"DEFINING WHAT WE DO—ALL OVER AGAIN": OCCUPATIONAL IDENTITY, TECHNOLOGICAL CHANGE, AND THE LIBRARIAN/INTERNET-SEARCH RELATIONSHIP

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Although a growing literature explores occupational identity, or the overlap between "who we are" and "what we do," this literature has not fully considered how occupational identity may interact with technological change. In this paper, we explore this interaction, asking how an occupation's identity shapes and is shaped by its interactions with a new technology. We focus, specifically, on the relationship between librarians and Internet search. Drawing on an analysis of 22 years of articles from library journals, we demonstrate how and why librarians initially discounted Internet search and differentiated themselves from it. We argue that these responses were associated with a "paradox of expertise," by which librarians missed innovation opportunities around one of the most important information technologies in history precisely, and ironically, because of their deep knowledge of non-Internet searching. Later, however, we demonstrate how librarians engaged with this same technology, drawing upon it to redefine their occupational identity. Our findings demonstrate how occupational identity conditions the interpretation of a technology, while also showing how these interpretations can change with ongoing interactions. We also illustrate how occupational identity itself can change in response to new technology. Finally, we elaborate upon why expert insiders may not actually be best positioned to pursue emerging technologies.

In 1990, a person searching for the contact information of their state legislators would, most likely, approach a librarian—a member of an occupation whose identity rested, in large part, upon organizing, searching for, and retrieving information. Less than two decades later, however, "information search" would come to be synonymous with the Internet search engine. That same person, rather than approaching a librarian, would most likely search Google for an answer—and, just as important, the librarian would no longer claim such a search as integral to her identity anyway.

The phenomenon of technology supplanting a task previously performed by a person is nothing new. Scholars have offered less attention, however, to the ways in which an occupation's identity—the overlap between "who we are" and "what we do" (Ashcraft, 2013; Pratt, Rockmann, & Kaufmann, 2006)—shapes and is shaped by its interactions with a new technology.

In this paper, we explore the relationship between librarians and Internet search in order to shed light on the more general question of how technological change and occupational identity can be mutually shaping. We base our analysis on 22 years of articles about the Internet in journals written by and for librarians, capturing the emergence of Internet search through to the present. Our findings illustrate how librarians initially described Internet search technology as a niche and emphasized their own unique (and superior) value. These reactions, we argue, were associated with a "paradox of expertise" that led members of the occupation to miss important innovation opportu-

nities around Internet search precisely, and ironically, because of their deep knowledge of non-Internet searching. Later, however, librarians not only embraced Internet search but also imported aspects of it into other library practices, redefining their occupational identity by leveraging the same technology that had threatened to displace them in the first place. Ultimately, we develop a model of how a new technology can challenge an occupation's identity and how members of this occupation can reinterpret this technology to redefine their identity and to shape subsequent innovations.

Our work carries implications for scholars who study both technology and occupational identity. Specifically, we show how occupational identity can be a lens that shapes both the interpretation and adoption of technology, and we demonstrate how these interactions can change over time. We also elaborate upon the ways in which technology and technological change can shape occupational identity. Finally, we theorize the conditions under which a paradox of expertise is likely to arise, along with actions that occupation members can take to address it.

Occupational Identity and Change

All occupations are associated with an occupational identity, which refers to the conjunction of "who are we?" (as members of this occupation) and "what do we do?" (Ashcraft, 2013; Barley, 1989; Pratt et al., 2006). Often, occupational identities are defined in relation to other occupations (Leavitt, Reynolds, Barnes, Schilpzand, & Hannah, 2012; Sluss & Ashforth, 2007; Sluss, Van Dick, & Thompson, 2010; Somers, 1994). Thus, occupation members engage in an ongoing negotiation as to the roles and obligations that accompany their occupation, how these roles and obligations are distinct from those of other occupations, and what meaning occupation members attach to these roles and obligations.

Conflicts between occupations, therefore, can be particularly revealing of occupational identity. For example, Leavitt et al. (2012) explore the case of U.S. Army soldiers who also serve as medical personnel, and they contrast the occupational identity of soldiers against that of medical professionals. This contrast is particularly acute since both occupations appeal to moral judgments, yet they interpret these judgments differently. Studies of occupations with apparent task or jurisdictional overlap—as with optometrists and ophthalmolo-

gists, doctors and nurses, and tenure-track versus contract researchers—also highlight how occupation members may define "who we are" by contrasting themselves against other occupations (Abbott, 1988; Bechky, 2011; Begun & Lippincott, 1987; Collinson, 2004, 2006).

The dynamic tension inherent in this relational view of occupational identity also suggests one mechanism for occupational identity change: In the process of constructing an identity in relation to other occupations, a given occupational identity may itself change. Thus, occupational identities are not static, but, rather, inherently shifting. As Ashcraft (2007: 10) describes the situation, occupational identity "is an ongoing rhetorical endeavor," such that occupations continuously engage in a process of defining "who we are" and "who we are not." For example, Bechky (2011) argues that the process of professionalization (Abbott, 1988; Freidson, 1970; Hughes, 1984) is, in part, an exercise in occupational identity change. Thus, efforts by members of occupational groups to establish accreditation standards or to influence legislation that regulates their activities—two hallmarks of professionalization—also result in changes to these occupation members' related sense of "who we are." Pratt et al. (2006) also analyze changes in occupational identity. In their study, medical residents encountered inconsistencies between their identities and their actual work experiences. These inconsistencies led the residents to "customize" their identities in different ways, which, in turn, influenced subsequent assessments and, at times, identity customization efforts (see also Chreim, Williams, & Hinings, 2007).

Most of the literature on occupational identity change emphasizes changes in meaning or "who we are." For example, Oerton (2004) describes how massage therapists worked to redefine their occupational identities by dissociating from sex workers and by drawing upon the health care field. Although these therapists engaged in the same activity, they shifted the meaning of this activity. Similarly, Ashcraft (2007) describes how early airline pilots worked alongside their union and the airlines themselves to redefine that occupation's identity away from daredevil imagery and towards an identity characterized by scientific knowledge, technical skill, formal rank titles and uniforms, and an image of omnipotent, protective fathers. Again, the fundamental activity—flying—remained the same, even as the occupational identity tied to this activity changed. Studies of "dirty work" in fields

ranging from nursing to domestic help also high-light how occupation members can strive to manage the meaning attached to what an occupation *does* (Ashforth & Kreiner, 1999; Ashforth, Kreiner, Clark, & Fugate, 2007; Hughes, 1962; Simpson, Slutskaya, Lewis, & Hopfl, 2012).

Scholars of occupational identity change have offered relatively little attention, however, to the other intertwined component of occupational identity: "what we do." As Ashcraft (2013: 11) argues:

> We thus make profound miscalculations that the nature of work can speak for itself, that "what we do" is an obvious activity rather than a contested site of social construction, and that the burning occupational identity question is how individuals *relate* to what they do, not how *the very nature* of what they do is also constructed.

In turn, without a better understanding of changes in what occupation members *do*, our understanding of occupational identity change is itself limited.

Occupations and Technological Change

The lack of attention to what members of an occupation do is particularly surprising since an extensive literature highlights how technology, specifically, can transform work practices.[1] Historically, much of the work on the relationship between technological change and work practices adopted a deterministic stance, positing that particular technologies led to particular effects (Mohr, 1971; Perrow, 1967; Woodward, 1958). For example, contingency theorists posited that different production systems—composed of machines, processes, and people—led to different organizational systems (Aldrich, 1972; Blau, Falbe, McKinley, & Tracy, 1976; Burns & Stalker, 1961; Lawrence & Lorsch, 1967; Woodward, 1958).

More recently, scholars have adopted an approach that Leonardi and Barley (2010) label "voluntarism." This approach emphasizes the ways in which people interact around technologies and the codependence of the "technical" and the "social." Although different perspectives within voluntarism emphasize different aspects of this relationship, scholars who adopt the voluntarism approach are united in their conviction that a technology's effects are not predetermined, but, rather, socially contingent (Bailey, Leonardi, & Barley, 2012; Barley, 1986; Orlikowski, 2007; Orlikowski & Scott, 2008).

Two streams of work within this perspective are particularly relevant to the relationship between occupations and technological change. One stream of work, which Leonardi and Barley (2010) label "interpretation," demonstrates how "people make sense of new technologies by drawing on frames imported from other domains, such as . . . the subculture of their occupation" (Leonardi & Barley, 2010: 12). Orlikowski and Gash (1994: 178) initially proposed the idea of a "technological frame" to capture the "assumptions, expectations, and knowledge [that people] use to understand technology in organizations." In turn, one important influence on an individual's "frame" is her occupation (Van Maanen & Barley, 1984).

A number of studies have demonstrated how workers draw upon their occupations to interpret a new technology. Sometimes, this interpretative frame is evident in the language that workers use to describe a new technology. For example, Gopal and Prasad (2000) demonstrate how teachers learning to use a group decision support system framed this technology in the terms of the classroom. In other studies, the interpretive frame is most evident in the contrast between occupations. For example, Orlikowski and Gash (1994) highlight how consultants and technologists in the same consulting firm approached Lotus Notes technology from the vantage point of their respective occupations and functional areas, and thereby interpreted the technology differently. Still other work shows how these occupationally informed interpretations of a technology may reflect broader occupational identity struggles. For example, in Prasad's studies of nurses (Prasad, 1993, 1995; Prasad & Prasad, 1994), he shows that nurses felt underappreciated by physicians and hospital administrators, and that they parlayed these perceptions into a framing of a new database technology that would enhance these nurses' stature in the hospital (see also Jian, 2007; Yeow & Sia, 2008).

By illustrating how occupational affiliations shape the interpretation of a technology, this work suggests that occupation members' answer to "who we are" and "what we do" might condition their

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[1] Although "technology" is a broad concept that scholars have treated in various and sometimes conflicting ways (Barley, 1990; Leonardi, 2008; Orlikowski, 1992; Orlikowski & Scott, 2008), the literature on technology and occupations focuses upon technological artifacts—that is, "the bundle of material and symbol properties packaged in some socially recognizable form, e.g., hardware, software, techniques" (Orlikowski & Scott, 2008: 408). We follow that focus in our research.

perception of what a *technology* might "be" and "do." Because these studies focus on how occupational identity shapes the interpretation of a technology, however, they do not elaborate upon how the occupational identity itself may change, nor do they consider how occupations may both respond to and *shape* technologies. Moreover, these studies focus almost exclusively on the initial interpretation of a technology, not tracing how these interactions may change over time (Leonardi & Barley, 2010).

Another strand of research, which Leonardi and Barley (2010) label "enactment," explores the ways in which the introduction of a new technology can challenge and change localized occupational roles and role relationships. This research, therefore, speaks more directly to the question of how the work itself—"what we do"—might change with the introduction of a new technology. In Barley's studies of radiologists and technicians (Barley 1986, 1988, 1990), for example, occupational roles shifted with the introduction of new medical imaging technology. Bailey et al. (2012) also document shifts in occupational roles as a result of new technology introductions. Their study explored how information technology enabled the offshoring of model building in an automobile company, "IAC." In turn, IAC managers leveraged this capability to split the simulation engineer's role into two new occupations: simulation modelers (based overseas) and simulation analysts (based domestically). Finally, Edmondson, Bohmer, and Pisano (2001) studied the relationship between occupational roles and the introduction of a new technology: minimally invasive cardiac surgery. Across 16 hospitals, they found that successful introductions were accompanied by changes in the role relations between surgeons, nurses, technicians, and anesthesiologists, such that individual members of these occupations acted more collaboratively and less hierarchically. As these studies illustrate, research in the enactment tradition emphasizes how particular occupation members may reinterpret their roles in light of new technology implementations.

By connecting technological change to reinterpretations of "who we are" and "what we do," these studies also suggest that technological change can reinforce or challenge occupational identity. Unfortunately, none of these studies actually explore occupational identity or how it shifts over time; although they document localized shifts in roles and role relations, they do not connect these shifts to changes in the occupation as a whole. Moreover, as with the "interpretation" literature, these studies do not explore how an occupation may not only respond to but also shape technology. As a result, the literatures on occupational identity and on work and technological change remain disconnected: Studies of occupational identity overlook the ways in which technology shapes "what we do," while studies of the interpretation and enactment of technologies vis-à-vis occupations overlook how these interactions may shape collective occupational identity and technologies themselves. Our research, therefore, explores the intersection between occupational identity and technological change, asking how an occupation's identity shapes and is shaped by its interaction with a new technology.

METHODS AND DATA

To address this question, we conducted a qualitative longitudinal study at the intersection of a particular technology, Internet search, and an occupation with a clear identity, librarianship. In the United States, public libraries appeared as early as the seventeenth century, often supported with funding from private donors and, sometimes, gifts of books (Ditzion, 1947). A primary function of public libraries is to provide access to information. Around 1900, librarians assumed a more active role in achieving this goal, not only managing the circulation of books, but also developing "reference desks" and a specialized "reference librarian" function tasked explicitly with identifying sources that matched or responded to patrons' inquiries (Martin, 1998). Over time, librarians have developed a wide range of tools, including the card catalog, subject guides, periodical guides, and database search tools, all of which aim at facilitating the search for relevant information. A number of historic commentators, in turn, emphasized that the core work of the librarian—and, indeed, the occupation's identity—lay in organizing and searching information. For example, library commentator Michael Gorman argued, in 1994, that: "Bibliographic control (which I am calling 'information organization') is the way we, as librarians, think and should think. It is the essence of what we do" (Taylor, 1994).

The primary purpose of Internet search technology also lies in the identification of relevant information (Van Couvering, 2008). The Internet was started under the U.S. Advanced Research Projects

Agency (ARPA) in 1967, and it first connected universities who were ARPA contractors (generally, through their computer science departments). Early on, the Internet provided a means of connectivity and services such as email, but few files were "stored" or routinely available on it. As more universities were connected to the network in the 1980s, however, the number of files grew rapidly (Abbate, 1999).

Initially, the Internet had no search capability per se, though it did employ hierarchical directories known as "Gophers" (named for the mascot at the University of Minnesota, which developed this organization system). As the number of Internet files continued to grow, however, these individual hierarchical guides were inadequate for locating information. Thus, modern search engine development coincided with the World Wide Web's early growth spurt, when it went from 130 sites in 1993 to 600,000 sites in 1996 (Battelle, 2005). This rapid growth in web sites—combined with a rapid growth in the number of Internet users, displayed in Figure 1—accentuated the need to develop a way of finding information on the Web.

Approximately 74 search engines were developed between 1989 and 2011. (Exact numbers vary somewhat across accounts.) Some of these search engines form the backbone of companies that lie at the heart of the information economy. For example,

Yahoo, founded in 1994, had a market capitalization of $41 billion and employed 12,200 people at the end of 2013. Google, a more recent search engine, had a market capitalization of $377 billion and employed more than 47,000 people at the end of 2013.

We focused our investigation on the intersection of librarians and Internet search because this is a case in which a technology's functionality overlaps with an occupation's primary role (information search). Thus, this case is ideal for exploring how an occupation's identity shapes and is shaped by its interaction with a specific technology.

Data

In order to capture discourse within the library field that would be reflective of librarians' work tasks, interpretations, and identity around the Internet and Internet search, we focused on articles in journals written by and for those in the library field. For pragmatic reasons, we limited our investigation to the United States, though we hasten to add that U.S.-developed products and services dominated the search engine "market" throughout the period we explore. Specifically, our data consist of articles from *American Libraries* and *Library Journal*. *American Libraries* is the official journal of the American Library Association (ALA), with a

FIGURE 1
Number of U.S. Internet Users (Per 100 People) (Source: World Bank/data.worldbank.org)
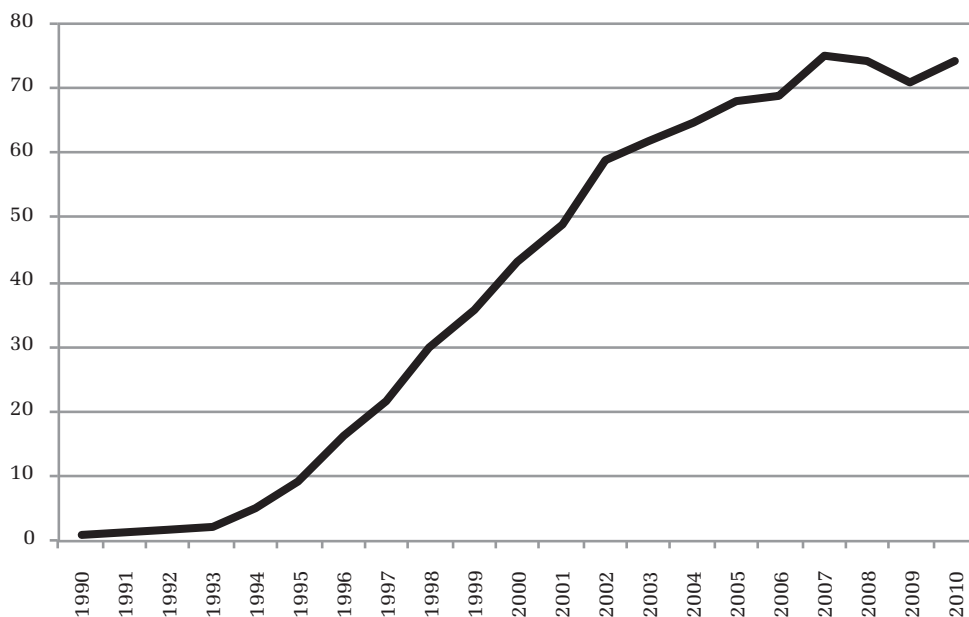
circulation of approximately 64,000 individuals and organizations. *Library Journal* is the most widely read journal in the field, with a circulation of more than 100,000 subscribers. Librarians are the primary authors and audience for both journals. Thus, the issues discussed and the perspectives conveyed are reflective of the library field as a whole; although any one article may reflect the opinion of its individual author only, the corpus together is indicative of the field.

We searched both *American Libraries* and *Library Journal* via EBSCO's Academic Source Premiere using the keywords "Internet," "search," and "web" for the period 1980 through to 2010. We eliminated some items from the results, such as advertisements, book reviews, and articles focusing exclusively on the controversy over Internet filtering in libraries, as these articles did not address the focus of our study. Our final dataset thus consists of 199 articles. The dashed line in Figure 2 illustrates the distribution of articles over time.

Occasionally, a single author appears frequently in our dataset, as with Joseph Janes of the University of Washington Information School. (Janes appears 15 times—the most of any author—representing about 7% of our dataset.) In these cases, the author is tied to a regular column that addresses issues of technology. We systematically compared these articles to other articles from the same time period, however, and we found no differences between the two sources.

Data Analysis

Having gathered discourse around the Internet and search within the field, each author independently read the full text of each article. We began by coding the overall response to the Internet in each article, which we term the "discursive response." We initially noted two major types of articles: (1) articles that described Internet search and (2) articles that suggested some action that librarians should take in response or relation to Internet search. Articles that described Internet search often raised questions as well. For example, the author of a 1993 article wrote, "I've got some grand questions . . . How will the resources be arranged? How will they [non-librarians] learn to use these tools to advantage?" (Polly, 1993). Another author writing in 1993 wondered if Internet access was worth the cost and perceived hassle:

> Why should a library offer all this variety in reference? It strains budgets, engenders coping with hardware and software, and requires infrastructure changes, such as to electrical outlets, phone connections, and the physical arrangement of the reference desk. It means the library staff has to keep up with all the new options, all the features of the various options, and know how to instruct users in the use of it all.
>
> (Tenopir, 1993)

Articles that suggested an action on the part of librarians proposed a number of possible responses. For example, one article quotes a librarian in Georgia who argues that librarians should pro-

FIGURE 2
Prevalence of Articles and Discursive Responses Over Time
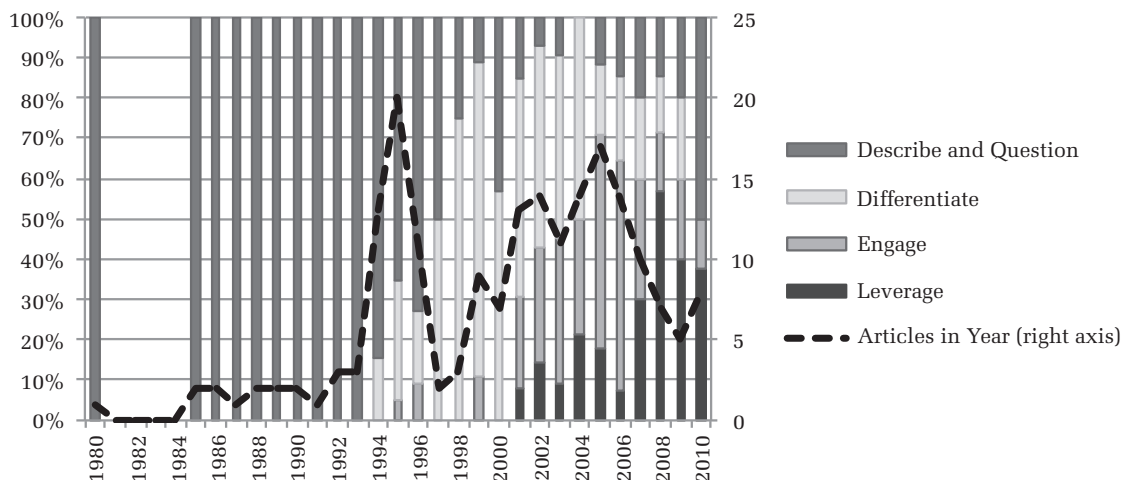
vide "exclusive Internet services including doing the search for a fee" (Schneider, 1998). Another article suggests that librarians should join forces with Google and other search engine companies: "If you can't beat 'em [join 'em] . . . [Libraries can focus on] allowing search engines to index proprietary information" (Tenopir, 2004). Yet another article suggests that librarians should engage in new activities inspired by the Internet, such as data mining in order to deliver book recommendations: "both Amazon and iTunes offer some version of 'those who bought this also bought these'-type of recommendations. Libraries can do something similar if they make use of circulation data" (Tennant, 2005). We coded these different responses based upon the relationship that they proposed or portrayed between the tasks carried out by Internet search engines and the tasks carried out by librarians (e.g., reflecting "what they do"). This coding process identified three primary responses: (1) differentiate *within* searches by describing librarians' unique activities and value, as with the suggestion of the Georgia librarian quoted above ("differentiate"); (2) engage with users and search firms to develop broad Internet search tools, as with the suggestion that librarians join with Google ("engage"); and (3) leverage Internet technology to create new areas of work, as with the suggestion that libraries use data mining to make book recommendations ("leverage"). Finally, we categorize the first type of article—those articles that describe Internet searching, often questioning it, but which do not suggest an action—as the fourth discursive response ("describe and question").

As our research question is inherently longitudinal, we also traced the prevalence of the four discursive responses over time, as illustrated in Figure 2. Thus, we associated one of the four responses with each article and we traced the percentage of articles in a given year that reflected each response. The changing patterns of discursive responses as well as qualitative changes in the tone of the discourse over time bracketed the rough boundaries of the four periods we address in our findings (Langley, 1999). Thus, in 1999, for example, our dataset included articles that we coded with three different discursive responses. In this year, however, "describe" is waning and "engage" is just emerging, while "differentiate" is the dominant response. As Figure 2 makes clear, however, the periods do not have clear edges, but, rather, overlap with one another. We place little emphasis, therefore, on spe-

cific dates and numbers, instead tracing more general patterns.

Next, we desired a finer-grained sense of the data and relationships between concepts. Thus, we generated detailed codes that captured the nuances of each article. For example, an excerpt from a 1996 *Library Journal* article reads:

> Surveys of Internet users reveal a consistent theme: Most are overwhelmed and confused by the disorganized flood of information. As a result, librarians have an opportunity to carve their niche as the de facto information navigators of the Digital Age. Developing a collection of [Internet] resources, selecting the best materials for our patrons, and providing them in an easily accessed format expands our traditional service into an online forum.
>
> (Riley, 1996)

We coded this passage to indicate that some Internet users are overwhelmed and confused; that these feelings are tied to the quantity of information and a lack of organization; that librarians perceived an opportunity to define a niche as a result of these challenges; that part of this "niche" would involve librarians serving as "navigators"; that librarians would collect and select among Internet resources; that an easily accessed format mattered; and that these moves presented an opportunity for librarians. We also kept track of various authors and their affiliations, as with the Joseph Janes case noted above.

We then sorted codes that were repeated and similar to one another into first-order categories, as detailed in Table 1. For example, after comparing codes to arrive at first-order categories, we captured the excerpt above through the following categories: "Internet searching is difficult to conduct"; "the Internet is disorganized"; "librarians should decide which online resources to collect"; "librarians conduct searches"; and "librarians develop screened catalogs of the Web." Our coding process was an iterative one, in that we developed and refined these codes as we read and re-read additional articles (Strauss & Corbin, 1998).

As we developed these first-order categories, we found that some of them reflected nuances of broader themes, which we label second-order themes. For example, the claim "Internet search is difficult to conduct" was part of the larger theme "perceived problems with Internet search," while the claim "librarians conduct searches" was part of the larger theme "conducting searches." With a deeper understanding of the first-order categories

TABLE 1
Examples of First-Order Categories

First-order category	Example
Searches should result in the "best" answer	"Good enough pretty much sums up [Internet search] quality, but should our schools and colleges be satisfied with mediocrity? Do we pride ourselves with producing good enough library researchers, good enough graduates?"
Searching should be an easy, convenient, and fast process	"Many library catalogs and bibliographic databases feature the little [search] box, with advanced search features either hidden or demoted, emphasizing ease of use over power and sophistication."
Searching should meet user desires	"The user just wants a search box. Arguments as to whether or not this is 'best' for the user are moot."
Internet search is primitive	"The Internet includes lists of documents available at many of the sites where a group of data files are archived . . . but so far there is nothing as sophisticated as a catalog or index . . . what about the day when there are thousands of documents at each site? And how will we know which site has which documents?"
Internet search is difficult to conduct	"Most of today's database searchers spend a lot of time learning the commands of a variety of systems, how to formulate queries."
Internet search uses questionable sources	"Certainly, Internet [sic] provides access to myriad information. However, some of that information is ephemeral and of questionable quality."
Internet search gives incomplete results	"Whether you're using Hotbot, Lycos, Dogpile, Infoseek, or any one of a dozen other search or metasearch engines, you're not searching the entire Web. Sites often promise to search everything but they can't deliver."
Internet search gives irrelevant results	"A search for information on actor Will Smith can produce hits on hundreds of unrelated Smiths."
Internet search gives too many results	"Today, web surfers are often frustrated or overwhelmed when locator services such as Lycos, AltaVista, or WebCrawler turn up as many as a thousand hits."
Internet search encourages poor research habits	"Have we created a generation of search zombies who listlessly tap away at the keyboard with no strategy at all . . . and then mindlessly settle for whatever their first Google page yields?"
The Internet is a secondary resource	"Remember that not everything is available online. Some information . . . is easier to find in print. Go to the net only after exhausting print resources."
The Internet complements non-Internet resources	"Commercial online, alternative online, Internet, CD-ROM, or locally loaded databases—which are most important? ALL are important. All librarians must be cognizant of all, literate in all, prepared to search and offer all."
The Internet is a key resource, but search engines are inadequate	"[Search engines] are not perfect, but improving . . . I would argue that a [given] search engine is only one of many tools for finding data on the Web."
The Internet is the dominant resource and search engines work well	"Google, or similar web search engines, is the information-finding tool of choice for many users—far ahead of proprietary online services or libraries and light years ahead of print sources."
Librarians conduct searches	"Librarians should be able to take the hand of the information seeker and step into the knowledge stream to help find, evaluate, and get whatever is needed."
Librarians should teach users how to search	"Teaching how to search the Web is hot—it's become standard practice in public-service librarianship."
Users and librarians search together	"Helping people through the maze of online information sources such as the Internet is very similar to helping people through a maze of reference books, catalogs, and classification schemes."
Users search on their own	"We serve a new generation of potential library users so comfortable with its [search's] easy gratification that they feel no compelling need for a deeper library service."
Librarians interpret search results	"[Patrons] need our expertise to be confident that the sources from which it [a search result] is taken are valid, uncorrupted by hidden motivations, and as complete, current, and authoritative as can be found."
Librarians teach users how to interpret results	"Librarians have to take action to educate users to the idea that all information sources are not equal."
Users interpret search results	"For a host of queries, of course, the Google or AltaVista search may be all a user needs. Librarians must reconcile themselves to this fact."
The Internet is disorganized	"What we had was a library where all the books were dumped on the floor and there was no card catalogue."

(table continues)
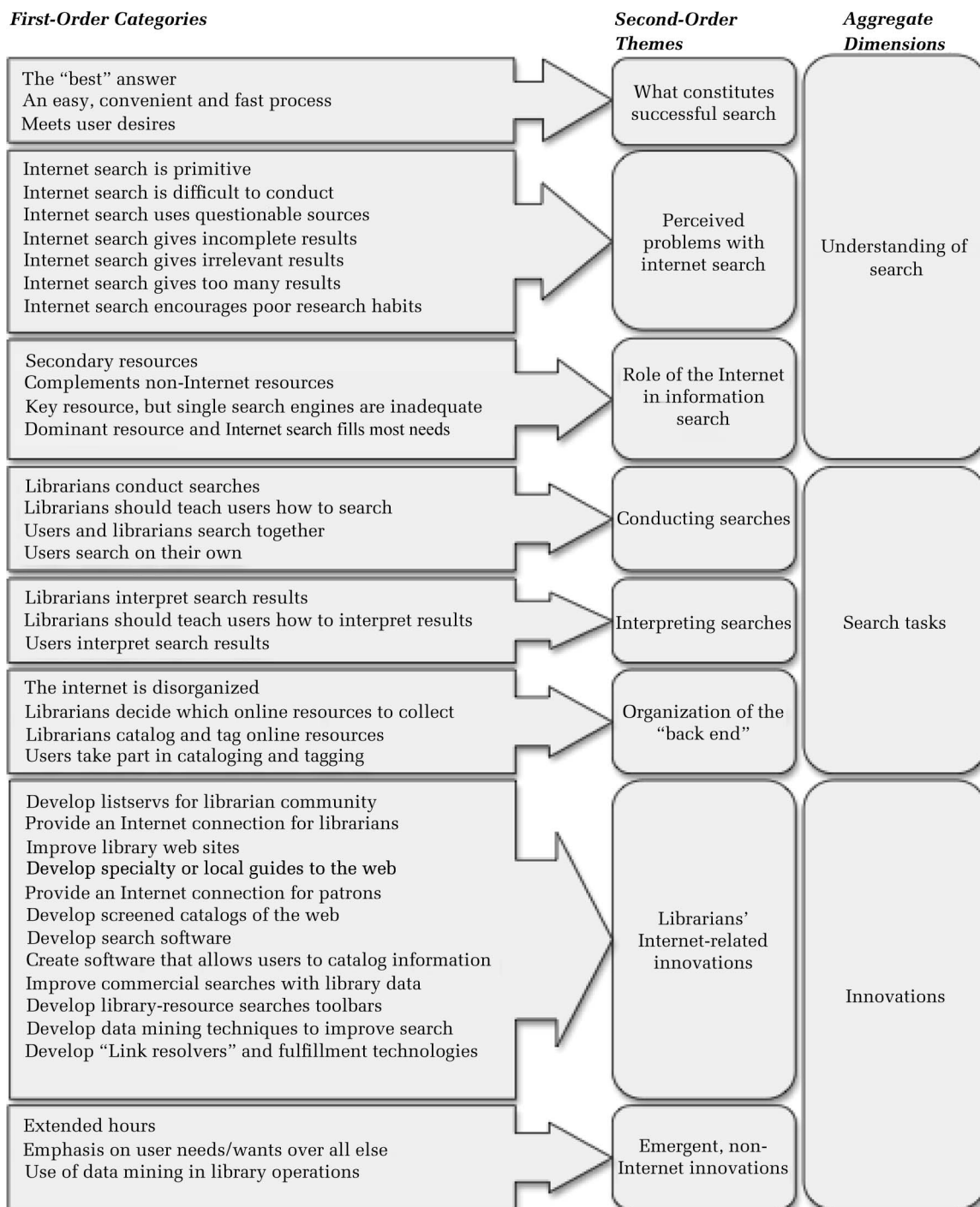
TABLE 1
(Continued)

First-order category	Example
Librarians should decide which online resources to collect	"In the future, we will use Web-based reference sources that bear an uncanny resemblance to books currently in our reference collections. It will be our job to select these resources"
Librarians catalog and tag online resources	". . . name, title, and subject access in any of the [Internet] tools just mentioned must be provided by people—people who have a thorough grounding in the principles of information organization."
Users take part in cataloging and tagging	"Bringing together millions of indexed web sites and their relative importance based on human judgment [e.g., not just librarians] can be a powerful relevance indicator."
Develop listservs for librarian community	"ALA listserv archives . . . would enable all of us who use the Web to easily retrieve past messages from the ALA lists by subject or name."
Provide an Internet connection for librarians	"For staff, it [an Internet connection] is essential."
Improve library web sites	"Easy-to-use templates allow you to create a site with your own links and images literally in a matter of minutes."
Develop specialty or local guides to the Web	"The Connecticut Library home page can be searched by area (find the nuclear power plant in Middlesex County!) or by subject . . . The attractive imagemap, 'Clickable Connecticut,' is divided into easy-to-read county-related sections."
Provide an Internet connection for patrons	"Patron access to the Internet has emerged as the hot new service since our 1991 survey."
Develop screened catalogs of the Web	"We use a number of criteria to evaluate whether a Web resource is worth cataloging. Basically, it must contain valuable content, have good graphical presentation, and at least appear to have some degree of stability."
Develop search software	"[We are talking of] building one wonderful Internet resource, one well-known place where we can direct our users, a site that is trustworthy and high quality . . . a Yahoo with values and a brain."
Create software that allows users to catalog information	"With LibraryThing (librarything.com), Portland, ME-based web developer/publisher Tim Spalding has repurposed the library catalog into a social web application and, in the process, made cataloging fun."
Improve commercial searches with library data	"Reference Extract seeks [to combine] librarian-selected sites and Google's automated approach . . . The URLs would be harvested from actual reference interactions."
Develop library-resource search toolbars	"It's pretty apparent that the box [search engine box] is here to stay, so I say it's high time librarians reclaim it for ourselves . . . If your library doesn't have one yet, find the person on your staff who can build it . . . Plug-ins are one step of many we need to take to embrace and thrive in the emerging information environment."
Develop data mining techniques to improve searches	"'We would like to match circulation data to WorldCat titles to see if it is possible to group or cluster circulations by titles and if these titles are related by subject, author, publisher, etc.,' says Lynn Connaway of the OCLC Office of Research."
Develop connections from searches to library holdings	"Academic libraries are challenged to integrate the Google Scholar article discovery experience with the library location and fulfillment experience."
Extended hours	"If resources can be accessed from home at 10 p.m., then patrons should be able to get help then, too."
Emphasis on user needs/wants over all else	"LJ's Librarian of the Year, Susan Nutter, who has positioned her library at the center of the North Carolina State University campus, says, 'I truly believe that you have to listen to [students and faculty] and do what they want . . . it's their library.'"
Use of data mining in library operations	"Corporations employ data mining to analyze operations, find trends in recorded information, and look for new opportunities. Libraries are no different."

and second-order themes, we then assembled the second-order themes into aggregate dimensions. Figure 3 conveys the relationships between first-order categories, second-order themes, and aggregate dimensions. Two of these aggregate dimensions—understanding of search and search tasks—reflect librarians' collective identity, or "who they are" and "what they do," as well as their interpretations of how the technology related to that identity. The third dimension captures innovation activities, both Internet related and not.

With the first-order categories, second-order themes, and the aggregate dimensions identified, we then examined how they related to our four discursive responses. Thus, we noted which first-order categories tended to appear in articles that we

FIGURE 3
Categories and Themes

First-Order Categories *Second-Order Themes* *Aggregate Dimensions*

The "best" answer
An easy, convenient and fast process
Meets user desires
→ What constitutes successful search

Internet search is primitive
Internet search is difficult to conduct
Internet search uses questionable sources
Internet search gives incomplete results
Internet search gives irrelevant results
Internet search gives too many results
Internet search encourages poor research habits
→ Perceived problems with internet search

Secondary resources
Complements non-Internet resources
Key resource, but single search engines are inadequate
Dominant resource and Internet search fills most needs
→ Role of the Internet in information search

→ Understanding of search

Librarians conduct searches
Librarians should teach users how to search
Users and librarians search together
Users search on their own
→ Conducting searches

Librarians interpret search results
Librarians should teach users how to interpret results
Users interpret search results
→ Interpreting searches

→ Search tasks

The internet is disorganized
Librarians decide which online resources to collect
Librarians catalog and tag online resources
Users take part in cataloging and tagging
→ Organization of the "back end"

Develop listservs for librarian community
Provide an Internet connection for librarians
Improve library web sites
Develop specialty or local guides to the web
Provide an Internet connection for patrons
Develop screened catalogs of the web
Develop search software
Create software that allows users to catalog information
Improve commercial searches with library data
Develop library-resource searches toolbars
Develop data mining techniques to improve search
Develop "Link resolvers" and fulfillment technologies
→ Librarians' Internet-related innovations

→ Innovations

Extended hours
Emphasis on user needs/wants over all else
Use of data mining in library operations
→ Emergent, non-Internet innovations

had coded with each of the discursive actions. For example, all of the first-order categories in the second-order theme "perceived problems with Internet searching" appeared in articles coded "Describe and question," some of these categories appeared in articles coded "Differentiate," and few or none of them appeared in either "Engage" or "Leverage." This analysis showed us that, over time, librarians

ceased to see Internet search as problematic. As Table 2 illustrates, we systematically examined our first-order categories and second-order themes across the four discursive responses.

We then examined how these relationships changed over time. This analysis revealed that, as the discursive responses changed, so too did librar-

ians' interpretations and experiences of Internet search technology, as shown in Table 3. Changes in interpretation aligned with changes in librarians' understanding of which activities were part of their work, or "what we do." Because "what we do" is an integral part of occupational identity, these changes in understanding evidenced changes in

TABLE 2
Grouping of First-Order Codes Across Discursive Responses

Describe and question	Differentiate	Engage	Leverage	First-order categories	Second-order themes
X	X	X		The "best" answer	Successful search
		X	X	An easy, convenient, and fast process	
		X	X	Meets user desires	
X				Internet search is primitive	Perceived problems with Internet search
X				Internet search is difficult to conduct	
X				Internet search uses questionable sources	
X	X			Internet search gives incomplete results	
X	X			Internet search gives irrelevant results	
X	X			Internet search gives too many results	
X				Secondary resource	Role of the Internet in information search
X	X			Complements non-Internet resources	
	X	X		Key resource, but single search engines are inadequate	
		X	X	Dominant resource and Internet searching fills most needs	
X	X			Librarians conduct searches	Conducting searches
	X	X		Librarians should teach users how to search	
	X	X		Users and librarians search together	
		X	X	Users search on their own	
	X	X		Librarians interpret search results	Interpreting searches
		X		Librarians should teach users how to interpret results	
		X	X	Users interpret search results	
X				The Internet is disorganized	Organization of the "back end"
X	X			Librarians should decide which online resources to collect	
X	X	X	X	Librarians catalog and tag online resources	
		X	X	Users take part in cataloging and tagging	
X				Develop listservs for librarian community	Librarians' Internet-related innovations
X	X			Provide an Internet connection for librarians	
X	X			Improve library web sites	
X	X			Develop specialty or local guides to the Web	
	X	X	X	Provide an Internet connection for patrons	
	X			Develop screened catalogs of the Web	
	X			Develop search software	
		X		Create software that allows users to catalog information	
		X		Improve commercial searches with library data	
			X	Develop library-resource search toolbars	
			X	Develop connections from searches to library holdings	
		X	X	Extended hours	Emergent non-Internet innovations
		X	X	Emphasis on user needs/wants over all else	
			X	Use of data mining in library operations	

TABLE 3
Changes in Occupational Identity with Associated Technology Shifts

Librarians' occupational identity and approximate time frame	State of Internet search	Internet technology use	Librarians' experience of Internet search	Librarians' interpretations of Internet search	Librarians' Internet-related innovations
Masters of search (through mid-1990s) Librarians understand searching and have mastered its intricacies. They are the only ones to consult if someone needs to find information because they understand users' information needs and how to find the right answer for them.	Basic search engines search titles of documents, no relevance searching Example: Archie	Email Larger libraries created web sites archiving useful links Some regions or states had online interlibrary loan services	Internet search gives too many results, often of low relevance and from poor quality sources.	Internet search is flawed and should be avoided unless there are no other options	Mainly focused on mimicking print resources and facilitating use by librarians Examples: Listservs, library web sites
Masters of interpretation (mid- to late 1990s) Librarians understand searching and information needs, and are better suited than others to interpret the results of searches, regardless of the tool used. They have specialized information that allows them to determine which sources are reliable and valuable, and to narrow down too-large searches to the pertinent results.	Directories and keyword searching in full-text, early relevance searching Examples: Yahoo, Lycos, AltaVista	Some library home pages including lists of links Online interlibrary loan common Online databases (formerly on CD-ROM) for articles Web sites added to catalogs	Internet search is successful for some searches for basic facts, but still returns too many results that are irrelevant to user needs.	Internet search offers limited usefulness, but requires expert interpretation of results to be effective	Still often mimicking print resources or integrating resources into existing catalogs or catalog-style resources Examples: specialty guides, screened catalogs
Teachers (early 2000s) Librarians, because they understand the underlying principles of good searching, are suited to teach others how to create and use effective searches and to evaluate search tools for effectiveness.	Functional algorithms for relevance-based results combined with a simple but powerful interface Example: Google	Search engines (esp. Google) used as an additional tool Home pages common Internet Public Library Computer training in libraries	Internet search works. It would work even better if search engine firms would talk to librarians about searching.	Internet search is valuable, but requires training to understand the results given. The user focus of search engines is a valuable model.	Focus turns towards users, with user integration at front and back ends Examples: user cataloging, data integration
Connectors of people and information (later 2000s) Librarians understand information and so are best suited to creating resources and training that help people to connect with the information they need. They use tools created by non-librarians and improve them to better match users and information.	Searching expands to non-text results and continues to improve relevance algorithms Examples: Google, Bing	Search engine (esp. Google) use common Most libraries have web sites featuring blogs and other dynamic content	Internet search works very well, and can be further enhanced through librarians' innovations.	Users are well served by search engines, which points to a model for a variety of other services that librarians can offer their users.	Innovation with library-focused technology development building on broader Internet technology Examples: search toolbars, link resolvers

occupational identity tied to their changing interpretations of the technology.

Moreover, as librarians' identity shifted, their experience of searching changed again, and, thus, their responses shifted to match this new experience. Over time, these shifts led to greater engagement with Internet search technology and, eventually, librarian-led innovations in this technology. Thus, librarians moved from largely dismissing Internet search to, ultimately, ceding searching to the technology and focusing on new activities opened up by the technology-occasioned identity change. This understanding of how librarians' experience of, and response to, searching informed their occupational identity primed the development of a process model that captures the interactions between changes in Internet search technology as a whole, librarians' innovation activities, and librarians' occupational identity, as reflected and reshaped by their interpretations of Internet search. We examine this model in detail in the following section.

FINDINGS

Our goal is to understand how librarians' occupational identity shaped and was shaped by their interactions with Internet search. To preview our results, we found that librarians' original conception of themselves as "masters of search" precluded their involvement in Internet search. Librarians had been organizing and retrieving information for more than a century, and they based their identity on claimed expertise regarding how information should be organized and searched for. Specifically, they believed that the appropriate outcome of a search was a single "correct" answer, not numerous potentially relevant—but often irrelevant—results. They matched this outcome to the conduct of searching by trained professionals: librarians. We argue that librarians' strong identification with the task of searching and strong sense of what constituted a successful search led to a *paradox of expertise* that precluded their involvement in Internet search. A "paradox of expertise" occurs when a group has existing mastery of a function with close ties to their occupational identity that limits their ability to recognize the value of a technology that attempts to mimic, alter, or improve that function in ways that do not match the group's current understanding.

Through interaction with Internet search technology over time, however, librarians' understanding of both the technology and their appropriate tasks related to searching shifted. This changing understanding was tied to a series of shifts in librarians' occupational identity, from "masters of search" to "connectors of people and information." In turn, these shifts in identity enabled librarians both to engage in innovation around Internet search and to develop innovations in practices that were not directly related to Internet search but that drew from librarians' redefined identity.

We structure our findings around the four occupational identities through which the field transitioned, which are tied to specific discursive responses (as illustrated in Figure 4). Following the chronological trends illustrated in Figure 2, we present our results in historic "time," associating each identity and discursive response with an era. We hasten to add, however, that the transitions between these approaches are neither smooth nor uniform (as illustrated by Figure 2); instead, our presentation of data attempts to structure an inherently complex and messy history.

In Figure 4, the major arrows from left to right indicate this historical progression in both librarians' identity and Internet technology. The curved vertical arrows indicate that librarians' occupational identity both shapes and is shaped by their experience and interpretations of search. We revisit and elaborate upon this model at the end of our findings section.

"Masters of Search"

Initially, librarians did not view Internet search as viable because search engines could not search successfully, according to the definition librarians used. Librarians defined a successful search as one that returned a single correct answer. Search engines, on the other hand, returned numerous answers of varying usefulness. Alongside this understanding, librarians reasoned that responsibility for the various elements of search—organizing resources, identifying relevant resources, performing a search, and interpreting the results—resided with librarians themselves, who had the expertise and deep situated knowledge to best respond to an inquiry. Librarians' practices reflected this attitude: they preferred to do searches for patrons and, whenever available, chose online directories of resources collected by other librarians for finding resources on the Internet. They saw themselves, therefore, as the masters of the process of searching for answers to questions and of organizing information for effective retrieval.

FIGURE 4
A Model of How Librarians' Occupational Identity Interacted with Internet Search
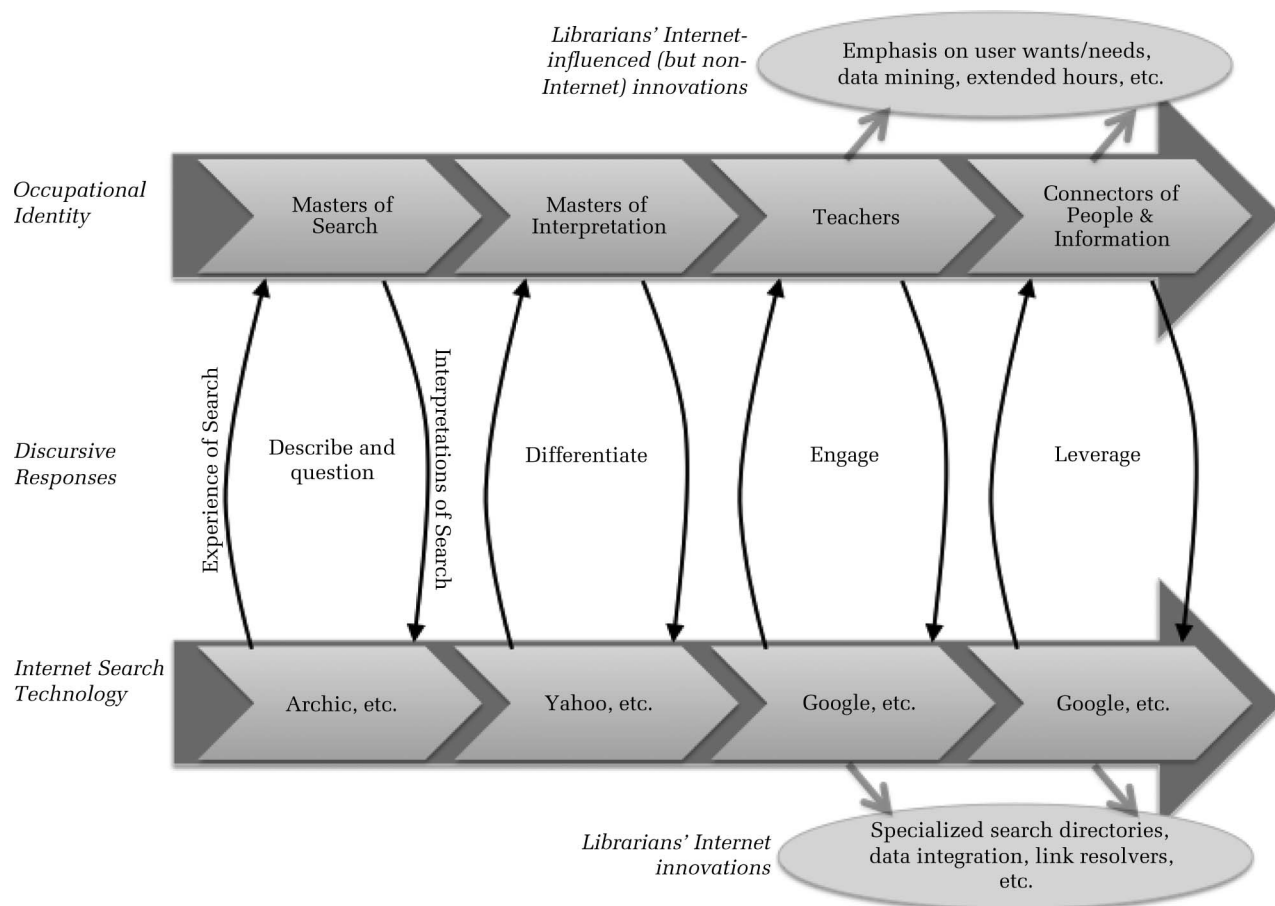
Experience of search. Librarians were quick to recognize the growth of the Internet and the challenge of navigating its resources. For example, reporting on a survey of librarians, one article stated:

> Navigating Internet [sic] is not easy. An academic librarian, reflecting on the lack of bibliographic control, simply stated, "The net needs librarians; it's a chaotic cornucopia!" Many respondents reiterated the point.
>
> (Miller, 1994)

More provocatively, Peter Graham, an associate librarian at Rutgers University at the time, described the Internet in 1994 as, "a household with shared keys but where the lights are off and we have to grope around [to find what we're looking for]" (Polly & Cisler, 1994a).

Librarians in the 1990s also pointed out that, although the Internet was growing rapidly, a great deal of information was not on the Internet. Thus, they argued that search engines were secondary

tools. For example, a 1991 author framed Internet pages as another type of article. Continuing, he claimed:

> Too much importance has been attached to the ability to keyword search the entire text of articles. Such capability requires, for documents not already available on tape, time-consuming manual rekeying of [the original] text [to put it in a database].
>
> (Billings, 1991)

In other words, most resources *were not* available digitally and *would not be* available digitally, limiting the role of Internet search. The overall sentiment of articles in this period was that Internet search was an ineffective means of searching a small amount of information that was likely to yield questionable results.

Navigating the Internet was made more difficult, librarians claimed, by the fact that most *anyone* could publish on the Internet, bypassing the bibliographic controls that accompanied professional

publishing. One 1994 article lamented, "Many librarians react negatively to the chaotic disorganization of the Internet. Because anyone can be a publisher with WWW, the lack of organization is a real problem" (Polly & Cisler, 1994c). Thus, involvement of users, unmediated by professionals, underlay the Internet's challenges.

Librarians' perspectives were reinforced by their presumption that users would find Internet search to be difficult. Writing in 1994, the editor-in-chief of *Library Journal*, John Berry, opined, "Any encounters with the Internet . . . quickly show how much further the technology will have to go before it is even minimally user-friendly" (Berry, 1994). That same year, another librarian argued, "We do not have 'user-friendly' systems yet for nontechies" (Polly & Cisler, 1994c). Articles such as these reinforced the view that patrons could not be expected to be familiar with the idiosyncrasies of searching.

Interpretation of search. Librarians discounted Internet search engines as solutions to the problem of information searching. In fact, most early articles dwell on perceived problems with Internet search. Common critiques include claims that searching is difficult and that search results are incomplete, turn up irrelevant information, provide too many results, and rely on questionable sources. For example, a 1994 article pointed out, "Certainly, [the] Internet provides access to myriad information. However, some of that information is ephemeral and of questionable quality" (Miller, 1994). In other words, Internet search engines provided a "solution" that violated the core tenets of how librarians conceived of searching.

To librarians, therefore, the solution to Internet search in this first era was twofold: take the hand of patrons to search the Internet, as they had done with pre-Internet searches, and work to improve the back end of the Internet through the selection, electronic tagging, and cataloging of Internet resources to facilitate improved searching. A 1991 article by Harold Billings, then director of the University of Texas at Austin libraries, captured the "take the hand" sentiment well. In referring to how librarians might work with patrons to search the Internet, Billings wrote:

> It is important that librarians . . . help shape the flow of information. Librarians should be able to take the hand of the information seeker and step into the knowledge stream to help find, evaluate, and get whatever is needed.
>
> (Billings, 1991)

Though Billings uses the metaphor of the librarian as a "driving instructor" later in his article, most of these early articles portray searching as an activity carried out by librarians without patrons. Where there were questions, librarians turned to one another. For example, Anne Feeny, then a graduate student at Rosary College's Graduate School of Library and Information Science, created the listserv "Stumpers" in 1992 for reference librarians to pose reference questions to one another. A key feature of Stumpers is that it was "by librarians and for librarians"; rather than opening search to patrons, it served as an internal resource for librarians to communicate search needs to one another, and then, only after finding "the" answer, to communicate this single answer to the patron (Olson, 1994).

The dominant approach of librarians, in fact, was to apply methods and relationships to the Internet that they had already developed for other technologies. As early as 1980, librarian Jan Turner claimed that online resources would be "roughly equivalent to a great big *Reader's Guide* [an annual printed index to periodical articles]" (Berry, 1980). Another author forecast in 1994:

> The future will see reference workers, available to users by telephone or electronic mail, who understand the structures of the Internet and other online information sources in order to help people find what they want.
>
> (Taylor, 1994)

Librarians thus believed they could remain information intermediaries even in the Internet age.

Just as librarians conceived of themselves as the appropriate mediators to the front end of searching, they also expressed their proper role in relation to the back end or the behind-the-scenes selection and tagging of resources and other "hidden" aspects of the technical infrastructure. To librarians, Internet architects and administrators had initially ignored the back-end organization of information. For example, the author of a 1991 article lamented, "Thus far . . . more attention has been paid to the highways for carrying information than has been addressed to the road signs that should tell us which highway will carry us to our information destination" (Billings, 1991). Later, librarians argued that attempts by systems administrators and programmers to organize this information had led to even more problems. For example, the authors of a 1994 article argued, "The first Gopher collections [Internet search resources] were developed by systems administrators and programmers, not librari-

ans, with predictable [bad] results" (Polly & Cisler, 1994d). In 1995, Steve Cisler, a senior scientist at Apple Computer's corporate library, chimed this same tone again:

> The Apple Library is . . . managed by Dale Mead with the help of Mary Wisnewski. The skills they [Mead and Wisnewski] bring as librarians in organizing the information and making the paths clear to hundreds of thousands of users each week are critical to its success. This is just one of the arguments why librarians should be doing this sort of maintenance and not automatically cede it to the MIS group or the campus computing center.
>
> (Cisler, 1995)

In articles from this era, librarians viewed the back-end organization of the Internet as their rightful domain and they perceived actions by other groups as problematic.

This view was tied to a particular perspective on the organization of the Internet for purposes of searching: providing the "one best answer"—the activity at the heart of librarians' identity—depended upon a library-style approach to the organization of information on the Internet. Thus, librarians advocated for selecting, cataloging, and tagging appropriate resources. For example, a 1994 article by Arlene Taylor, then a professor at the University of Pittsburgh's School of Library and Information Science, suggested the Internet could and should be organized like a giant card catalog with headings for subject, author, and title. Taylor's excerpt below begins with a reflection about a 1994 *Newsday* article:

> The [*Newsday*] article then quoted Ed Krol, author of *The Hitchhiker*'s *Guide to the Internet*, who observed, "What we had was a library where all the books were dumped on the floor and there was no card catalogue. Now there's a card catalogue and people are starting to put books on the shelves." I am fascinated that computer experts use library analogies to describe what is going on and what is needed; but at the same time, people are saying that the organizing components of libraries are passé. However, Krol's analogy is just that—an analogy. What is really going on is that principles developed by technical services librarians to organize printed information during the last century-and-a-half . . . are being used, almost unwittingly . . . to bring order out of the chaos of online information. . . . People in computing either don't know about the principles of organization developed by libraries in the last 150 years, or they seem to think that they couldn't possibly be applicable for electronic data. So they are reinventing the wheel.
>
> (Taylor, 1994)

To librarians, providing accurate and singular search results was tied, by necessity, to the back-end cataloging of resources; only through accurate tagging of electronic records on the Internet could librarians employ their traditional means of searching to identify the best answer. The author of a 1994 article, for example, praised closed CD-ROM databases—a non-Internet electronic resource—for adding more and more fields and search options in order to increase the relevance of search results. With its random and disorganized content, the Internet was far afield from the back-end standardization and tagging that enabled this search approach (Tenopir, 1994).

In turn, librarians expressed that the solution to Internet search rested with librarians tagging each webpage, just as they had done for decades to enter books and other resources into card catalogs. For example, Arlene Taylor's article, quoted above, continued, "Many people seem not to realize that name, title, and subject access in any of the tools just mentioned must be provided by people—people who have a thorough grounding in the principles of information organization [e.g., librarians]" (Taylor, 1994).

Identity issues. Internet search engines offered a method of searching that violated librarians' expert opinions of how searching should be done. The Internet offered neither an organized collection nor tools to effectively determine the best answer to a patron's query. By contrast, as experts steeped in the idiosyncrasies of searching, librarians believed that patrons needed their expertise to arrive at the one best answer to an inquiry. Because Internet search was so far beyond the acceptable boundaries of good searching, librarians saw little or no threat to their occupational identity. Instead, they either dismissed Internet search outright or described it as a niche tool that may be added to the toolkit. There is no suggestion in this period that Internet search is a replacement for what librarians do and, therefore, no threat to their occupation's identity.

Innovation. Ultimately, librarians had limited engagement with Internet search in this early period, as a result of their understanding of searching and related tasks. Their explicit technological activities were focused on providing an Internet connection to staff (but not patrons), working with email listservs, and developing basic web sites. In some cases, librarians also developed specialty guides to the Web, mimicking printed subject

guides that allowed them to apply their quality control and filters and to tell patrons what they needed. As one author argued in 1995:

> While the general guides to the WWW . . . give users unfiltered and unannotated access to every resource they can identify, librarian-built guides like the ones described here separate the Champagne from the snake oil, provide the resources most useful for their clientele, and add helpful commentary to their highly organized pages.
>
> (Schneider, 1995)

These librarian-created guides were narrow in scope and limited in number, but they accorded with librarians' dominant perspective on searching.

By contrast, librarians missed the opportunity to develop search engines that would automate information organization and searching and that would enable patrons to search directly. Indeed, their understanding of searches, as informed by their occupational identity, suggested that such activity would have little value.

"Masters of Interpretation"

By the mid-1990s, librarians' experience with the early Internet started to change the way they viewed themselves and their work. Where they had previously seen themselves as masters of searching, mediating between patrons and databases, they began to shift towards seeing themselves as interpreters of results and managers of back-end functions such as cataloging and organizing collections of resources. This change in identity both reflected and influenced their practices. Rather than searching *for* patrons, they began to include patrons in the search process as they recognized that patrons would use search engines whether these engines gave ideal results or not. At the same time, librarians emphasized that search engines were not the only—or best—place to search, and that results from search engines needed expert interpretation with respect to the validity and reliability of specific sources. In addition, librarians posited that simple facts retrieved from the Internet were trivial, reinterpreting "real" reference work around questions that required more than simple answers—and thus required a professional interpreter to determine the true and complete answer.

This period witnessed the introduction of Yahoo, which would go on to become the decade's most popular search engine, and which, critically, employed an approach to searching that mimicked the

subject categories at the heart of librarians' traditional approach to searches. In this similarity, however, librarians perceived a threat. In turn, their dominant response was to differentiate their tasks and understanding from the services provided by search engines.

Experience of search. A 1994 article in *Library Journal* is indicative of librarians' growing acceptance of Internet search. In reporting on a discussion about whether libraries should bother to get online, the author writes:

> Yes! Yes! Yes! For staff it is essential. [Note that librarians still conceived of the Internet primarily as a staff resource.] I've learned so much from the Internet I couldn't imagine being a librarian without it. I answer questions daily, find people potential job openings, get info that our small library could never get as quickly as the net provides—all because of the access we have. The Internet doesn't solve all information needs, but it is an extremely important arrow for any library's quiver.
>
> (Polly & Cisler, 1994b)

As evidence of increased acceptance, online references appeared for the first time on the New York Public Libraries "Best of Reference" Top 25 award in 1996 (Lampasone, 2008).[2]

Yahoo, as noted above, represented a shift in Internet search technology that both mirrored and threatened librarians' approach to search. A 1998 article lauded Yahoo for taking an approach similar to that of librarians:

> The better web navigation sites have adopted and adapted library techniques and skills. Yahoo, a fledgling at the time some librarian projects began, has become an Internet pillar, evolving from browsable directory to multifaceted portal site. Compared to search engines that turn up random hits ranked by dubious "relevancy," Yahoo's browsable, cross-referenced categories—which often lead to multiple subcategories—represent an advance.
>
> (*Library Journal*, 1998)

Thus, some librarians saw in Yahoo, for the first time, an approach to Internet search that mimicked their own perspective on the organization of information (subject categories). To other observers, however, Yahoo's "loose standards" served to undermine librarians through a poor implementation of their superior approach. For example, Michael Gorman, described as a "cataloging guru," re-

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[2] Both Yahoo and AltaVista appeared in the 1996 listing.

marked, "[Yahoo is] not even vaguely comparable to the worst kind of cataloging" (*Library Journal*, 1998). By adopting a keyword-oriented approach— one that historically was tied to librarians' identity—Yahoo simultaneously reinforced and threatened this identity.

Librarians maintained that the primary problem with Internet search was its inadequate cataloging. Without a better back end, librarians contended, front-end solutions like Yahoo would never enable patrons to find the best results. In turn, if they could not identify the best results, then these tools were inconsistent with librarians' notions of a successful search, and, thus, had limited value to users. As one 1999 article relayed:

> Today, web surfers are often frustrated or overwhelmed when locator services such as Lycos, AltaVista, or WebCrawler turn up as many as a thousand hits. More likely, you can't tell the difference between a page written *by* someone and a page *about* that person. A search for information on actor Will Smith can produce hits on hundreds of unrelated Smiths. Yet people are drawn to the Net like prospectors to a gold rush to find information that is important to them . . . Why not use traditional library tools and techniques to organize the Internet? After all, many of the problems in organizing data on the Internet are similar to those faced by librarians in the real world. Think of all the things coming into a library over the transom that catalogers can't identify, put a date on, or understand because of the language.
>
> (Chepesiuk, 1999)

To librarians, then, the key to Internet search continued to lie in cataloging and tagging Internet pages to facilitate accurate searching.

Interpretation of search. Librarians had developed Yahoo-like subject guides early on, as relayed in the previous section. Librarians' guides, however, were small and focused, whereas the breadth and size of Yahoo and other search engines again raised the challenge of "too many results." In turn, librarians linked large numbers of results to dubious quality and utility. In this era, however, rather than dismissing Yahoo and other search engines as irrelevant or marginal, librarians accepted them as an initial and important step in search and they strove to differentiate themselves by emphasizing complementary tasks that they could perform.

A 1999 article was one of many to make the case for differentiation and it critiqued librarians who would compete with the likes of Yahoo: "Ironically, in a competitive society in which agencies and organizations are looking to differentiate their services, librarians are working as fast as they can to look like and be a provider of the same technology that can be found elsewhere" (Vavrek, 1999). The authors of a 2001 article made the case for differentiation through analogy, positing that if libraries compete head-to-head with the Internet, they would go the way of the "horse-and-buggy in the age of the automobile"; if libraries differentiated from the Internet, however, the authors suggested that they could draw a lesson from radio stations, which reinvented their formats in the wake of television (Rodger, D'Elia, & Jörgensen, 2001). One year later, Joseph Janes, a professor at the University of Washington Information School (itself re-branded from a "library school") titled his inaugural column for *American Libraries*, "Defining what we do—all over again" (Janes, 2002a).

Identity issues. Librarians both drew upon and shifted their traditional identity in their efforts to differentiate from Internet searching during this period. First, librarians relied on the plurality of sources on the Internet itself to reinforce the need for their direct involvement in searches. For example, the author of a 2001 article titled "10 Reasons Why the Internet Won't Replace Libraries" argued:

> The Internet is like a vast uncataloged library. Whether you're using Hotbot, Lycos, Dogpile, Infoseek, or any one of a dozen other search or metasearch engines, you're not searching the entire Web. Sites often promise to search everything but they can't deliver. Moreover, what they do search is not updated daily, weekly, or even monthly, regardless of what's advertised. If a librarian told you, "Here are 10 articles on Native Americans. We have 40 others but we're not going to let you see them, not now, not yet, not until you've tried another search in another library," you'd throw a fit. The Internet does this routinely and no one seems to mind.
>
> (Herring, 2001)

In this era, therefore, librarians paid increasing attention to what they termed the "invisible web"— Internet resources missed by search engines. For example, in 1999, Mary Ross, a librarian at Seattle Public Library, argued, "A search engine is only one of many tools for finding data on the Web. It's important to remember that a search engine is a tool, not a strategy" (*American Libraries*, 1999). Accordingly, librarians' rhetoric shifted from "the Internet is only a small slice of relevant reference resources" to "the Internet is a key resource, but search engines do not adequately capture it and librarians are needed, therefore, for their ability to

use multiple search engines" (Smith, 2001). Unlike the earlier era, the Internet was now viewed as the primary vehicle for searching, but librarians were still at the heart of Internet search and they drew upon their ability to find information across a variety of sources.

The effort to maintain librarians at the center of searching was reinforced by librarians' emergent strategy of differentiating "fact finding," which patrons could do, from "guiding" and "interpretation," which required librarians. Thus, part of librarians' refined occupational identity lay in emphasizing involved and valuable searches as their exclusive domain. For example, the author of a 2002 article claimed:

> [Librarians should] refocus the mission of library information services and resources to the deeper, more complex information needs of users engaged in searches that require higher levels of authority and more comprehensive scope.
>
> (Jackson, 2002)

A critical part of differentiation lay in distinguishing between "locating" information and "interpreting" information. For example, another article from 2002 likened searching on the Web to "quick-fix pornography" and chided readers that, "Answering trivial questions fast is itself a trivial pursuit" (Isaacson, 2002)—and something best left to patrons. Instead, librarians' occupational identity was tied to *interpreting* information. For example, when an interviewer asked Mary Ross, the Seattle librarian, to forecast in 1999 about the library reference desk in the year 2010, she remarked, "I think there will still be a librarian there, because users still need that personalized information interface [to interpret findings]" (*American Libraries*, 1999). Another article, also from 1999, relayed the story of a tour guide in China who, while touring a group of U.S. librarians, had questioned the need for libraries in the future:

> The guide went on with his spiel about getting around in his city, about how efficient transportation was but how complex getting from one place to another could be. He talked about what was important and what could be skipped. He emphasized his role as guide to the complicated maze of sights and sounds that make up his city. I had him right where I wanted him. "So," I said, "you are beginning to understand librarians. What you do is very much like what we do. We are guides in the world of information, just as you are a guide to Guangzhou." . . . My colleagues applauded.
>
> (Kniffel, 1999)

To aid in this differentiation, librarians drew analogies with other professions, too. For example, Bernard Vavrek, then a professor of library science at Clarion University, asked readers to "consider doctors for a moment. Health professionals are still in control. They *interpret* information in the exercise of the professional responsibilities. The need for personal human service is obvious" (Vavrek, 1999, emphasis in original). Another 1999 article relayed how both Cisco, Inc. and Find/SVP, a commercial information reference service, featured "live person" services and the author claimed, "the reference librarian will always serve as an important filter for quality information" (Lipow, 1999). Thus, librarians ceded part of their traditional occupational identity to patrons by casting that part as less valuable. In turn, they redefined their occupational identity to emphasize interpretation.

Innovation. Librarians' innovation activities during this period reflected their attempts at differentiation. Thus, some librarians expanded librarian-developed directories beyond local specialty guides to encompass the entire Internet, but with the searchable content limited to that which librarians had already identified as valuable (Veatch, 1999). Other librarians planned for search software that, likewise, would provide a single librarian-developed portal through which people could explore the Internet: "[We are talking of] building one wonderful Internet resource, one well-known place where we can direct our users, a site that is trustworthy and high quality . . . a Yahoo with values and a brain" (Schneider, 2002). The basis of these innovations lay in differentiating them from the Internet as a whole by emphasizing the controlled quality of search—a point of differentiation central to librarians' identity.

Librarians also proposed new "metadata elements" to be included with the HTML code of webpages in order to facilitate searching: the idea was that librarians could provide an infrastructure for the Internet that would enable them to treat it like other resources. Even metadata, however, drew critiques from many librarians insofar as it would move the back-end cataloging function away from librarians themselves. As one commentator argued in 1999:

> What the [metadata proposal] says is "here are some slots into which you [e.g., webpage creators, not librarians] can put names, titles, subjects, etc., and we don't care where those names, titles, subjects, etc., come from or how you formulate them." . . . There is no third way between cataloging, con-

trolled vocabularies, etc. (expensive and effective) and the chaos of keyword searching on the Web (inexpensive and utterly ineffective).

(Chepesiuk, 1999)

Though librarians had accepted non-librarians' involvement in simple searches, they were not yet ready to cede control over the back end.

Librarians' reluctance had little import anyway, as they soon realized that most webpage authors ignored the metadata fields and that other webpage authors manipulated the fields in order to influence search engine results to their advantage. Librarians' independent search directories fell flat, too. For example, a guide developed at the Nashville State Tech Library in the late 1990s had cataloged only 2,000 items by the year 2000. By contrast, Google had indexed one billion pages by the same date. Ultimately, while the Internet had become a key tool, and librarians recognized that patrons could and should use this tool for at least some queries, the mismatch between librarians' notion of searching—interpreting high-quality single answers as facilitated by a carefully constructed catalog—and the realities of the Internet—a noisy, inchoate, and random set of files—continued to stymie their active involvement in developing or contributing to Internet search technologies.

"Teachers of Search"

By the early 2000s, search engines had advanced to a point where they often returned relevant results, and librarians began to recognize that they could not compete with them on pure searching. Librarians ceded their position as searchers in favor of identifying themselves as teachers and mentors *to* searchers. Instead of interpreting the results of searches, therefore, they taught library users to interpret their own results. In addition, they invited users to join them in back-end organizational tasks such as tagging and organizing online resources.

Experience of search. The continued and growing acceptance of search engines is evident in librarians' rhetorical shift from ambivalence and cautious acceptance to open admiration. A 2001 article in *American Libraries* was the first article to unabashedly "love" Google—using only positive terms and not mentioning potential drawbacks—and it captured the sentiment of the new millennium. As the author wrote:

Madeline Taylor of the Health Services Library at St. Joseph's Hospital and Medical Center in Paterson,

New Jersey, has a major love jones for Google (but then, who doesn't?). "I'm not sure how I survived before I found Google," enthused Madeline, "and I don't want to be without it—ever." . . . Agreed: it's the first tool I use.

(Schneider, 2001)

Similarly, the author of a 2004 article titled "Is Google the Competition?" claimed that Google and other search engines had become the preferred search tool for both patrons and professional librarians:

Google, or similar web search engines, is the information finding tool of choice for many users—far ahead of proprietary online services or libraries and light years ahead of print sources . . . [Studies] show that a majority of students first turn to search engines for school assignments . . . What may be more surprising is that subject experts also often favor the Web.

(Tenopir, 2004)

By 2005, in fact, an *American Libraries* article claimed, "'Librarianship without the Internet' is so unthinkable now that searches for that phrase come up dry in both Google and Yahoo" (Janes, 2005). Internet searching was firmly entrenched in librarians' understanding of searching and search tasks.

Moreover, searching moved from an activity that librarians dominated and viewed as core to their occupational identity to an activity in which librarians could no longer compete. For example, the author of a 2004 article admonished librarians who dared to challenge search engines:

I ran across a catchy little slogan: "Librarians: the Best Search Engines." . . . This is not a game we want to play. If we see search engines as our competition and try to beat them at their own game, we can't possibly win. They will always be faster and cheaper and easier to use, in almost any circumstance, than any library. Why in the world would we want to try to compete with them?

(Janes, 2004b)

A 2008 article struck a similar note, arguing that, "library search[ing] pales next to Google and other web-based search engines. The simple but powerful 'Google search box' is a model for what we need in libraries" (Eisenberg, 2008).

Interpretation of search. The articles from this period also are telling in that critiques of Internet search, which dominated the early discourse, largely disappeared. Instead, articles focused on new innovation and increased engagement of users (see Table 2). In part, this trend may reflect im-

provements in the underlying technology. The discourse suggests, however, that it also reflects an acceptance of Internet search's shortcomings. Indeed, studies from 2004 indicated that search engines still missed 10% to 20% of the Web and were biased towards U.S. and "popular" pages (Van Couvering, 2008).

In part, this recognition encouraged differentiation of a different sort: articles in this period begin to emphasize the non-search roles that librarians and libraries could serve. For example, a 2002 article focused on libraries and technology argued that libraries should not get caught up in technology, and should, instead, be "a place of sanctuary and silence where [one] could contemplate and make sense of it all" (Janes, 2002c). A year later, the same author emphasized how:

Searching is one important part of "library work," but there are many others. Other functions worth considering include access to reference services (synchronously or asynchronously), simple reference tools, the ability to perform simple functions like placing holds or renewing items, and checking the user's library record.

(Janes, 2003)

Stephen Abram, a panelist at a 2006 ALA session on the future of searching, was even more forceful: "No one comes to libraries to search. Users come to us for learning, community, and other services" (Albanese, 2006). These commentators and others encouraged libraries to move beyond information searching altogether. Given the historic emphasis that libraries placed on providing access to information, this suggestion (and its implementation, in part) was remarkable.

What librarians gleaned most from their experience with Internet search, however, was to reconsider the role of the patron vis-à-vis their own occupational identity. This approach was closely tied, as a result, to a newfound and fierce emphasis on users. (In fact, the word "users" comes to supplant the traditional term "patron" in articles from this period.) Librarians, therefore, began to frame a successful search as "giving patrons what they want"—not necessarily giving them "the right answer." A 2003 article advocated that librarians drop their "library-centric" view and instead adopt a "user" view:

If we cared, we'd pay more attention to people like Marissa Mayer, interface designer at Google, when she says, "Google should be 'what you want, when you want it.' As opposed to 'everything you could

ever want, even when you don't.'" How is that for a concept? Meanwhile in Libraryland, the murmuring continues about "Google-ization" and the dangers of appealing to the lowest common denominator. You'd think taking care of our users—our customers—in a manner in which they are accustomed to is beneath us. This is a recipe for going out of business.

(Klein, 2003)

The interpretation of Google is particularly interesting in this passage. Whereas librarians had previously interpreted *Internet search* as providing too many results of marginal relevance, this article criticizes *libraries* for providing "everything you could ever want, even when you don't." By placing user interests and perspectives first, rather than librarians' previous notions of search, the author highlights the incompatibilities between perspectives and encourages his colleagues to adopt the user perspective.

This customer-centricity grew to dominate librarians' perspectives on search. For example, *Library Journal*'s Librarian of the Year in 2005, Susan Nutter, pleaded in her cover story interview, "I truly believe that you have to listen to [students and faculty] and do what they want . . . it's their library" (Fialkoff, 2005). A 2008 article claimed that, "librarians who insist on directing patrons to specialized, difficult-to-use databases are old-fashioned and providing poor customer service" (Rethlefsen, 2008). What mattered in this new perspective was customer responsiveness, not finding the best answer.

In turn, librarians emphasized ease-of-use as a primary search criterion. As commentator Janes wrote in 2004, "For the vast majority of people, ease of use is paramount . . . Why burden the casual, disinterested user with bells and whistles they won't or can't use?" (Janes, 2004c). The author of another 2004 article claimed:

Google has taught us, quite powerfully, that the user just wants a search box. Arguments as to whether or not this is "best" for the user are moot—it doesn't matter if it's best if nobody uses it.

(Miller, 2004)

As the author argues, search moved from providing what was "best" to providing whatever the user/patron wanted, even if it was shallow, fictional, misdirected, or overwhelming—all of the things that librarians had railed against just a decade earlier.

To be sure, librarians continued to fret about the quality of user searches. For example, one author questioned, "Have we created a generation of

search zombies who listlessly tap away at the key-board with no strategy at all . . . and then mind-lessly settle for whatever their first Google page yields?" (Rethlefsen, 2008). Whereas librarians pre-viously attributed these shortcomings to Internet search itself, however, they now viewed them as motivation for training users how to interpret re-sults themselves.

Identity issues. Placing users at the forefront of searching enabled Internet search to absorb librar-ians' historic occupational identity. Whereas librar-ians had previously claimed the role of searching for and interpreting results for themselves, they now emphasized training and education for *pa-trons* on how to filter and interpret. For example, the author of a 2001 article enthused, "Teaching how to search the Web is hot—it's become standard practice in public service librarianship. We teach classes, hold workshops, distribute handouts, mount tutorials on the Web. We . . . don't hesitate to help" (Cohen, 2001). Another author argued, "Li-brarians have to take action to educate users to the idea that all information sources are not equal" (Berry, 2004). The following year, another com-mentator claimed that such efforts were necessary in order to maintain the occupation's standing: "We must put education [about how to interpret results] at the forefront of our efforts to avoid mar-ginalization" (Bell, 2005). Thus, librarians came to define a new occupational identity, in part, around training *others* how to do the very tasks—searching for and interpreting information—that had formed the basis of their earlier occupational identity.

Librarians also moved users to the forefront in the back-end cataloging and tagging of online infor-mation. Whereas librarians previously held onto the idea that managing back-end tagging and cata-loging was one of their sacred domains (recall the author who earlier railed against metatags), they now pointed to user contributions as essential. For example, a 2004 article discussed how index terms could be suggested and vetted by the general public instead of developed by expert librarians, and it offered a glowing review of a Carnegie Mellon Uni-versity experiment that took this approach to cata-loging images (Janes, 2004a). A 2007 article pointed out that enrolling users in cataloging and search could improve the frequency of updates and could involve the "many patrons who possess subject expertise" (Farkas, 2007). By shifting their occupa-tional identity to emphasize the role of "teacher," librarians also opened space for patrons or users to assume some of their historic tasks.

Innovation. These moves were reflected in li-brarians' innovation activities, too. Thus, as librar-ians adopted a new identity that both shaped and reflected their experiences with Internet search, they also began to contribute innovations around Internet search. For example, as a 2008 article re-porting on LibraryThing, an open-source cataloging tool, notes:

> With LibraryThing . . . Tim Spalding has repurposed the library catalog into a social web application. . . . LibraryThing brings into large-scale practice what the most visionary among us can only talk about . . . folksonomies, crowd-sourcing, a populist concern for authority, and a cooperative method for constructing it. . . . Some 350,000 users have cataloged nearly 23 million books to date. Not surprisingly, librarians love LibraryThing.
>
> (*Library Journal*, 2008)

The once-sacred domain of back-end cataloging had been opened to patrons and it reflected a more communal approach to searching; searching was not denigrated by the participation of users, but, rather, enhanced by the application of their unique per-spectives and expertise.

By opening up to users and engaging commercial search engine firms, librarians hoped that the en-gagement would run both ways. The author of a 2002 article, for example, wrote:

> I would love to see us work with the Google folks. We have many similar goals, getting people help in finding information they want chief among them. If we can align with them to achieve those goals in mutually beneficial ways, it could create a real sea change—not only in librarianship but on the Web as well.
>
> (Janes, 2002b)

The image represented is one of neither ambiva-lence nor differentiation. Instead, the author pro-poses a dialog with Internet search companies for the purpose of furthering the goals of both libraries and Internet search companies. Later that decade, another article described a library-led initiative, Reference Extract, which would use library data to improve commercial Internet search:

> Reference Extract seeks a third way that combines the strength of both librarian-selected sites and Google's automated approach while avoiding as many of the limitations as possible. The initial idea was to replace page rank, which sorted results based on the number of pages pointing to other pages, with reference weighting, where results were ranked on how many times reference librarians pointed to a

given web site. The URLs would be harvested from actual reference interactions, thus making it part of the current workflow of librarians and using this work to provide the context in which the citation was made.

(Lankes, 2009)

Thus, the idea was that librarians, having adopted a new perspective on search, could work alongside users and commercial companies to develop improved Internet search tools.

"Connectors of People and Information"

In the last period that we document, librarians were no longer competing with search engines. They had accepted that Google and other search engines were effective tools for finding resources, and had turned, instead, to a focus on making the library's services user focused. In turn, they examined long-standing library practices from the users'—rather than librarians'—point of view, expanding hours and simplifying the online catalog interface. They also drew inspiration from online technologies to introduce new practices, such as data mining circulation information to better understand what materials patrons wanted. Their identity no longer depended on search mastery but, rather, on connecting users with what users wanted or needed, whether that was a computer with which to search or the full text of an article discovered online. Internet search itself thus moved from being understood by librarians as a problem-ridden secondary resource that did not match their notion of searching to a dominant resource whose simplicity, speed, and user orientation led librarians to reassess their relationship with patrons.

Experience of search. Librarians' experience of search in this period often centered on Google. The dominance of Google is reflected in a pair of 2010 articles by Joseph Janes of the University of Washington Information School. In one article, Janes writes, "Give everyone a shotgun and some gasoline—losing Google and Wikipedia simultaneously would undoubtedly lead to a *Mad Max*-like fall of civilization, so it'd be every person for themselves" (Janes, 2010b). A second piece reports on reaction by librarians to a Google search commercial during the 2010 Super Bowl: "As a blogger at The Net Impact revealingly commented, 'Google commercials? Isn't that rather like, say, oxygen commercials or knife and fork commercials?'" (Janes, 2010a). To these librarians, Google and other Internet search services were so integral to the practice

and meaning of searching and library reference activities that conduct of these activities in their absence was unthinkable.

Interpretation of search. The shift in the response to search was especially apparent in a 2007 article titled "A Librarian's 2.0 Manifesto." The manifesto includes: "I will not wait until something is perfect before I release it, and I'll modify it based on user feedback," "I will not fear Google or related services, but, rather, will take advantage of these services to benefit users while also providing excellent library services that users need," and "I will avoid requiring users to see things in librarians' terms but, rather, will shape services to reflect users' preferences and expectations" (Cohen, 2007). Together, these pledges capture core aspects of the new perspective around search: the goal is not perfection but meeting customer demand; search can and should be relegated to Google; and patrons ("customers" or "users") reign supreme, particularly in the event of conflicts between users' desires and librarians' sense of fitness.

A 2008 article, in fact, offered a rebuke of those who would claim that old technologies (and their associated understandings) were superior:

[Years ago,] Clifford Stoll, author of *Silicon Snake Oil* . . . made a lot of noise (and probably a good deal of money) on the lecture circuit railing about how technology was overrated and how we were being sold a bill of goods; for example, wasn't the card catalog far superior to the online catalog? . . . Stoll was mostly and overwhelmingly wrong. Developments such as word processing, electronic spreadsheets, networks, email, the Web, and Google better meet the needs of people than the manual systems that came before.

(Eisenberg, 2008)

Similarly, another author categorized the idea of focusing on the "right" answer as an artifact from a previous era, similar to an earlier library practice of limiting patron access to materials: "In the really old days, many librarians quite seriously argued against open stacks, not because things would get stolen or misfiled (though true), but because uneducated people who weren't used to looking for books might pick the wrong ones" (Janes, 2010c). In fact, even though search dominates discussion around the Internet in the 1990s and most of the 2000s, most Internet-focused articles at the end of the 2000s are unconcerned with search and instead focus on new topics such as mobile Internet access (Farkas, 2010), online scholarly publishing and in-

centives for academics (Smith & Mercer, 2010), and text messaging in libraries (Mathews, 2010).

Identity issues. If the dying away of discourse about the Internet as a threat is an indicator, then the role of librarians in information search—and the tasks and understandings that justified their historic identity—is largely a resolved question by 2010. Innovative library technology activities, which borrowed heavily from what librarians observed in search engines, also enabled librarians to craft a new identity that relied less on information searching, cataloging, and storage, and instead emphasized connecting people and resources to one another. For example, librarians began to focus on "fulfillment," meaning the provision of resources such as academic articles once a search engine had already located them (as with the Google Scholar link resolver) (Dempsey, 2005). They also emphasized their ability to connect people to the Internet infrastructure in the first place. As commentator Janes wrote in 2007:

> Deep down inside, I think a lot of us are bothered by . . . simply providing computers and Internet access. . . . [I]t certainly seems different from our traditional book-centered, service-oriented professional and institutional model. Well don't let it bother you. . . . It's good because it helps connect people with information, one of the raisons d'être of libraries.
>
> (Janes, 2007)

In other words, librarians now defined their occupational identity not around information searching so much as the more flexible and diffuse notion of connecting people and information. In fact, in some articles, the library itself is transformed from a physical repository of information to an environment intended to facilitate community and interactions (Albanese, 2006)—the same language, ironically, used to characterize the Internet.

Innovation. Although librarians hoped to engage both companies and users in developing search tools for the Internet as a whole, these efforts faltered. By the end of the decade, librarians thus focused their innovation efforts on library-specific resources. In this narrower domain, librarians made important contributions. For example, a 2005 article relayed a library-developed improvement to Google Scholar that was later implemented by the search engine:

> I laud the librarians who cajoled sweeter juice from the bitter navel-gazing of others. Peter Binkley at the University of Alberta was one of the first to create a browser extension for Firefox that would add SFX

link resolvers to citations in Google Scholar. Link resolvers standardize citations from disparate resources . . . and compare the citations to a local library's holdings—a middleman for finding full text of articles. Dozens of refinements followed, including plug-ins for Internet Explorer, links to other services, and ultimately a link-resolver service offering from Google itself.

> (Pace, 2005)

The focus upon library resources, rather than the whole of the Internet, played out in other technological adaptations and developments, too. For example, drawing upon their growing emphasis on simplicity in interface design, a number of librarians programmed toolbars for web browsers that allowed users to quickly and easily search their home library's resources from Internet Explorer, Firefox, and other web browsers. A 2007 article, for example, highlighted initial offerings from Virginia Tech's library, the Harris County Public Library in Texas, and Stanford University's library.

Moreover, librarians began importing Internet-influenced technologies and perspectives into non-Internet-related library activities. For example, some articles justified extending library hours on the basis of the fact that Internet resources could be accessed at all hours and, therefore, libraries should be open late, too (Kawakami, 2002). Observing the use of data-mining technologies developed for Internet search, other authors noted that data mining could also be applied to library operations. For example, the author of a 2005 article noted that, "Corporations employ data mining to analyze operations, find trends in recorded information, and look for new opportunities. Libraries are no different. Librarians manage large stores of data—about collections and usage, for example—and we also want to analyze this data to serve our users better" (Cullen, 2005). Brushing aside "largely misplaced concerns on client privacy," a 2009 article suggested that librarians take a cue from Google and start data mining their own search records in order to identify patterns: "It ain't just Google that can harvest and aggregate search terms to intuit about its users. We've got weblogs of our own, not to mention records of what people search in our catalogs and databases" (Janes, 2009). Another 2005 article suggested that one use of such data mining could lie in an Amazon-style recommendation system for libraries:

> [B]oth Amazon and iTunes offer some version of "those who bought this also bought these"-type of

recommendations. Libraries can do something similar if they make use of circulation data and OCLC [Online Computer Library Center] is experimenting with just that. "We would like to match circulation data to WorldCat titles to see if it is possible to group or cluster circulations by titles and if these titles are related by subject, author, publisher, etc.," says Lynn Connaway of the OCLC Office of Research.

(Tennant, 2005)

Thus, librarians drew inspiration from Internet practices and they sought ways to apply them to their work as librarians—thus redefining their occupational identity by drawing upon the very technology that had threatened their occupational identity in the first place.

A Grounded Model of Occupational Identity and Emergent Technologies

The relationship between librarians and Internet search provides an instructive example of how an occupational identity can interact with a new technology. We found, specifically, that librarians' occupational identity refracted Internet search by shaping both librarians' interpretations of the technology and the activities in which they engaged. Like a lens that bears the imprint of the light it refracts, however, this process also changed the occupational identity itself. In turn, the changed identity refracted the technology differently and, therefore, was associated with different interpretations and activities. This process repeated over time, resulting in changes to both identity and technology.

The four discursive responses that we identify serve as evidence of this process and these changes. First, librarians viewed themselves as "masters of search," and described Internet search as a flawed contender in that space, questioning its efficacy and critiquing its perceived shortcomings in relation to their understandings of searching. They did not see this technology as a challenge to their identity because they did not perceive that it "did" what librarians did. Second, as librarians began to recognize that Internet search might, in fact, overlap with their roles, they viewed it as an identity threat. In turn, they reinterpreted their identity to focus on interpretation of information, differentiating their activities from that of search engines. Third, librarians saw themselves as teachers of search tools and thus engaged with search engines, learning from them and joining with users and

firms to contribute to changes in the Internet as a whole. Finally, librarians refocused their identity towards connecting people and information, using their new understanding of Internet search technology to expand their occupational activities and directing their innovation efforts towards developments that were closely tied to library functions and that reinforced this redefined identity. As our analysis makes clear, therefore, librarians' adoption and adaptation of Internet search technologies must be understood as a function of their occupational identity. In turn, as their occupational identity itself changed through these interactions, it shaped further interactions.

The sequencing that we uncover is critical to our explanation. Specifically, later perspectives capitalized upon the "slippage" opened by earlier ones. For example, an overriding theme in the history that we convey is the ascendance of patrons or users in all aspects of search. This user role, however, began with the limited and controlled "co-piloting" of patrons and librarians in conducting search queries—a small step, with patrons still excluded (in librarians' views) from interpretation and organization of the back end. Nevertheless, this small step opened a crack in librarians' traditional role, enabling users to move from "search query co-pilot" to "search query pilot" to "full participant in every aspect of search and information organization." The point is that librarians' reinterpretation of their identity vis-à-vis search progressed not through a "punctuated equilibrium"—despite the radicalness of search technology—but, rather, through a series of small steps that built upon the space opened by previous steps.

At the same time, these shifts in librarians' occupational identity enabled librarians to make focused contributions to the very technologies that had threatened their identity. In other words, as long as librarians thought of Internet search as a problematic niche or as a perceived threat that required them to differentiate themselves, they suffered from a paradox of expertise and were unable to fully leverage the technology or to make contributions to it. By contrast, as librarians shifted their occupational identity, they were able to leverage Internet search to reinforce this identity and to make substantive contributions to further advancements in search technology.

Figure 4 illustrates this process graphically. Reading from the bottom left, librarians interpreted early Internet technologies with a particular understanding of search and associated search tasks that

reflected their identity as "masters of search." This interaction was associated with limited Internet-related innovations and an initial reshaping of librarians' collective occupational identity. Moving to the right, librarians interpreted changing Internet technologies with revised understandings of search and associated tasks that reflected a changed collective identity. As librarians' collective identity changed to cede search to the Internet, their Internet-related innovations also grew and had influence on the Internet as a whole. Critically, this identity shift, as well as interactions with Internet technology, also led to new innovations seemingly disconnected from the librarian–Internet relationship that nonetheless resulted from these interactions (pictured in the upper-right oval). Thus, Figure 4 illustrates how occupational identity can shape different interpretations of technology over time, and how these interactions can work to redefine occupational identity and to enable innovation activities.

DISCUSSION

Our research makes three fundamental contributions. First, we show how occupational identity serves as an interpretive lens for new technologies and how these interpretations shape both adoption decisions and ongoing interactions with technology. Second, we introduce the concept of a "paradox of expertise," elaborating upon the ways in which an occupation's mastery of a task may lead it, ironically, to dismiss innovation opportunities related to that task. Finally, we demonstrate how an emergent technology can influence changes in occupational identity, and we elaborate upon the consequences of this relationship for both the occupational identity literature and the broader literature on occupations and professions. We discuss each of these contributions below.

Occupational Identity as a Lens on Technology

Our research builds on studies that illustrate how participants may draw on their occupational identity as they interpret new technologies (Gopal & Prasad, 2000; Orlikowski & Gash, 1994; Prasad, 1993; Prasad & Prasad, 1994). Thus, we demonstrate how librarians' interpretation of what Internet search "was" and "did" drew upon their sense of "who *they* were" and "what *they* did." As a first cut, therefore, we add to a growing corpus of work on the social construction of technology and, spe-

cifically, on how occupational identity and technology interpretation interact.

We depart from the prior literature, however, in two ways. First, we link technology interpretation to technology adoption. Studies of occupational identity and technology interpretation typically investigate situations in which the people "interpreting" are not the people who chose to introduce the technology into the setting. For example, in Bailey et al.'s (2012) study of automobile engineers and simulation technology, and in Orlikowski and Gash's (1994) study of Lotus Notes technology, managers in each organization introduced the technological change, while the study authors focus their attention on how the workers responded. Barley (1986) does not explicitly state who made the decision to acquire the CT scanners that he studied, though he does note that the radiologists did not know about them until their arrival—implying that hospital administrators made the decision. Edmondson et al. (2001) write that different groups, including administrators and surgeons, were responsible for the introduction of minimally invasive surgical techniques into the teams that they studied; aside from the surgeons—and even then, in only some cases—the teams apparently did not have a say. In these studies, therefore, the occupation members whom scholars investigate lack agency with respect to the adoption decision. In our study, by contrast, librarians' interpretation of Internet search preceded and shaped their adoption of this technology. By linking together interpretation and adoption, our findings thus bridge the literatures on occupational identity (e.g., Ashcraft, 2013; Ashforth & Kreiner, 1999; Leavitt et al., 2012; Pratt et al., 2006) and on technology diffusion (e.g., Geroski, 2000; Rogers, 2003; Rosenberg, 1986) by demonstrating that an important influence on diffusion may lie in the way in which occupational identity shapes a group's interpretation of a new technology.

Second, we depart from the prior literature by moving beyond an occupation's initial interactions with a technology to show how occupation members continually interpret the technology and how these interpretations change with use. Leonardi and Barley (2010) claim that one shortcoming of "interpretive" studies of technology is that they look at what happens when a new technology is first introduced, but not at what happens later. As they write (Leonardi & Barley, 2010: 15):

Researchers in this [e.g., the interpretive] tradition have largely ignored the role of situated action and interaction. People certainly draw on the familiar to make sense of the new. Yet, some of their understanding of a new technology must inevitably emerge as they encounter its constraints and affordances in the here and now. Conceivably, studies in this camp have glossed over emerging meanings because they focus only on an early stage of use. One would expect meanings to change as people become more familiar with a technology. Understanding the processes by which interpretations arise over time in the course of everyday action is crucial for developing a more complete view of how technologies are socially constructed. Charting such changes would require researchers in the interpretive camp to collect longitudinal in addition to cross-sectional or comparative data.

We respond to Leonardi and Barley's challenge by demonstrating how interpretation shapes use and how use shapes subsequent interpretations. (The mirrored vertical arrows in our model in Figure 4 indicate this discursive relationship.) In turn, we show how initial interpretations can be very different from later ones. In our case, for example, librarians moved from describing and largely dismissing Internet search to differentiating from it, to engaging with it, to leveraging it into new tasks, roles, and, ultimately, identities. Had we limited our study to the initial engagement only, we would have missed these other interpretations.

Tracing these changes in interpretation over time also highlights other influences on the interpretive lens. First, we show how librarians' own contributions to the technology (in later periods) shaped their subsequent interpretations of it. Van Maanen and Barley (1984: 344) write, "Perhaps the best indicator of a community's response to innovation is whether or not the innovation comes from within the community and whether or not it will remain under the community's control." We both verify and refine this insight. As librarians generated innovations in later periods, we certainly find that they were enthusiastic about Internet innovations coming from their own ranks. We also show how they viewed innovation by members of their own occupation as a way to imprint or influence a technology from outside their occupation.

We did not find any evidence, however, that librarians resisted Internet search because it came from the outside. Indeed, librarians have embraced other technologies with origins outside of their occupation, including the printing press, microfilm, and trucks (which they repurposed as "bookmo-biles" or mobile libraries). Instead, librarians' early challenge with Internet search was that it performed a similar role to librarians but in a way that did not match their understanding of the appropriate conduct of that role. Arguably, of course, technologies that come from outside of an occupation may be more likely to approach a role in a different way than technologies that come from members of the occupation. Nonetheless, our findings suggest that the internal or external origin of a technology may matter less than its apparent consistency or inconsistency with an occupation's approach to and understanding of its role.

Second, and related to this point, we acknowledge how technologies are situated in a broader social context, even as members of specific occupations interact with them. In our case, Internet search was growing by leaps and bounds, largely independent of how librarians chose to interpret it (see Figure 1). In turn, this growing diffusion of Internet search through the general population—and the concurrent improvements in the technology—served to influence librarians' changing interpretations. Thus, our data suggest that part of an occupation's response to a technology undoubtedly is shaped by the macro context outside of that occupation.

By highlighting both the occupation-level interpretation of Internet search and the broader social trends connected to this technology, our work responds to a call in the literature to consider multiple levels of analysis in studies of occupations and technology. Leonardi and Barley (2010: 35) argue that most studies either focus on the micro, which misses the societal power of technology, or focus on the macro, which denies individual agency. Bechky (2003: 722) also points to a need to consider how "macrosociological processes influence jurisdictional outcomes [even as] the task boundary is further specified through occupational interactions at the point at which the work takes place." By blending individual agency, evident in how librarians interpret search, with the broader patterns of change in Internet search technology, our study represents an initial step towards integrating these levels of analysis.

Paradox of Expertise

Our work also highlights how these interactions may give rise to a "paradox of expertise." Expertise in an area of work is usually a benefit to an occupation. Depth of expertise is the basis of claims of

professional jurisdiction (Abbott, 1988) and experts are given the responsibility for defining the meaning of those areas within their jurisdiction (Freidson, 1970; Hughes, 1958). These definitions limit what is and is not a correct approach to an area of work (e.g., "searching is finding the single correct answer") and create boundaries of legitimacy for practices in this area, which can be policed to retain jurisdiction (Abbott, 1988).

Because this expertise is the basis of the occupation's existence and function, it is part of their identity: both "what we do" (e.g., information searches) and "who we are" (e.g., experts in searching). Approaches to this work that do not align with occupation members' expert opinion of what the work is will naturally lead occupation members to dismiss these approaches. After all, these occupation members are the experts and, therefore, *know* which approaches are acceptable and useful. Therefore, when new technologies are misaligned with occupation members' expert understanding of the area of work, occupations can fall into the paradox of expertise. As previously stated, the paradox of expertise occurs when a group has existing mastery of a function with close ties to their occupational identity that limits their ability to recognize the value of a technology that attempts to mimic, alter, or improve that function in ways that do not match the group's current understanding.

Our identification of the paradox of expertise adds to the repertoire of explanations for why incumbent groups may not pursue a new technology. One such explanation holds that insiders do not engage in innovation because they do not want to cannibalize their existing business and because they do not have capabilities in the new area (Christensen, 2000; Henderson, 2006; O'Reilly & Tushman, 2011). Most often, this view informs our understanding of strategic decisions made by firms. Our analysis of librarians, however, did not highlight such considerations. Librarians' decisions were not driven by fears about losing existing patrons (the analog to a firm "cannibalizing existing business"), but, rather, by the belief that Internet search was not the best way to help patrons. Moreover, librarians had the technical capabilities to develop search engines: librarians across the United States had been working with databases, programming their own database management software, building online catalogs, and running local area networks since the 1960s (Bobinski, 2007). In other words, competitive considerations and capabilities are not the primary explanation in our case.

Another explanation for the failure to pursue a new technology is more cognitively focused and suggests that some potential innovators do not actually recognize certain innovation possibilities (Baron & Ensley, 2006; Shane & Venkataraman, 2000). One reason for this lack of opportunity recognition can be the application of a different "technological frame" or way of interpreting a technology's possibility (Bijker, 1997; Orlikowski & Gash, 1994). Research in this tradition focuses, therefore, on how individual cognitive processes (Baron & Ensley, 2006; Shane & Venkataraman, 2000; Tripsas & Gavetti, 2000) or organizational identities (O'Connor & Rice, 2001; Tripsas, 2009) can interfere with the initial identification of opportunities. Our research shows that occupational identity can be another frame through which potential innovators assess innovation possibilities. In fact, our study highlights how an occupational identity can lead individuals to dismiss the promise of an opportunity that they fully recognize because, ironically, their mastery of the existing approach encourages them to devalue solutions that do not match this approach. Thus, librarians' conceptualization that searches should provide "one best answer" led them to evaluate Internet searching against this criteria, and, in turn, to discount Internet search as a niche technology that did not warrant significant attention. Our case, therefore, highlights how the paradox of expertise can be another explanation for why some insiders do not innovate.

Our results suggest that the paradox of expertise is apt to arise under three conditions. First, the paradox of expertise is likely to arise when the task performed by a technology overlaps with a task that is closely tied to an occupation's identity. Existing work has documented overlap between technologies themselves (e.g., Alcácer & Gittelman, 2006; Oxley & Sampson, 2004) or between the tasks that two different occupations may both perform (e.g., Abbott, 1988; Bechky, 2011; Begun & Lippincott, 1987; Collinson, 2004, 2006). With the paradox of expertise, however, we are concerned with cases in which technology and occupation overlap. Such overlap may not be problematic when the task in question is not closely tied to an occupation's identity. In the case of librarians, for example, the printing press made more books available; microfilm enabled access to more books and the storage of more information; and transportation advances allowed librarians to bring books to the people. In each of these cases, however, the task performed by the technology did not overlap with a task at the

heart of librarians' identities ("what we do"). Thus, books and microfilm provided information, but did not find it; bookmobiles brought materials to patrons, but did not help them locate the materials they needed. In fact, librarians could use these other technologies to *extend* their roles. By contrast, Internet search engines overlapped with what librarians fundamentally *did*. Thus, a paradox of expertise might be expected when a technology threatens to *replace* rather than *extend* a task that is closely tied to an occupation's identity.

Second, the paradox of expertise is apt to arise when the technology performs such a task in a manner that is inconsistent with occupation members' understanding of how that task *should* be performed or what the outcome of that task *should* be. Search engines, for example, retrieved *every* result, whereas librarians believed that searches should retrieve the *correct* result. This difference in the approach to searching and in the interpretation of what constituted a successful search made it difficult for librarians to initially recognize the value of search engines. Microfilm, by contrast, did not create the same problem because it matched librarians' approach to storage: storing everything, even if doing so requires special equipment, is better than losing access. Thus, an occupational group might be expected to miss or dismiss an innovation opportunity with a new technology when the technology performs a task using a method or yielding a result that does not accord with that group's understanding.

Finally, our results suggest that the paradox of expertise is apt to arise when an occupational group has a strong and stable identity. Here, there is an irony in the librarian account. Several scholars (Abbott, 1988; Bechky, 2011; Freidson, 1970; Hughes, 1984) argue that professionalization is, in part, a process of identity modification; as an occupation professionalizes, it works to refine and strengthen its identity. Librarians expended considerable effort on professionalization, founding a professional association (the ALA) and a professional journal (*Library Journal*) in 1876 (Ditzion, 1947; Garrison, 1979; Martin, 1998). In the 1920s, they created a Board of Education for Librarianship and established training programs at the graduate (Master's and PhD) level (Jackson, 1974; Martin, 1998). In other words, librarians actively established the hallmarks of a profession: standardized systems of instruction and training, a professional association with a governing board, and rules for how they would conduct their work (such as cata-

loging according to the Anglo-American Cataloging Rules). Professions, however, encourage comparing inside the professional boundary and contrasting or differentiating across the boundary (Abbott, 1988). Members of a profession also are likely to overestimate their profession's worth (Blau, 1957). Thus, librarians' efforts to establish a strong professional identity may have exacerbated their early dismissal of a technology that undermined this identity. Ironically then, librarians' very efforts at increasing their professional standing may have made them more susceptible to a paradox of expertise. More generally, we might expect that other highly professionalized occupations will be particularly susceptible to a paradox of expertise.

Our identification of this paradox of expertise raises natural questions regarding how members of an occupation might work to overcome this liability. Although we can only speculate, two possibilities are intriguing. First, occupations that experience the frequent infusion of new workers may be better positioned to recognize the value of outside innovations. Several studies highlight how young workers are more likely to adopt new technologies in the workplace (Canton, De Groot, & Nahuis, 2002; Caselli, 1999; Weinberg, 2004). It is possible that newness to an occupation may enable these young workers to value innovations that are not associated with the occupation. In turn, occupations can work to refresh their ranks regularly.

A second moderating factor on the paradox of expertise may be an occupation's history of identity shifts. When the Internet emerged in the 1980s and 1990s, librarianship had not experienced an identity shift in many decades—perhaps since the rapid growth of U.S. public libraries in the middle of the nineteenth century (Ditzion, 1947). It is possible that occupations that confront identity crises more frequently may be better equipped to respond proactively. An example of this may be seen in Prasad and Prasad's (1994) study of the computerization of a health maintenance organization, in which nurses and physician assistants (who noted their continual struggle for recognition of their professional identity) supported adoption of a computer system as a signal of professional status, while doctors (whose professional identity was unquestioned) were less enthusiastic.

An interesting implication of these moderators, if true, is that the fluidity of occupational identity is an opportunity and not a liability. Thus, frequent threats that force frequent occupational identity

shifts may hold the silver lining of better equipping an occupation to avoid the paradox of expertise.

Technology as a Shaper of Occupational Identity

Finally, our work demonstrates not only how occupational identity shapes interpretations of new technologies and innovation activities around them, but also how technology can reshape occupational identity. Building on the idea that occupational identity is a relational term, the occupational identity literature has focused largely on contrasts in "who we are"—that is, between one occupation and another (e.g., Bechky, 2011; Leavitt et al., 2012); between occupational and individual identity (e.g., Ashforth & Kreiner, 1999; Kirkham & Loft, 1993; Kreiner et al., 2006); and between occupational and organizational identity (e.g., Ahrens & Chapman, 2000; Anteby, 2008; Covaleski, Dirsmith, Heian, & Samuel, 1998; Fine, 1992).

Our study focuses attention, especially, on "what we do"—the other intertwined component of occupational identity. In so doing, we show that technology, too, can serve as a "foil" (Ashforth, Rogers, & Corley, 2011; Ashforth & Johnson, 2001) against which occupational identity is defined and redefined. Specifically, when a technology "does" a very similar thing as an occupation, it can encourage members of that occupation to refine their occupational identity.

In fact, pushing the role of a new technology as an identity foil one step further, our case suggests that members of an occupation can construct their roles in relation to the tasks that technology enables *non-occupation members* to do. For example, Internet search technologies led librarians to define themselves in contrast to patrons, rather than in contrast to another occupation. Parsons (1939) emphasized that professions can be built upon a contrast in technical competence between members of the profession and the rest of society. He writes, "[P]rofessional authority has a peculiar sociological structure . . . based on the superior 'technical competence' of the professional man [sic]. . . . professional authority is limited to a particular technically defined sphere" (Parsons, 1939: 460). Thus, by extending "technical competence" to the general public, new technologies can serve to undermine the raisons d'être of a profession in the first place. Our study, therefore, recasts occupational identity as a question of the relationship between an occupation and the general public, thus contrasting with the literature's emphasis on comparisons between occupations and organizations or between occupations and other occupations. In turn, this perspective suggests that new technologies that extend the tasks and abilities of members of the general public may present occupational identity challenges across a wide swath of fields, including doctors in an era of Internet self-diagnosis; lawyers in an era of online contract templates; recording studio engineers in an era of at-home music software; and travel agents in an era of online booking (Metzger, 2012).

At the same time, we show that occupational identity may be defined not only in terms of contrasts, as the existing literature emphasizes, but also by appropriation. Librarians, for example, not only defined themselves *against* or in contrast to Internet search, but also (later) drew upon and *appropriated* Internet search to underlie their revised occupational identity. (Similarly, the nurses of Prasad & Prasad's (1994) investigation leveraged new computing technology to enhance their occupational status.) In our study, in fact, we show the use of contrast *against* technology versus appropriation *of* technology may change over time, as in the shift that we document from a "differentiation" response to a "leveraging" response. Although our data do not speak directly to this point, our case suggests that an occupation may choose to differentiate its occupational identity from a technology when the technology in question is still emerging and when its ultimate diffusion or success remains unclear. Conversely, an occupation may choose to appropriate features of technology in service of an occupational identity when the technology in question is associated with particular resources, prestige, or momentum that may be beneficial to the occupation. To this point, it is worth noting that "differentiation" was the dominant response in our data when less than half the U.S. population used the Internet. By contrast, "leveraging" was the dominant response as the majority of the U.S. population used it (see Figures 1 and 2).

These findings on the relationship between technological change and occupational identity also have implications for the literature that explores differences between occupations and professions (e.g., Abbott, 1988; Etzioni, 1969; Freidson, 1970; Hughes, 1984). Historically, much of this work on focused on the distinction between professions, semi-professions, and non-professions, and upon processes of professionalization. Scholars have paid less attention, however, to the role that technology can play in these processes, particularly

through its influence on identity. Technology can challenge a profession, as we demonstrate, and may in fact underlie processes of "de-professionalization" (Haug, 1973; Posner, 1993; Ritzer & Walczak, 1988; Toren, 1975). In turn, examination of how technology may induce de-professionalization may lead to new emphases and new insights in the literature on professions by focusing investigations on the work itself. Abbott (1998), for example, has called for work on occupations to move beyond an emphasis on categorization into professions, semi-professions and non-professions and instead to investigate the work that members of an occupation actually do. He writes:

> The professions all exist on one level. To be sure, occupations often create examinations, licensing, associations, and ethics codes. But all the licensing in the world does not protect an occupation when new knowledge transforms the nature of its work, when other occupations take parts of its work away, when the capital requirements of its work gradually force it to be organized in different ways. What really matters about an occupation . . . is its relation to the work that it does.

Abbott (1998: 432) continues by encouraging scholars to "stop thinking about an occupation's structure and start thinking about the work that it does." (In fact, he uses librarians as an example of an important occupation, regardless of their standing as a "profession" or "semi-profession.") Van Maanen and Barley (1984: 318) reach a similar conclusion, writing, "[T]he professions are not to be considered as a class apart from other occupations."

Our research builds upon these insights, encouraging exploration of an occupation by examining the relationship between technological change and the work that members of the occupation do—and by emphasizing how occupational identity serves to bind "what we do" with "who we are." By taking this approach, we show how the movement between occupation and profession may be conditioned by that occupation's relationship with an emerging technology. In turn, the re-creation of occupational identity is one process through which technology can both challenge and reinforce, extend, or establish professionalization.

Boundary Conditions and Future Research

Because our model is tied to our investigation of librarians and Internet search, some consideration of its transferability is appropriate. First, we focus on a case in which the technology itself—Internet search—expanded its reach and influence enormously. This pattern may have influenced librarians' approaches and may underlie their ultimate success around narrowly focused innovations. It is possible that a more focused technology—or, perhaps, a more dominant occupation—may be associated with different kinds of relationships. Nonetheless, these other relationships would likely still reflect processes that we uncovered, including the interpretation of a technology through the lens of the occupation's identity.

The redefinition of an occupation's identity, however, may depend upon having enough overlap between the activities of an occupation and a technology so as to motivate action and not so much that there is no longer room to maneuver or to redefine: librarians' initial approach—dismissing Internet search as a problematic niche—is representative of the former situation, in that there was not enough overlap between their identity and their interpretations of the technology to facilitate influential interactions. Occupations that have disappeared entirely—such as elevator operators, bowling-pin setters, and street-lamp lighters—may represent the latter situation, in that technology fully consumed them.

Of course, technologies may threaten an occupation without directly threatening its identity. For example, Metzger (2012) describes how travel agents adopted online ticketing readily, seeing it as an opportunity to expand their services rather than recognizing that the technology might eliminate the need for their services. Because travel agents' identity focused on educating clients about destinations and on creating travel packages, and not simply on ticketing, they were unprepared when online ticketing slipped out of their control. In turn, travel agents missed the opportunity to shift their identity since the lack of alignment between their identity and the technology rendered it an "invisible threat" (Metzger, 2012).

Conversely, recognizing the threat to occupational identity is not sufficient in itself to allow an occupation to engage effectively with new technology or to craft a new identity. Numerous service occupations, such as those highlighted above, have been entirely replaced by technologies that members of these occupations recognized as threats. These occupations were unable to craft new roles for themselves, however, and so were fully consumed by the technology.

This recognition highlights two possible requirements for the sort of identity shifting and technology engagement that librarians undertook. First, librarians had the technical skill to engage with and even to shape Internet search technology. By contrast, elevator operators, as one example, had little occupational skill in developing automated elevator control systems. Thus, our observations may be particularly applicable to more highly skilled "knowledge work." Second, neither librarians' domain of practice nor their skills were bound up in a single technology that could be replaced. Instead, librarians had a certain amount of room to maneuver, even as technology encroached upon a task central to their identity.

The limitations inherent in our single case study also point to several opportunities for future research. We find two of these opportunities to be particularly intriguing. First, our study is firmly rooted in information technology and in one of the earliest "information management" occupations (librarianship). Of course, information technology appears to be permeating most every occupation imaginable as society at large shifts to a "computational infrastructure" (Leonardi & Barley, 2010; Yates, 2005; Zuboff, 1988). Nonetheless, it would be informative to explore the dynamics between occupational identity and technological change outside of the information technology context. For example, how might these processes play out with materials technologies, transportation technologies, or biotechnologies?

Second, a major outstanding question concerns multiple identities. We limit our analysis to occupational identity and we present extensive evidence concerning how and why occupational identity matters. At the same time, however, individuals may claim a number of identities simultaneously, as with soldiers who also serve as medical personnel (Leavitt et al., 2012), and identities can be active across a number of levels of analysis, including those of individuals, groups, and organizations (Ashforth et al., 2011; Ramarajan & Reid, 2013; Vough, 2012). It remains an open question with regard to when and how people draw upon each identity across different situations. Thus, it would be fruitful to explore the dynamics between technology change and identity through other identity lenses, and to consider the ways in which different identities interact with one another through the process of engaging with technological change.

Ultimately, our work signals a strong payoff to be realized from such explorations. Given the ubiquity and multiplicity of both occupations and technologies—and the multiple ways in which they may bump up against one another—the intersection between them remains a ripe area in which to explore social behavior more generally.

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