing their understanding of the types of repertoire drawn upon by catalogers.

## Findings

### *Types of design tasks*

After the observations, researchers first classified the tasks conducted by participants into three general types (see Table 2). Original cataloging tasks saw catalogers creating a brand new record for a previously undescribed resource; these tasks may be seen as the most comprehensive, and from a design perspective they represent situations in which catalogers must design an original solution. These tasks are traditionally the most time consuming, and as noted in the chart, P1 and P6 were not able to complete their original cataloging tasks during their sessions. During copy cataloging tasks, catalogers find pre-existing descriptions for resources, but may need to make adjustments, thereby adopting but altering someone else’s design. Record modification tasks saw participants altering a previously completed record (i.e., correcting a mistake, adding further information), and reflect the iterative nature of designing descriptions. Taken as a whole, these three types of tasks represent a spectrum a design activities undertaken by catalogers. Participants performed these tasks for a number of types of library materials, as depicted in Table 2.

	Cataloging Tasks			Total	Materials Types
	Original Cataloging	Copy Cataloging	Record Modification		
<b>P1</b>	2*	0	0	2	fiction monographs
<b>P2</b>	0	2	2	4	non-fiction monographs, broadside
<b>P3</b>	2	1	1	4	music score/parts, children's fiction
<b>P4</b>	2	0	0	2	music sound recordings
<b>P5</b>	2	0	0	2	music scores
<b>P6</b>	5*	11	4	20	adult and children's monographs including large print, braille; videorecording, non-fiction audiobook

<b>P7</b>	0	2	2	4	print serials, non-fiction monograph
<b>P8</b>	3	0	1	4	electronic thesis, non-fiction monographs

Table 2. Summary of cataloging tasks and materials. (Asterisk denotes incomplete tasks.)

### *Types of repertory knowledge*

Further analysis of these observation sessions and the tasks was heavily focused on types and instances of repertoire use by the catalogers (i.e., previous experiences, designs, and sources of knowledge). The researchers sought to identify the different ways in which repertory knowledge manifests during all cataloging tasks. The researchers identified three major types of repertory knowledge demonstrated by catalogers: internally embedded repertory knowledge; externally embedded repertory knowledge; and seeking out new knowledge using other sources (see Figure 1). The following text discusses each of these types in more detail.

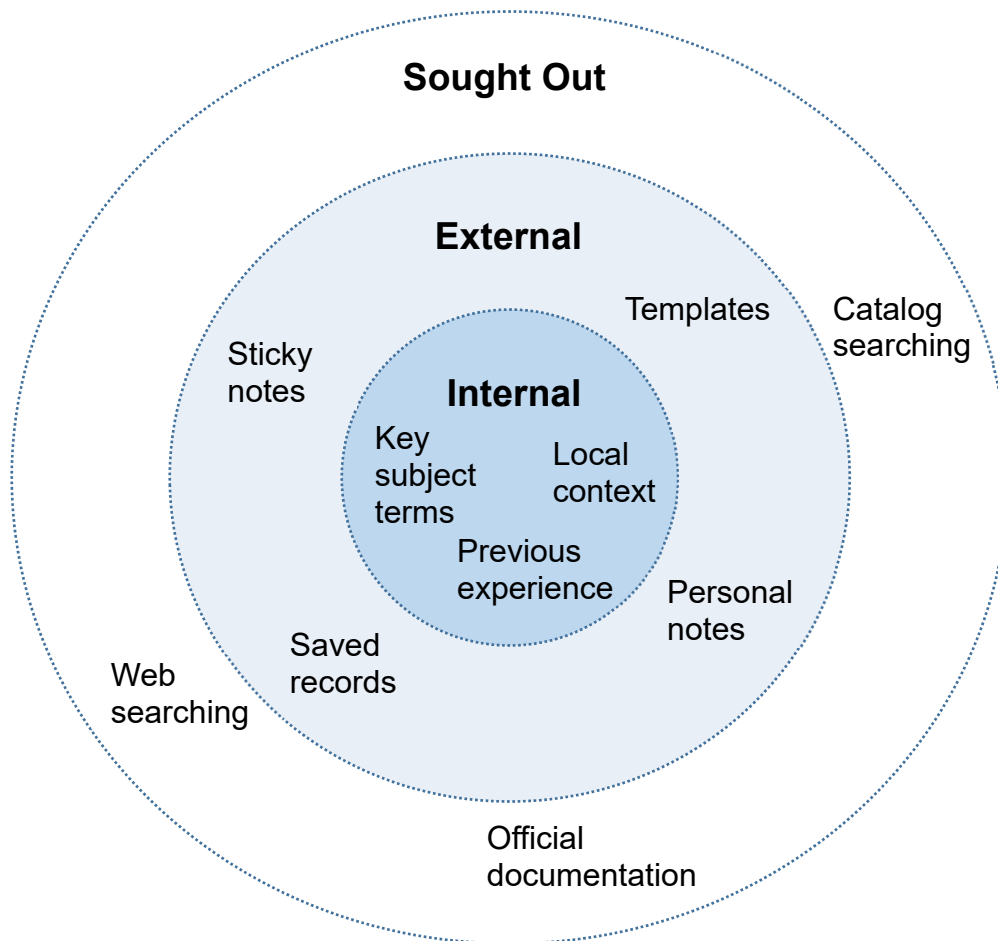


Figure 1. Types and examples of cataloger repertoire.

### 1. *Instances of previous knowledge brought to bear on current situation (internalized)*

Examples of using previous existing knowledge to make decisions and proffer judgements in current situations were clearly recognized with all of the participants. While many instances were evident to the researchers, some participants explicitly mentioned drawing on knowledge from their own prior experiences. For example, P4 said “And then just from experience I know that [name] does not have an authority for his orchestra, so I'm just going to get rid of the 710 and make a 700 for [name].” Other instances were more implicit, but clearly evident to the researchers. For instance, P5 stated “Theodore Presser usually doesn't give a place of publication so I need to bracket that. And they always capitalize that O which is annoying. So I have to change that.” P5 clearly has previous knowledge about this specific publisher which she brings to bear when making cataloging decisions for the current resource-in-hand. All of these examples, of which there were many, represent the application of a cataloger's internal knowledge: this information is taken directly from their memory.

Given the abundance of these examples, the researchers tried to identify potential sub-types of internalized repertory knowledge. While a formal typology seems excessive, multiple sources for this internalized knowledge seemed evident. The researchers identified three major sources of internalized repertory knowledge: task experience; subject/domain expertise; and institutional context.

#### *Task experience*

Many participants showed evidence of applying knowledge from previous experiences completing various tasks during their cataloging work, such as searching for existing records in OCLC Connexion (P2) as well as understanding and applying MARC tags (P3, P6). But knowledge from previous task experience was not limited to concrete cataloging tools and standards. Nearly all participants demonstrated knowledge gleaned from their work cataloging past resources. P8 offers a prime example of this, where she makes decisions about a resource-in-hand because she remembers a cataloging a similar resource in the past:

This, my friend and colleague Amelia bought when she was, actually she didn't buy it, when she was in Canada she ordered it. But I know it's similar to a couple that she bought when she was up there, and it looks very familiar to one that I cataloged and did an original for. And I'm going to use that original as a model to improve the record that exists for this one... (P8)

While other examples were less concrete and did not recall specific resources, general past knowledge gleaned from prior cataloging work still informed participants' decisions, such as P5, who mistrusts vendor records based on previous exposure to and work with them, and P7, who knows alternate places to look for sources of author information when it is not on a book's title page because she has faced similar situations in past work.

#### *Subject/domain expertise*

Several participants clearly drew on previous subject knowledge and expertise. This was most evident in participants whose cataloging work targeted specialty domains, such as P4 and P5, who both specialized in music cataloging. Both bring a deep knowledge of information about music that extends beyond what they have learned through the completion of their cataloging duties. P4's knowledge impressively extends to recognizing specific obscure instruments based on listening to music recordings:

...this one just has a note that says, "Vibraslap, question mark". Because, I swore I heard one in the audition, and when I Googled it, it said that it wasn't invented until 1967. And these, we don't think were recorded then, and, you know, between 1961 and 1965.

Even though she consulted Google for knowledge about dates, P4 relied on her previous internal non-cataloging knowledge to preliminarily identify the instrument she heard in the recording. Likewise, P5 also relies on prior familiarity with music, especially types and genres, stating "I'm going to call this art music, because it seems like it fits under that category. It's larger than chamber music, and it's definitely more of an art music composition, by the looks of it" and "This looks kind of like a study score, I'm probably going to classify this as a study score since the notes are so small. And that's something I already know, I don't have to look that up."

#### *Institutional context*

All participants drew on personal knowledge of local institutional contexts, recalling information about histories, policies, and practices that influenced their current work. P1 decides that a resource-in-hand "looks like another local author book" based on familiarity with the library's existing collection of similar resources. P2 describes what are essentially local cataloging policies, although he never refers to any policy source or documentation—the knowledge is all internalized after many years at the same institution. Much of P2's work is informed by this knowledge of institutional history. This includes changing local practices around first editions, as explained in the following quote:

Once upon a time, if they felt they had a first edition, they always put in a note that said first edition, so I put the note in as a 500 note, unless by some chance it says it on the piece. They apparently assumed they had a first edition, unless there was some evidence they didn't. And, it's a way of carrying over what they did and what they thought was important when this was cataloged for the first time in 1965.

A second example from P2 reflected his historical knowledge of previous institutional projects:

In fact, I even know where this came from. Back when we went into NOTIS in about 1990 we did a load of records from I think University of Toronto called the UTLAS load and that is where this came from. Which I suppose is one of the problems of having worked here so long.

Other participants demonstrated similar knowledge, such as P3's extensive knowledge of the evolution of integrated library system products in her institution, and P6's in-depth familiarity with a complex system-wide classification system that varied among member libraries.

Catalogers also demonstrate a great deal of decision-making based on previous knowledge about their institution's collections.

I have cataloged so many of these [institution name] students' theses that I know what kinds of things they work on, from the engineering stuff, to the art, animation, just, yeah, it's not what my background is. My background is English and French, so I hardly ever get to use my French except when I'm doing stuff for the [special collection]. (P8)

Even though P8 was never formally trained in the subjects of the resources she typically catalogs, she has developed a repertoire of knowledge around those topics, including appropriate subject headings and classification numbers, just through her familiarity with the library's collection and its subject focus.

## 2. *Storage for that knowledge (external)*

Though the participants relied heavily on internalized knowledge, externalized knowledge also constituted a significant part of their repertoires. In such cases, they drew on personal knowledge and experiences that were important to them but not completely committed to their memories. Rather, they had embedded this information in external artifacts and documents. These resources were in known locations, either physically or digitally, and participants knew the nature of the information they would find in each of them. For each participant, these resources formed a personally curated collection of externalized knowledge that could be easily consulted. These collections contained a variety of artifact and document types; most prominently represented were saved records, templates, and personal notes.

Five of the participants were observed turning to previously completed catalog records for assistance in a new cataloging task. In each of these cases, the catalogers consulted records that they had created and recognized as being relevant to their current situation. For catalogers such as P1, these exemplary records were collected over time and stored in a save file for future use. Speaking of his save file, P1 stated, "...I'll go back and forth and, you know, copy and paste information from other records. Just so I don't have to make all these decisions over and over again." Turning to these records allowed P1 to benefit from previous problem-solving activities and save time during data entry. Utilizing a personal collection of example records does, however, rely to some extent on general memory of the records and their contents. Other participants relied even more heavily on memory: rather than keeping a formal save file of example records, they turned to known records in their local catalogs that they had previously completed. For example, P6 catalogs in a public library and frequently sees similar works from popular authors. Having repeatedly cataloged books from a single author, P6 knows she can look up a record she created for a previous book and use it as the basis for a new record. She explained, "... you really don't have to do much. You change the title, you change the... you know, because everything else is the same." In instances such as these, memory led the cataloger to a known record, and they were then able to use the externalized knowledge stored there.

Similarly, participants utilized previously created record templates meant to assist in their more routine cataloging tasks. These templates represented cataloger expectations of the commonalities among similar classes of materials, and served to save time and support consistent cataloging. For P8, templates were a necessity given the volume of similar materials cataloged. In describing her template for dissertations and theses, she explained that they had to catalog several hundred of these each year. For P8 then, her thesis and dissertation template served as a distillation of the common attributes she had noticed among these frequently encountered materials and helped her save time. In other instances, templates were used to facilitate shorter-term cataloging projects. P4's position is focused on cataloging analog sound recordings, and within this set of materials, she had created specific templates down to the publisher label. She explained:

I'm doing entirely Latin American 45s right now, so, that... there was originally a template before we got into some of the labels that were a lot larger, so I took the original template and made one for this label, Alegre, so that it was easier to derive.

Again, P4's template contains a representation of all the common information she had come to expect of this collection. Relying on this external knowledge made the cataloging process faster and easier.

Beyond records and record templates, externalized knowledge was also stored in personal notes concerning various aspects of the record creation process. These personal notes took a number of forms across participants. P7, a law cataloger, preferred working with print records and resources where possible. This affinity for physical, print resources carried over into her personal notes as well, which took the form a folder filled with saved documentation. She referred to these documents as her cheat sheets, and each contained her notes on handling a more exceptional cataloging situation. These cheat sheets were quite specific; as she explained, "I have different cheat sheets for title change for monographs, and author/editor changes. I have, when it's a series or title change, I have a cheat sheet for that." Together, these personal notes contained her knowledge on handling rarely encountered resources. Other participants relied on digital documentation, for example, P4, who kept extensive documentation in her personal Google Drive account. P4 also referred to these documents as her cheat sheets. For her, a major function of these notes were to assist her in navigating the controlled vocabularies LCSH and LCGFT; her sheets contained a list of her more commonly encountered headings, and were easier for her to consult than the official documentation for these vocabularies. Finally, paper sticky notes were commonly observed at the participants' desks, and served as another source of personal documentation. When asked about some of hers, P6 explained that some were to assist her in classifying sound recordings, stating, "Yeah, yeah all the different genres, because there are so many." P6 had used her sticky notes to record the music genres she commonly encounters, saving her from having to consult the fuller list. Whether containing knowledge on routine or rarely encountered situations, personal notes embodied important information that made the catalogers' work processes easier.

### *3. Finding new knowledge*

Catalogers embedded their personal knowledge into external documents and artifacts of their own creation as a kind of way to externally "save" it for future use. Broadening the scope of cataloger's repertoire beyond this, participants were observed consulting a range of other external resources created by other parties. At such times, the participants actively sought out these other resources to leverage as additional sources of knowledge. In some cases, they turned to well-known external resources, familiar and routinely consulted enough to belong to their larger collections of supporting resources. In other cases, participants sought out previously unknown resources in an attempt to discover and incorporate new knowledge, representing a kind of emergent repertoire building. Both situations will be addressed here as the larger category of sought out resources.

Half of the participants were observed seeking out pre-existing records, created by others, in order to help them with a current cataloging task. Unlike the saved, personally created records described above, these records were unknown to the participants until they found them via on-the-fly searching. In some cases, this was done due to cataloger unfamiliarity with the kind of resource being cataloged. Though P3 handles a variety of materials for her school district, music scores are generally rare outside of a current project. As she said, "Because it's a music score, so I don't... usually I would go through and copy somebody else's." Though P3 had little previous knowledge or experience with this format, she was able to identify records for similar resources and borrow metadata from them. Seeking out other records was also done to facilitate subject cataloging. In assigning subject headings to a fiction work, P1 stated the following:

So I either use, try to find something related on OCLC, or see what we have in our local catalog, and kind of go from there. Very rarely go to Library of Congress Subject Headings or anything like that.

Again, other records for similar resources were discovered, in this case in order to build off other catalogers' subject knowledge and save time on a current cataloging task. At other times, catalogers were confronted with these records when attempting to find viable copy. For example, P5 found a record for a similar resource, and rather than starting from scratch, used this newly discovered record as the basis for her new record.

Beyond catalog records, the participants turned to well-known, professional cataloging resources as additional sources of knowledge, especially the official documentation for subject and classification systems. In all cases, these resources were designed by other parties, explicitly for use by catalogers. Participants consulted them for difficult to remember details and for assistance in navigating less familiar situations. For example, though participants demonstrated an impressive memory of call numbers during their work, three participants working with Library of Congress Classification were observed checking the official documentation to assist in assigning a number. While two of them consulted the online resource Classification Web, P7 consulted her print copy of the KF class, adding, "Usually if it's a number that I don't have, I will go to ClassWeb, but otherwise if it's a KF it just seems easier." As most of her materials fall within the KF class, consulting this specific print volume was easiest for her. In the course of her music cataloging, P5 consulted a particularly large number of professional resources, including the Yale cataloging website, the MLA best practices guides, official documentation for the LCMPT, and OCLC's *Bibliographic Formats and Standards*.

Though these professional sources were familiar to the participants, other, previously unknown resources generally not aimed at catalogers were also sought out. In such cases, catalogers looked for new knowledge to assist in describing a resource, often in regards to its intellectual content. For example, P4 checked Wikipedia articles to learn more about a musician and his style of music while cataloging a recording of his, and later consulted the Discogs website to learn more about when a particular recording was made. Newly sought out resources were also relied upon during the creation of summaries and subject terms. This was clearly demonstrated in P1's session, in which he used a search on Google to find out more about the plot of a fiction work he was cataloging. This search led him to Google Books and Amazon, as he narrated here:

I'm gonna go back to the Google record, to the Amazon record, and, Amazon, like will give you some product details and sometimes it's helpful, especially with publisher information, but it's not very helpful here, so... Nothing really to add.

P1 used the information found here to assist in creating a summary, though, as in this case, the discovered resources were sometimes less helpful than anticipated. General web searching was employed by other participants, enabling the discovery of a composer's personal website (P5), and the website of a publisher (P7). In both cases, information discovered here assisted the cataloger in recording more basic descriptive metadata such as name and place of publication. Other resources that catalogers discovered during their observations included YouTube videos and collectors' websites. Overall, catalogers engaged in their own information seeking activities to acquire new knowledge, often of a very specific nature, and to supplement their cataloging repertoire.

## Cataloging data and related repertory knowledges

During observations, catalogers relied on a range of repertory knowledge for all manner of tasks associated with their work. Within this, however, certain trends were noted concerning which repertory knowledge was utilized for which elements of data. Basic descriptive information, including title, date, and publisher name, are often transcribed directly from a resource. For providing or modifying such information within records, catalogers relied on the item in hand (physical or digital), combined with a working memory of cataloging rules. Beyond this, catalogers relied on particular types of repertory knowledge for other descriptive information. Table 3 shows the relationships between repertory types and specific types of bibliographic metadata, aggregated from the results of all observations.

		Format	Summary	Subject/ genre	Classification	Collection	Author	Publisher
Internal	Personal knowledge			X			X	X
	Institutional knowledge			X	X	X		
External	Templates	X						
	Example records	X		X	X		X	X
	Cheat sheets			X	X	X	X	
	Official documentation				X			
	Best practices guides	X						
Sought Out	Catalog records			X	X			X
	Other web resources		X				X	X

Table 3. Descriptive information and associated repertory knowledges.

Different cataloging information and tasks tend to rely on different repertory knowledge, with some tasks relying on more kinds of knowledge than others. Determining subject and genre headings relied quite extensively on internal repertoire such as personal knowledge and institutional knowledge, along with external sources such as personal notes and local examples. Determining a classification and collection relied on similar repertory sources. This similarity may stem from the fact subject, classification, and collection assignment all serve to place materials in the context of a local collection. As such, these tasks rely on knowledge associated with an institution and its practices, much of which may be internalized, or stored externally in local notes or cheat sheets.

In contrast, recording some data routinely involved seeking out new knowledge sources. Summaries vary with each individual resource, and as such, sources such as memory, cheat sheets, and official



documentation are not applicable. Catalogers turn to web searches and common web resources including Google Books and Amazon for help with this specific information. Similarly, finding additional background information on authors or publishers also entailed discovering specific information through web searches and other online sources. Some catalogers had developed personal knowledge of frequently confronted authors and publisher over time though.

Finally, templates or saved records functioned differently from other repertory sources here: these artifacts may contain any kind of bibliographic information. Templates and example records utilized during observations included a range of information, including physical format, subject and genre headings, and publisher information. The relevant contents of a template or saved record can vary among cataloger and task, and may support the determination of any kind of information in a given situation.

## Discussion

This study observed, identified, and attempted to categorize repertory knowledge used by library catalogers in their work. Although this work identified three overarching types of repertory knowledge, each of these major types was constituted of multiple sub-types of knowledge, diverse strategies, and myriad sources—far more diverse than one might expect for a highly specialized occupational role. Generic design tasks observed including original cataloging, copy cataloging, and record modification. However, even within the ostensibly narrow confines of this cataloging work and the types of data it encompasses, all of the participants in this study completed a wide range of cataloging-related activities. The catalogers observed performed descriptive cataloging, subject cataloging, and classification, all of which utilize different standards (e.g. RDA, LCSH, DDC, LCC, etc.) and may benefit from subject-specific knowledge. Additionally, these catalogers performed name authority work, which not only necessitates knowledge of cataloging standards but also benefits from knowledge about the people being described and other related contextual information. Catalogers worked with multiple technologies, including local integrated library systems (sometimes multiple systems within a single library setting), vendor products (e.g., OCLC tools), and non-library-specific technologies (e.g. Discogs, Google, Amazon, Wikipedia). Many were involved in multiple projects (such as retrospective conversion, inventory maintenance, and new collections), sometimes concurrently.

### *Diversity of repertory knowledge*

To complete such a diverse range of activities, catalogers need a wide range of knowledge, both about cataloging-related topics but also many other areas. Catalogers working in subject-specific collections such as law or music of course need prior knowledge of those topics, but generalist catalogers, such as those working in public, school, or even smaller academic libraries may encounter all manner of topics. The broader their general internal repertoire beyond just cataloging knowledge, the better prepared they can be to tackle their work. This certainly parallels the concept of repertoire in design work, where the ability to create better designs hinges on the scope and diversity of a designer's repertoire (Schön, 1983) and a diverse repertoire may be gleaned from sources beyond a topical focus (Lloyd and Snelders, 2003; Salmon and Gritzer, 1992; Wahl *et al.*, 2008).

Beyond cataloging- and subject-related repertory knowledge, a great deal of repertory knowledge in observed in this study was rooted in internalized knowledge of local institutional context. This includes

repertory knowledge of local collections, practices, policies, and historical events that catalogers used to guide their decision-making. This also closely parallels designers whose repertoires span the course of their working history (Tan and Melles, 2010), as examples of institutional knowledge related to policies and processes over time at their institutions ranged from the immediate to the distant past. Such repertory knowledge was drawn upon for tasks including descriptive cataloging, subject cataloging, classification, and data encoding. These tasks would generally be considered to be guided by a cataloger's knowledge of cataloging and data standards; however, this study reveals that local institutional knowledge plays a large role.

While the above discussion refers to cataloger's internally embedded repertory knowledge, the participants in this study also engaged in a great deal of externally embedded repertory knowledge. Gulari's (2015) explication of the differences between design knowledge as repertoire vs. repository may offer some insight regarding this phenomenon. Repertoire refers to internal and digested knowledge that is regularly reused while repository refers to an external knowledge source, usually more institutional, formal, and impersonal. The catalogers in this study created and relied on repository knowledge more than might be expected of designers based on Gulari's claims. However, the externalized knowledge from the catalogers seems to fall somewhere in between Gulari's delineations: although externalized knowledge storage was more explicit, structured and static, such as cataloging templates designed for reuse or lists of recurring vocabulary terms, it was also personal to that cataloger, and often informal, even to the point of handwritten notes or other casual formats.

One interesting observation related to the breadth and diversity of catalogers' repertoire is their explicit acknowledgement regarding their lack of knowledge. Almost all participants at one point or another during their work session admitted that they did not have repertory knowledge at hand to help make a cataloging decision. For example, P5 stated:

I don't do as many band [scores], I mean, certainly it's, there's a lot of things written for band, but I may look, I don't know the classification number for that off the top of my head, so I'm gonna go back here for a second.

Not only does this example indicate an acknowledgement of lack of knowledge, but it ties to repertoire in that P5 states that she has not encountered enough of this resource type in past work to have made a repertory impression that could guide her decision-making.

#### *Internal repertoire: repetition and memory*

In conceptualizing repertoire in three major types based on location (Figure 1), it is also possible to consider mechanisms by which certain repertory knowledge may be drawn closer to the center, from sought out, to external, to internal. Though a number of such mechanisms likely exist, one of the most important noted during this study of catalogers was repetition. Through constant consultation and use of specific sources and information, knowledge is added to a cataloger's repertoire and becomes more relevant and drawn upon over time. This repetition can lead newly discovered sources of knowledge to be saved as external, frequently relied upon sources, and eventually, internalized in some manner. Observation and cataloger comments supported the role of repetition in both the move from sought out to external repertory knowledge, and from external to internalized repertory knowledge.

Repetition is a key way in which repertory knowledge becomes memorized, internalized, and called upon on-the-fly. From drawing upon memorized personal knowledge, to remembering and locating key

external resources, to applying specific subject terms from memory, catalogers were observed to rely on memorization to some extent in their use of all types of repertory knowledge. In many cases, memorization had been achieved through repetition over time. Several examples of this in the present study concerned the use of subject headings and classification. Though P8 has no formal engineering or design background, she frequently assigns subject headings to theses and dissertations on these topics. Over time, she has developed a knowledge and set of expectations concerning this subject matter; furthermore, she now remembers key subject headings for these frequently confronted topics and during observation was able to apply them correctly without consulting official documentation. These specific subject headings are common and useful enough that she has personally memorized them and no longer needs to consult external documentation. P1 was similarly seen applying certain subject headings from memory, and P7 was seen to draw upon personal memory of classification numbers for American law. In all three cases, catalogers have only internalized the most repeatedly useful portion of an external repertory knowledge; more unusual cases would still require consultation of personal notes or cheat sheets, or official documentation.

One particularly noteworthy implication of this reliance on memory concerns the use of official standards. In performing their work, catalogers rely upon cataloging standards such as AACR2 and RDA, along with the encoding standard MARC. These standards are largely specific to the library community, and are highly complex. It is surprising then that catalogers did not consult them during the observations. In cataloging in accordance with AACR2 or RDA, catalogers relied on their memory of rules or upon pre-existing templates and records that conformed to these rules. Adherence to shared standards has long been critical to the library community (Henderson, 1976). For catalogers, it is possible that continual usage of these standards, as well as exposure to data conforming to these standards, has led them to internalize the most relevant portions of these documents. Previous work has shown catalogers' tendencies to work from memorized portions of standards (Sauperl, 2005). Further study of how catalogers internalize and interact with memorized standard knowledge, as well of the accuracy of this knowledge, would contribute to a better understanding of repertoire, memorization, and the enactment of standards in library settings. This reliance on memory, however, may curtail the development of a diverse repertoire that can lead to better decision-making (Salmon and Gritzer, 1992; Wahl & Baxter, 2008), as catalogers may become overly reliant on a small pool of subject terms they have come to memorize, disregarding other potential headings that would need to be sought out.

#### *External repertoire: source materials*

In instances where previous knowledge is drawn upon frequently but memorization is infeasible, externalized repertoire represents a middle ground. Catalogers in this study looked to pre-designed record templates or previously created descriptions, often for more routine cataloging tasks. Rather than constantly consulting official standards such as RDA or MARC, catalogers found templates to be a more efficient solution: these templates performed design work ahead of time, and represented the most relevant repertory knowledge for a particular situation.

When confronted with a novel problem during the course of their work, catalogers seek assistance through new knowledge from a range of sources, including catalogs and web resources. Once a newly discovered source has proven useful, for instance, a previously created record, catalogers may remember to turn to it again in the future for similar problems. Through continued consultation of a

useful source, catalogers may add it to their saved, external repertoire in some manner. P1, for example, has performed catalog searches for records that may be similar to common resources he confronts. Over time, he collects the more useful records into a personal save file in order to use them as a base for the creation of new bibliographic records. Repeated usage of the same records has seen them move into his externalized repertoire; he no longer searches catalogs for pre-existing records, instead going directly to specific records he has saved.

Such observations on how catalogers build up external repertoires echo previous findings showing that catalogers tend to prefer a limited pool of resources they are most familiar with (Miksa, 2008). When working with templates or previous records, catalogers rely on saved knowledge from themselves and from others, but in doing so, they are deciding these solutions are effective and in accordance with shared standards. In making such decisions, catalogers are again drawing upon their repertoire, but in an evaluative manner. Similar to how designers use repertoire to evaluate and critique design artifacts (such as Greenberg and Buxton (2008) describe), catalogers must make choices regarding the quality, appropriateness, and sufficiency of pre-existing records and templates in relation to their current problem. This means that catalogers will benefit from the large, well-developed repertoires described by Eisner (1998) and Nelson and Stolterman (2003b) if they are to discern nuanced details that distinguish quality work for work that merely adheres to standards.

#### *Beyond judgment: repertoire development*

The concept of cataloger's judgment has framed catalogers decision making as a process of "thinking like a cataloger," an analytical approach that distills a complex process into a single concept. Viewing cataloger decisions as a process of navigating and applying repertory knowledges exposes some of the more nuanced aspects of evaluative decision making, and more clearly reflects the role of previous experiences and artifacts that the cataloger has come into contact with. When a cataloger passes judgment on a record, template, or specific design choice, they are drawing upon their repertoire to do so. It is arguably this repertory knowledge that constitutes the "the familiarity of local policies and cataloging standards, deviating approaches, and individual knowledge" described by Diao (2017). As with other wicked problems, library cataloging is a design task with no correct solution, but rather, a range of better or worse solutions. Different catalogers will arrive at different solutions, influenced by their varying repertoires of knowledge, experiences, and available resources. Catalogers stand to benefit from more actively developing their repertoires.

Interestingly, while noted in this study, repetition is not mentioned in design literature as a tactic for developing repertoire, perhaps due to the abovementioned shortcomings. Instead, exposure to a broad knowledge base, even beyond the specific topical focus under consideration, helps develop repertoire (Salmon & Gritzer 1992; Wahl & Baxter 2008). However, it would be nearly impossible to predict and thus explicitly include such individualized prior knowledge into explicit repertoire development for catalogers. Instead, general techniques for repertoire development from design education may be useful for cataloging education and training, such as in the courses offered as part of graduate level library education. Interestingly, few references to formal graduate cataloging education arose in observations. Only one study participant mentioned her graduate library education, and it was only in reference to undertaking a cataloging internship; she strongly emphasized her on-the-job training. A large number of current graduate level cataloging courses frame the topic in terms of theory and practice (Joudrey and McGinnis, 2014), that is, learning *about* cataloging vs. learning to *do* cataloging

(Moulaison, 2012), while the actual decision-making witnessed does not fit neatly into those categories. Given the importance of hands-on cataloging practice and the need to support a more ideal balance of theory and practice in cataloging education (Snow & Hoffman 2015), educators need ways of offering the former without compromising the latter. Drawing on pedagogical techniques from design, including methods for repertoire development, may help address this issue.

Situating cataloging instruction in an environment akin to a design studio—a physical and intellectual space specifically created to support learning by doing—may help students internalize covert and implicit elements of design (like repertoire development) that cannot be adequately conveyed through other forms of education like lectures (Schön 1985). Specific exercises focused on repertoire development may also be of use. Lowgren and Stolterman (1998) note that repertoire is expanded and refined by “examining existing design artifacts and deriving abstract qualities from particular instantiations” (p. 234) and through explicit applications of reflective thinking that force designers to articulate and advocate for basic assumptions that often go unquestioned. Exercises such as “retrospective reflection” in which designers reflectively interrogate artifacts through a “reverse designing” process” (p.234) have potential implications for new pedagogical approaches to cataloging instruction. Studies of how designers teach and learn repertoire, such as Gray *et al.*'s (2016) use of design heuristics to scaffold the development of design repertoire, may also offer interesting models for cataloging education. The explicit use of reflection in these repertoire development exercises from design education help situate designers as reflective practitioners (Schön 1983; 1985); perhaps if applied to cataloging, they can help catalogers to become more reflective in their practice as well—an increasingly important role as emphasis on topics like the ethical impact of cataloging work increases (Snow 2019).

## Conclusion

It is clear that repertory knowledge is a significant factor brought to bear in library cataloging work in a variety of ways. Within the general activities of original and copy cataloging, catalogers drew on their repertoire during all aspects of their work processes, which included descriptive cataloging, subject cataloging, classification, and name authority work. During these tasks, they relied on previously created records, personal documentation, local institutional knowledge, and their own memories in assigning various elements of metadata, particularly subject and classification information. To capture the range of this repertoire, this study presented a framework of three major types of repertory knowledge observed, arranged by location relative to the cataloger: internalized knowledge, externalized knowledge, and sought-out knowledge. This study also found that catalogers develop their repertoire through new cataloging tasks as well as routine, ongoing work. Specific repertory knowledges may also move “inward” through the framework over time, transitioning from sought-out, to externalized, to internalized. There are a number of mechanisms through which this movement may take place, though repetition plays a key part.

The results of this study also provide evidence that, like other aspects of library work, cataloging may be seen as a design task. In viewing cataloging as design, repertoire is a useful means of understanding how catalogers accomplish a complex body of work. Additionally, by examining cataloging, this work provides insight into the design aspects of technical services work, a previously underexplored connection. Given the ubiquity of the design tasks observed in this study (record creation, record modification) across libraries and other information institutions, findings hold relevance for cataloging and other metadata

tasks in these settings. This study adds to a growing body of work calling for design approaches in libraries and related information institutions. The initial framework of repertory knowledges presented here may be also be useful in understanding how designers in more traditional design fields draw on experience, knowledge, and other resources in their work.

Findings from this study must be tempered with the understanding of several limitations; chief amongst these is the limited set of participants. A small number of catalogers from the same geographic region in the U.S. were observed; findings could be expanded through additional observations of catalogers from a wider range of places and settings. During any observational study, there is also the potential for participants to alter their behavior due to their awareness of being watched; this observation effect may have altered the ways in which participants routinely interact with their repertoire. Nevertheless, findings position repertoire as an insightful, nuanced perspective, capable of supplementing more traditional, judgment-based approaches to understanding cataloger's work. Further study is warranted in examining the relationship between repertoire and judgment, particularly in how catalogers learn to judge and evaluate records and other resources.

Findings from this study also present additional opportunities for future work. Though all work tasks saw catalogers drawing upon their repertory knowledges, supplementary detailed analysis of how repertoire is developed and used during subject analysis could offer further insight into an often-challenging task in library work. While this study noted the importance of repetition in developing repertoire, further study could reveal additional mechanisms through which catalogers develop repertoire and internalize it over time. In particular, the role of formal classroom education was only touched upon in the present study, raising further questions about its significance in establishing and developing repertoire. At a practical level, the ties between cataloging and design suggest that educators could benefit from incorporating design approaches into formal cataloger education and training. In particular, teaching and encouraging catalogers to develop and expand their repertoires can lead to increased creative problem solving capabilities. Finally, opportunities exist to connect back to the broader body of design literature: how do findings from this study compare to the use of repertoire in other design spaces, and how applicable might this study's framework be to other settings? Comparison with other types of design work will offer further insight here.

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