Academic and special libraries are in the midst of a shift toward hybrid collections. This shift from collection ownership to an information access model supports the distributed nature of learning and work. However, unanticipated consequences of these changes are emerging. One confounding result is a visible pattern of discontinuities in collections, with unique features for electronic products. Patterns of discontinuities encountered included the occurrence of intermittent holes and unintentionally masked information. This has both immediate and long-term implications for library users and services, and there are not yet coherent measures to assess these sorts of outcomes. A framework is required for the systematic evaluation of the effects of new systems such as bundled electronic resources. This research suggests that evaluating both use and non-use of electronic collections will supplement other acquisitions and service measures to support long-range planning and decision-making.

Introduction

The development of “hybrid” libraries and increased user-based demands for remote services have created a complicated landscape for collection building and management. Academic and research libraries have been selecting materials based on collection development principles for many years. One such principle is to make choices based on anticipated need (Buckland, 1989). It is no longer possible for libraries to meet all the anticipated needs through ownership (ALA, 1993). As students and faculty increasingly expect and need immediate desktop access to abstracts and full-text, collection developers are dramatically trading off ownership of print materials to pay for licenses to access electronic services. Libraries have turned to interorganizational arrangements, consortia, and licensing to provide access to necessary materials (Manoff, 1997). These changes have decreased the power of subject specialists to enhance collections, and shifted much of the acquisition negotiation from local library control to consortia participation (Billings 1996; Thornton, 2000). The reshaping of library collections and services has altered the “meaning and application of selection criteria for collections” (Hollerman, 2000).

Traditional principles of selection and deselection rely on a causal link between use and need. Current methods for evaluating the use of electronic collections rely upon logs and vendor statistics (Brooks & Dorst, 2002; International Coalition of Library Consortia, 1998; Moyo, 2002). Vendors use this data to make (bundled) collection offerings, and libraries are dependent on vendor data to assess the use of electronic materials. This data tends to only show use, and need must be inferred in a more abstract manner. As academic and research libraries shift from collection ownership toward an information access model, materials management systems are increasingly important for the support of both library services and user needs. Increased reliance on electronic resources bundling will require that systems developers and collections decision-makers have access to data on what their clients are doing with these access-based products, as well as understanding other downstream implications. Scholarly communication research can inform librarians and other information service providers on work practices in research, teaching, and learning. Additional research that tracks the influence of organizational relationships across the publishing-to-information access chain can
illuminates effects brought about by the current range of bundled electronic products.

One specific effect is the occurrence of discontinuities in content, which manifest in intermittent holes in collections and misplaced information. This study draws upon a social informatics perspective to examine the critical outcome of these sorts of discontinuities in electronic collections, and contributes an approach and theoretical perspective from which to examine consequences to scholarly communication. A closer look at the breadth (extent), causes, and consequences of outcomes such as these discontinuities will help libraries provide added value to their patrons using electronic materials. Although the problem of discontinuities in collections is only one of the unplanned outcomes of the shift toward hybrid libraries, it serves here as an example of the complexity of the social impacts of this change.

Here we will illustrate the social implications of these shifts via a snapshot of the publishing-to-access chain for Abstracting and Indexing (A & I) and Full-Text (FT) resources. This chain flows from the publishers, through electronic materials vendors that aggregate content, to the academic and research libraries that provide access. This analysis underscores the dependence upon electronic resource bundling by academic and research libraries and the people that use them.

Social Issues in Electronic Materials Management

In the following review we describe major issues for librarians, faculty, and students affected by electronic materials management. The shift from physical fixed media collections to ephemeral dynamic collections creates new demand on collection developers for resource allocation by their institutions. The resulting reliance upon resource bundlers and consortia arrangements led to loss of collection control by individual libraries, and helped to shift content control from customer to vendor.

The following synopsis is a general overview of a 20-year trend. Please note that there are complicated interconnections between publishers, vendors, libraries and users, and these issues are explored more fully by others (see, for example, Mackie-Mason, Riveros, Bonn, & Lougee, 1999; Odlyzko, 1997).

Choice of Media Becomes Mandate

Based on data from a 1995 study of eight university research libraries, Covi and Kling (1998) characterized materials management as a drift toward supplementing print collections with electronic materials. Since that time, students and faculty increasingly demand and prefer access to electronic sources, electronic delivery systems, and to networked information. Simultaneously, many publishers who provide electronic formats with their print journals do not allow libraries to buy the print alone. Confounding the dilemma between demand and resource constraints, electronic materials license agreements often indicate that the electronic version of a source may not be the same as the print version, which therefore continues as the version of record. For users it is not always clear which version is the version of record, and they may not know how the electronic version differs from the print.

The demand for desktop access to electronic materials in educational institutions pressures libraries to choose electronic materials and services over print sources. Academic and research library materials budgets have increasingly shifted money spent for print journal subscriptions and scholarly monographs to licenses for expensive but critical electronic indexes of abstracts, citations and full-text (Jaguszewski & Probst, 2000). Paradoxically, despite the explosion of electronic information, there is a dearth of comparison data on which to base difficult choices. Librarians rely on electronic mailing lists, conferences, and other forums to make sense of contracts, current license models, and changing content services. Although problematic, some people advocate usage statistics as "an effective means for gauging the value of consortia-provided resources" (Brooks & Dorst, 2002). Brooks and Dorst do note that libraries are able to track which resources are used the most, but there continues to be questions about the value of measurements and the type of statistics that vendors ought to provide (p. 54). This position does not go far enough because there is a critical need for methods of measurement of electronic materials use that will support evaluation in their social context.¹

Materials management arose out of an institutional movement to address economic and social pressures in the early 1990’s (Billings, 1996). Billings compared the movement toward materials management to the expansion of managed care in the health sector. As in health care, it had been difficult to predict the range of consequences on library systems and users. Today, libraries have lost some of their independence with regard to collections because the goal of libraries to own large and/or unique collections has been replaced by the need to provide extensive “anytime, anywhere” access. Another major problem for libraries is the lack of integrated tools to connect acquisition functions, materials management, and user needs. A third problem concerns libraries that are considering outsourcing records management of their electronic resources, which are rapidly increasing in number, and frequently change in composition. Even if these projects provide current information for collections and acquisitions, how can these external systems provide for interdepartmental (e.g., interlibrary loan) and user needs? The development of a theoretical framework to support measurement and evaluation of the use of electronic

¹ The newly “ratified” COUNTER initiative brings some standardization to electronic materials use measures (http://www.projectcounter.org/index.html). However, the set of variables included are limited to the same kinds of materials access counts that have been previously available by many vendors, which do not address the sorts of questions raised in this article.
collections has not kept pace with their rising priority and proportion in collections.

**Market Consolidation Leads to Product Bundling**

The expansion of computer networks and the shift toward electronic communication encouraged publishers and entrepreneurs to explore electronic product development. Use of the networks as a content delivery platform grew, accelerating with the exponential rise of Internet use. Shifts in scholarly communication and the annual increase in the amount of published information made way for a whole new market on the World Wide Web. Many have documented the recent bundling, licensing, and remote access trends in the scholarly publishing business, e.g., Tenopir and King (1998) and Mackie-Mason and Riveros (1997); it is likely that there will be additional changes to the current model. As it exists now, electronic resource publishing is a multi-layered system, often with confusing overlap across corporate entities. Publishers may vend their own journals and databases, or sell them through third-party vendors. Some of these third-party vendors are also aggregators that provide multiple sources of licensed content through an integrated, searchable Web interface.

In the information market, the aggregation model provides a method of economic efficiency. Bakos and Brynjolfsson (2000) explain that aggregation, “can make it easier for the seller to extract value from the given set of goods by enabling a form of price discrimination” (p.116). That is, the materials in a given set of resources will have different values for different consumers, and by creating sets of differently valued materials, sellers can set a price that still allows profit. Aggregators will bundle low-value materials with the high value (often “core”) materials, which allows a spreading of cost across subscribers. While this model works to recover cost for the publisher, it raises an immediate problem for customers, who are forced to pay for low-value journals and may have to purchase individual journals or resources which are not part of, or were dropped from a bundle (Bakos & Brynjolfsson, 2000).

Publishers and aggregators, susceptible to competitive market mechanisms and innovative technology developments, make business decisions that are at odds with the social structure of libraries. Events in the publishing industry that supply the materials in academic and research libraries have a direct effect on their access and availability. For users, one result is that electronic resources often lack the complete content of original sources (Metz, 2000). Publishers often decide to stop including or leasing out a particular journal, either to limit access in the market, or to take over the electronic offering themselves. For vendors, business problems include disruptive technologies (Cristensen, 1997), competition from alternative “information providers,” and lack of control over momentary changes made to the content offerings by publishers. Vendors providing aggregator services often seem to have no control in their agreements with the publishers, and although many of them have some subscriber notification system in place, this can leave holes in library collections. For libraries, reliance on aggregators means that they are limited in what sources they can license, as publishers ultimately control the content of bundled journals and other electronic resource packages. A dramatic example can be seen in movement toward “exclusivity deals,” such as the arrangement made between the Harvard Business Review and one vendor, which acquired the sole rights to offer electronic access to the journal (Bell, 2001; Krumenaker, 2001). Finally, because of the system of remote access for these resources, libraries depend upon these vendors for usage statistics (Shim, 2000).

There are favorable consumer arguments for electronic resource bundling and aggregated products, such as the ease of searching for materials through a single interface and options for using disaggregated content such as tables or figures. It is evident, however, that when information “goes missing” due to the current approaches to electronic resources bundling, there are implications for all levels of academic research. The breadth of this problem grows when other use/non-use dynamics are considered. The downstream effects for just-in-time searches or for responding to student learning needs may be magnified, particularly when faculty users are not proficient in negotiating electronic resources or are disinclined to seek answers to difficult questions about the accuracy of electronic resources. Faculty members need to know how to use these tools, and where to find the materials they use regularly; this requires that the libraries know what they use. Faculty must bear some responsibility in this, and communicate their needs to the library.

**Collection Use and Assessment Become Invisible**

There are many models to conceptualize collections for collection development decisions even though there are rapid changes in resources and content of academic and research library collections (Lee, 2000). However, when purchasing electronic materials from resource bundlers is the only realistic option, libraries must be able to anticipate how dependence on access through these vendors will influence the information behavior of people who use their services. In this article we discuss and advocate a social informatics perspective to guide analysis of use/non-use problems to inform the initial decisions for negotiating with resource bundlers, guide the design of interfaces and selection of access points to electronic collections, and maintain services to ensure that faculty and students can utilize the materials.

Lee (2000) proposes a definition for “collection” that takes into account the expanding resources managed by libraries and information centers. This definition incorporates a group of information resources, a defined user community, a collection development policy statement, and an integrated retrieval system. Lee adds that layers of control (ownership, lease, interlibrary loan, referral to another collection, and no availability) and accessibility (immediate
access, waiting/delayed access, and no access at all) pervade the collection. Because control and accessibility are both invisible and interdependent, users may not perceive holdings as collections. Furthermore, because “holdings” may actually belong to another sharing institution, users may expect full use privileges to materials that are not part of their (locally) accessible collection. The library thus becomes the “wizard behind the curtain” who works hard to maintain the illusion of immediate accessibility through a complex system of technical arrangements, content provision, consortia negotiation, and reference services.

However, Lee assumes in this definition that interactions with library systems primarily concern locating a known item. This is problematic, in light of our knowledge that users often come to information systems without an explicitly “known” need. If users without known needs require fully informed access to electronic resources, it is imperative that use be evaluated along with non-use. Librarians must assess the combination of behaviors to understand how electronic resources are understood and used—particularly to identify what is lost or missed.

**Librarians Must Work Harder to Make Access “Easy”**

Pervasive connectivity on campus and in the workplace has fortified user expectations for “24/7” access, from any location (National Academy of Sciences, 2002). Adding to the burden of competitive challenges in the higher education marketplace, this stimulates university demands on the library to provide these services. University libraries, though, have been caught in a bind of rising journal prices and a stream of new electronic products from which to choose—in a decade that saw acquisitions budgets flatten and even decline (Miller, 2000). These conflicting pressures compelled libraries to forge new alliances and participate in alternative publishing models. Libraries have joined consortia, groups of libraries that affiliate to share their resources, bargain together, and spread the cost of content. Consortia negotiate with publishers, other content vendors, and aggregating services for the individual libraries. Depending upon the negotiating model, individual libraries will have more or less say about the agreements that are inked. Libraries also participate in publishing programs such as Association of Research Library’s Scholarly Publishing and Academic Resources Coalition (SPARC) initiative, which supports the development of new and low cost journals. A recent side effect is the involvement of provosts and other senior academic administrators in scholarly publishing. Many provosts have become key players in creating alternative publishing options for faculty, and in negotiations between university libraries, consortia and major commercial publishers (Case, 2002).

Automation of library systems has altered service delivery in a number of ways, including reduction of material processing time and improved interlibrary delivery. Library users experience this as better service because the time required to access materials is reduced, and there is now electronic access to materials not previously available. However, the move toward the licensing-based access model has raised problems for the administration of library services. The processes of tracking changes in electronic materials and administering consortia agreements and stand-alone licenses are having a tremendous impact on the ability of library service units to “keep up” with the expected level of service demands. Reference librarians and interlibrary loan staff are of primary importance in the system, and to provide services to the university community, they need to know about the holes in collections, interface changes, and permitted distribution (i.e., access arrangements for different clients). Library administrators need to know how the changes in materials access affect not only the present library function and services but the role of the library in the work of universities in educating the next generations of information workers, scientists, scholars, and leaders. The academic library, as the center of recorded knowledge, has the key role in preserving the university’s capacity to provide the intellectual growth of the nation.

Reliance upon electronic resources has caused significant changes in collection development practices and purchasing processes. Historically, librarians used electronic databases when a patron arrived with an information request; the librarian searched the system, and returned the results to the user. Resource allocation for electronic materials has shifted from serials and department budget lines to the collection development budget (Thompson, Wilder, & Button, 2000). And, the electronic publishing marketplace is helping to drive the shift from ownership toward the information access model. This has been a period of constant change—publishers merging, aggregators developing products of bundled information goods, not-for-profit groups launching their own journals. These types of changes often mean that products change; bundles of information goods are reorganized. Customers have little say when this happens.

**Case Study: Exposing Intermittent Holes and Unintentionally Masked Information**

The academic community has enthusiastically embraced the value of accessible networked electronic resources. Libraries have adapted to demands for electronic materials and provide expensive resources with their flat or decreasing budgets (Miller, 2000). For members of academic communities, remote access to large collections of information catalyzes change for user interaction with the library. Users have come to value the convenience it offers, and are dependent upon access to electronic resources from homes and offices. The dependence of academics upon access to electronic materials increases the likelihood that they encounter discontinuous collections. It is a significant concern that discontinuities may not even be visible to librarians or users. For example, the convenience of electronic access often is accompanied by invisible differences from the published version of record. Intermittent holes and masked information demonstrate how decision-making for provi-
sion and arrangements of electronic resources influence scholarly communication.

Social issues arising from electronic materials management include long-term implications such as reduction in intellectual access, exacerbation of access problems attributed to non-use, and reduction in the library’s ability to assess and evaluate clients’ usage. These problems impact bodies of knowledge as the electronic materials authors depend upon become more inaccessible, especially to non-specialists. Institutional collections may have some or all of these issues, but every collection is vulnerable to intermittent holes and other discontinuities that result from the relationships between the system service providers. The analysis of intermittent holes and misplaced information will demonstrate how decision-making for provision and arrangements of electronic resources influence scholarly communication. It will also demonstrate how the loss of control over electronic collections could also mean a loss of information to guide decision-making and licensing negotiations. Therefore, the lack of conceptual framework to measure and evaluate the use of electronic resources poses a problem for collection developers. Because materials management issues affect the long-term ability of universities to ably provide for their unique educational and research agendas (Packer, 2001), we conclude with some insights for addressing these issues.

The following examples illustrate visible and invisible discontinuities and an introduction for why they occur. Explanations for the occurrence of discontinuities are explored more fully in the Discussion section.

Example 1: Intermittent Holes

One pernicious effect of the shift towards reliance upon electronic materials is the rise of intermittent holes in collections. Intermittent holes are breaks in the sequential continuity of scholarly publication. For a particular source, they occur when a library or online service provides only part of the total content published in that journal. Like a print journal subscription that was dropped for a few years and continued, the articles missing from the collection form a “hole.” Holes in electronic collections can occur for a variety of reasons. A bundled journal (or certain volumes) may disappear because a publisher may decide to sell electronic access to its journals itself, or exclusively through a single alternate bundler, and thus pull it from a current electronic product (Krumenaker, 2001). Tables, figures, full text, certain electronic formats, or whole articles may disappear or never appear in the electronic copy even though other parts of a journal issue are accessible (Metz, 2000). This may occur when license agreements change or limit the kinds of materials available in a particular resource bundle. Holes can also occur when the information supply chain has not eliminated technical error (misspelling, digitization problems, or software bugs). Holes in electronic collections can occur in sources published in both electronic and print forms. When libraries choose to purchase or make available electronic format based on user demand or cost and space considerations, they risk disruptions in the day-to-day availability of electronic holdings. Intermittent holes are gaps in the electronic collection; they may be invisible when users do not realize that the content exists, but either it never was or is no longer contained in the resource.

Example 2: Unintentionally Masked Information

Masked information is electronic content that is available in an electronic resource, but not readily accessible through the user interface or metadata. Though perceived as a hole in the collection, the item simply may not be accessible due to difficulties with interface use, typographical errors, or screening. Masked information is analogous to a book that the library owns but has been shelved incorrectly or a book whose title and author has been misspelled by a cataloger and thus does not show up on a search of the catalog. This masked effect can occur when interface features such as location of checkboxes and buttons or putting “advanced search features” on another screen make it difficult for users to locate electronic materials that are actually available. Compounding this problem is the difficulty many libraries have in keeping documentation up to date about the features and contents of each product. Information masking also occurs when there are interface changes in representations of the electronic material. As publishers upgrade their electronic products to appear more visually appealing or to simplify modes of access, they may obscure cues to indicate what content is available in what form. When providers repackage bundles of electronic materials and add new journal content, users may have difficulty finding the most recent volume or issue—some portals list articles in “Table of Contents form,” without adding distinguishing bibliographic data. When providers remove content without adequate notice, users will encounter difficulties in decision-making about a resource. Masked information can have rippling effects on knowledge production and the value information seekers find in particular sources.

The lack of complete and accurate metadata can also cause electronic services to “misplace” information. If searchable fields do not exist to identify electronic materials, some content may be screened, leading a user to assume that the material does not exist. When electronic materials exist in a source, but are not readily accessible because of system factors, that resource functionally conceals the value of the content for the user. Features such as ready indicators of scope or authority help users to decide when or how to use the product. When those features are not available, the resource also masks the value for the user. If scope or authority features are not available, a user may bypass a needed material in the product simply because it lacks an indication of value.

In the following sections, we present data on a multidisciplinary sample of electronic materials to show the extent and nature of intermittent holes and unintentional masking.
A discussion follows the presentation of data exploring underlying causes and responses to this phenomenon.

Method

Social informatics allows examination of electronic resources, such as e-books and online databases of scholarly publications, from an organizational perspective that takes into account the social processes that influence production of the sources as well as the ways the sources appear and are used (Kling, 2000). This approach is also known as a sociotechnical perspective in the research area of social analysis of technology. From a social perspective, publishers, resource bundlers, and libraries act to create products, license, and deliver online materials. Often, researchers and practitioners who develop principles of system design, information architecture, and various retrieval procedures build technological systems that embody their professional perspectives and perception of user requirements (Bowker & Star, 1999). From a technical perspective examination of these indexes reveals the comprehensiveness, variety, and formats of electronic materials. It also examines the ways electronic materials can be retrieved, presented, and utilized in a variety of interfaces. This sociotechnical perspective relates the system and user considerations reflexively: examining how the electronic resource shapes human information behavior and how human information behavior shapes the electronic resource.

To determine the extent (breadth) and causes of the discontinuities in electronic collections, we reviewed several electronic resources that offer A & I or FT services with a searchable Web interface. A crossdisciplinary comparison provided a strategy to control for disciplinary factors that might affect collection development, such as cost of products and norms influencing willingness to provide full text. The investigation included indexing databases of three disciplines: Business, Library and Information Science, and Communication. Data was collected in the fall of 2000 from publisher and vendor Web sites, or from product and “help” information available through the electronic search interface maintained by aggregators; information was also drawn from subject guides available on a research library’s Web site. This examination included searching for lists of included journals, establishing dates of coverage, availability of full-text, and frequency of available updates. To analyze this data, we compared electronic versions of the eight primary A & I and FT databases, and we were able to identify key features and lack of information in documentation. Data from this purposive sample of databases was arranged in several content-analytic summary tables to identify key dimensions of electronic collections (Miles & Huberman, 1994). Comparisons include each database (case), groupings of databases (by discipline), and key availability dimensions.

These databases provided a basis of comparison for looking at the changeability of this type of product, as well as examples and analysis of the problems that appear to be prevalent in bundled electronic resources. To examine consequences of these discontinuities and propose avenues to address them, we analyzed the agent roles in the publishing-to-access chain. By identifying events that lead to discontinuities we could develop a matrix to describe them and how they may (or may not) appear to users. Primary data for this study was gathered from vendor Web sites and product information materials, but also included are informal interviews with an acquisitions administrator, three subject specialists, and a reference librarian at two large research universities. Considered against components of current collection development decision-making systems, these semi-structured interviews provided both context and examples of discontinuities, internal library decisions, and their perceived and real consequences.

Findings

The availability of accurate and comprehensive information about A & I and FT resources was inconsistent. This is problematic because the features of a database are important to user decision-making about the use of these tools; information about these features needs to be readily visible. Currency, coverage, scope, selectivity, and authority are prominent features that inform users as to the possibility of retrieving relevant documents. These features, with the addition of overlap, inform librarians and information specialists in their decisions about acquisitions and reference services. It was quickly evident that there are limited, non-standardized systems for libraries to gather and synthesize the most current and relevant information about the bundled electronic resources. The comparison of electronic resources in these three disciplines illustrates the breadth and complexity of factors influencing availability of information about A & I and FT services. Information about these resources was generally difficult to locate and often incomplete.

In assessing the information that was available through the A & I and FT services about the content and coverage of their journal holdings, it was strikingly apparent that feature information was not consistently available. This was true across vendors within disciplines, as well as between disciplines. The two leading indexes in the Communication field, for example, provided the most comprehensive feature information on their Web site. However, only one of the three resources in LIS offered a comparable amount of data, and the Business resources provided only minimal details about the contents of their electronic bundles. The business indexes are very large, and because they include a mix of trade and professional material, it was conspicuously difficult to ascertain the level of authority of many individual content items without prior knowledge. This difficulty can be compounded by the fact that, even when an aggregator or vendor provides a filter for “peer review” during the search process, users have no way of knowing who made the designation, resulting in discrepancy about the meaning of
this term.2 The Ulrich Periodical Directory (http://www.ulrichsweb.com/ulrichsweb/), now widely available with a searchable Web interface, continues to be a primary resource used to find this information in many university libraries. This is a helpful resource for users who are made aware of this service, to look up a specific journal or browse by subject area. However, Ulrich’s is not always an adequate solution when students or other researchers are not looking for a known source, and, this service lumps all types of peer-review, giving journals a designation of “refereed.” Library users need metadata, or feature information, that will support their decision-making as to whether to use an electronic resource, and then how that system might best be manipulated to return pertinent sources.

In the Communications field, ComIndex and ComAbstracts are the main electronic resources. In comparison to the Business and LIS A & I resources, the online information about the Communication A & I services was the most comprehensive. Journal titles and descriptions of database scope were readily available, as were the dates of coverage for the journals listed in ComIndex. There was no clear indication of which journals are peer-reviewed. In addition, neither the scope nor the product overview gave any indication of how many journals were commonly considered “core” to the discipline, scholarly, or otherwise subject to some form of peer-review. Although one librarian subject specialist offered qualitative information about the contextual differences between the content of these resources, there was little information in the A & I publisher’s Web sites to help users decide which to use. That is, without some pointed investigation or specific instruction, library users would likely have found it difficult to discriminate across indexes and between journals.

As information professionals and LIS faculty are aware, the primary Library and Information Science A & I databases are Library and Information Science Abstracts (LISA), Library Literature, and Information Science Abstracts. In Fall 2000, the largest, LISA, indexed 550 journals; LISA included a large percentage of European and non-English language publications. However, the list of journals was not available through the publisher’s Web site (Bowker Sauer), nor was there any other detailed information. Information about the LISA database supplied through the SilverPlatter interface appeared to be the same product information brief that was found on the Bowker Sauer Web site.

The Business A & I and FT databases included ABI/Inform, Gale’s Business and Industry database, and Wilson’s Business Abstracts. These products were the largest of the three disciplines, and combine the most varied types of document sources. None of these publishers’ Web sites, or their hosts/aggregators provided information on authority. Faculty and students who are skilled in determining authority of scholarly research may be at a loss to discern quality of trade publications. For users from outside the discipline, the sheer number of indexed sources increases the need for clear descriptions. Overlap of titles within each product was not possible to calculate. In addition, good and current documentation on the scope and coverage of electronic A & I services was not readily or consistently available across all the vendors.

The fact that many A & I and FT publishers and database vendors do not provide readily accessible documentation of content makes librarians’ work very difficult. Access to information on the journals included in a particular database, such as dates of coverage, and defined or assigned level of authority (e.g., peer-reviewed or trade) would be of considerable assistance to those who provide reference services or bibliographic instruction, as these librarians are often not subject specialists. Desktop access to electronic resource documentation is essential to support high quality reference services demanded by today’s library users, particularly when reference questions are entering the system through multiple channels (i.e., face-to-face, phone, e-mail, online chat, etc.). In fact, the best practices document on high quality digital reference put forward by the Virtual Reference Desk Project (2003) implies that librarians would have access to materials they need to provide good service. Secondary data sources are available, including Ulrich’s and JAKE (http://jake.med.yale.edu/index.jsp), a database maintained through volunteer effort; however, these sources cannot provide data in as timely a manner as that which the vendors can provide (K. Kern, personal communication, July 16, 2003). Equally important, this sort of information is needed by librarians in interlibrary loan services to manage requests for documents that are, in fact, available in the user’s own library.

For direct-access users such as graduate students and faculty, this information can greatly affect their work as they make decisions about the value of electronic materials. Undergraduate students need this “metadata” to learn how to distinguish authoritative research from hearsay. Compounding these problems is an absence of the kinds of contextual information users need to explain conceptual differences in scope and specific content of these indexes. For example, one subject specialist specifically noted that Communication Abstracts, indexes in very broad communication terms, from interpersonal communication to satellite communications. Many of these journals are peer-reviewed but also indexed at some points (are) such trade journals as Telephony, and lately, some LIS-related journals such as Internet References Services Quarterly (SS1, October 16, 2000).4

2 It should be noted that Library Literature and Information Science (HW Wilson) currently has a very clear explanation of their peer-review designation (http://vwweb.hw wilsonweb.com/hw/help/ popup/PopupContents/ popup_peerreview_ contents .jhtml).
3 Although this publisher information was correct at the time of this study, Cambridge Scientific Abstracts now publishes LISA. Current information on this database may be found at http://www.csa.com/csa/factsheets/lisa.shtml.
4 Informal interviews with several librarians provided both context and examples of current problems in managing electronic materials. Sources of the quotes in this article are designated as SS1, SS2, etc., standing for Subject Specialist.
For users these details are invaluable with respect to decision-making about time allocation and which services would best meet their information needs. In general, the aggregating services that provide the Web interface for users to search through these bundled resources do not provide adequate depth of scope and coverage, and in fact, sometimes contain erroneous information.

As indicated in Table 1, it is not easy to find complete information about electronic resource databases. Information about the features of a database is important for decision-making about the use of the resource. The key categories, including currency, coverage, scope, and authority, are prominent features that act as cues to inform users about the possibility of retrieving relevant documents. These features are also important to subject selectors, reference librarians, and other information specialists because they inform their decisions about acquisitions and service delivery.

**Currency**

Currency information tells users how often the materials in the database or resource are updated, and how soon the most recent content is available, that is, when a journal is published how quickly it will be available in the system. Currency information can be important to determining relevance of a system for a particular search. This feature provides two clues to relevance: How often the database or system is updated, and how much of the most recent content is available. This information may be available in several locations, and kept by the vendor/aggregator or the library. On product Web pages, publishers often include frequency statistics about how often new content updates the database. This could easily be added to a library’s information about the resource. Whether this information is visible through the interface or through the library’s access page, it is useful for users to be able to judge pertinence of content for certain tasks. The other aspect of currency is how soon in the publication timeframe content becomes available in the database. Some publishers make the electronic version available before the print version.

**Coverage**

Coverage information describes how much of a journal run is available in a collection. Faculty and students need to know whether issues are missing to formulate good search strategies. For example, through one service, the CAB abstracts are only available from 1998 on. If, because the library now subscribes to this particular service, another ABI & I service is dropped because of overlap, researchers would lose access to abstracts prior to 1998. This increases the probability that there would be problems with “continued availability,” which is already threatened by the nature of licensing through third-party vendors (including aggreg-
libraries, where these bundles are widely used. However, a
might be most important for librarians in undergraduate
academic product only (respectively). This distinction
discrimination between stakeholders influences information availability (Table 2).
Electronic resources disappear, in part, due to the multilayering of the information delivery system. The effect of the multilayered purchasing system on the access model means more opportunities for human error in data entry or technical configurations, and administrative mix-ups. Sometimes events are controlled by changes in the publishing market, in which a business decision by any one actor in the sales or licensing chain can create a “non-use” scenario. In Fall 2000, for example, some top accounting journals were “pulled” from a national aggregating service. These “Monday morning” surprises cause reactive responses that appear to have become routine due to the frequency of unexpected changes.

In print collections, missing materials are relatively easy to notice, that is, the book is missing from the shelf. However, when electronic materials are missing, the circumstances are less obvious to the user. Making sense of these situations is difficult because of the hidden nature of the problem. Discontinuities effectively restrict the use of recorded knowledge, which can lead to new and potentially costly forms of non-use. Implications for the use/non-use decision by a “knowing ” user include complications in decision-making and increased cost. Costs include increased time to locate the material, increased need for librarian mediation, and any negative effects on future decisions with respect to this bundled resource due to questions of reliability. Still, there are solutions to accessing materials when the library user knows that they require a particular source. The larger problem occurs when the library user does not know that a source is missing, or that a bundled resource has material they might need.

The choice between obtaining electronic vs. print materials presents trade-offs for information availability. Table 3 details the causes of misplaced information for materials in print and electronic formats. It also shows how electronic

### Authority

Few databases indicate whether a source is subject to the peer-review process. Additionally, different systems flag different sources or texts as being refereed or subject to “peer review.” Journals and trade publications that have an editorial board, but are mainly position or nonscientific survey tracts are often flagged as refereed. Users need to know whether experts have rigorously scrutinized certain published findings. Faculty and student users rely on authority information to help discriminate levels of scholarship or quality during the search process.

### Scope

Scope details what type of texts will be contained in a database or resource bundle, and the level of selectivity applied to the journals or materials covered. The Business databases, for example, indicate that they include trade publications, newspapers, and newsletters. This information is relevant to users, as they may need different types of sources in different circumstances. Management students, for example, may need current industry reports instead of research journals for some of their work. It is important to know which database or resource to use to retrieve appropriate citations or full texts.

### Overlap

This feature describes the redundancy of content from one bundled product to the next; it is not included in Table 1, as the analysis was only calculable for the Communications products. While perhaps less important to users, the idea of overlap becomes increasingly important to subject specialists and their acquisitions’ decisions, as the number of products continue to increase and budgetary resources tend to remain flat. Krumenaker’s (2001) recent article suggests that collection developers need to consider both overlap, where journals are the same, and “uniqueness and exclusivity,” where content is found in only a single “academic” bundle and possibly in a commercial product, or in an academic product only (respectively). This distinction might be most important for librarians in undergraduate libraries, where these bundles are widely used. However, a general consideration of overlap may allow a selector to give greater weight in their consideration of other product features such as ease-of-use, interface, and full text. One could argue that this might lead to better products in the future.

### Discussion

Intermittent holes and masked information arise from dependence upon electronic resources’ bundling. The layered organization of the publishing-to-access chain interconnects the stakeholders in the access model, and, having multiple stakeholders introduces many opportunities for discontinuities to occur. Electronic resources can disappear on a permanent or temporary basis. Temporary discontinuities may be rectified by new products, correction of errors, training, and updates. Permanent discontinuities appear to arise from content control or selection issues. In addition, limited resources can play a key role in either basis. The following table shows how the occurrence of interconnections between stakeholders influences information availability (Table 2).

In print collections, missing materials are relatively easy to notice, that is, the book is missing from the shelf. However, when electronic materials are missing, the circumstances are less obvious to the user. Making sense of these situations is difficult because of the hidden nature of the problem. Discontinuities effectively restrict the use of recorded knowledge, which can lead to new and potentially costly forms of non-use. Implications for the use/non-use decision by a “knowing ” user include complications in decision-making and increased cost. Costs include increased time to locate the material, increased need for librarian mediation, and any negative effects on future decisions with respect to this bundled resource due to questions of reliability. Still, there are solutions to accessing materials when the library user knows that they require a particular source. The larger problem occurs when the library user does not know that a source is missing, or that a bundled resource has material they might need.

The choice between obtaining electronic vs. print materials presents trade-offs for information availability. Table 3 details the causes of misplaced information for materials in print and electronic formats. It also shows how electronic

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5 In his article, Krumenaker’s research identified the academic products as EBSCOhost, InfoTracWeb, and Proquest Direct. The commercial products he included were Lexis-Nexis, Dialog, and Dow Jones.
resources bundling can instigate the occurrence of missing materials and non-use patterns.

**Consequences of Collection Gaps and Concerns About Use and Non-Use**

One key difference between causes of print vs. electronic disappearance is the complexity of each. For example, print materials disappear due to either circulation control failure, human error, or both. Electronic resources disappear, in part, due to the multilayering of the information delivery system. The multilayered purchasing system in the access model provides more opportunities for human error in data entry or technical configurations, and administrative mix-ups. Sometimes, events are controlled by changes in the publishing market, in which a business decision by any one actor in the sales or licensing chain can create a new non-use scenario.

The current form of electronic resource bundling, in the license-driven access model, is causing intermittent breaks in the availability of texts and documents. These breaks are the holes and misplaced information that restrict the use of recorded knowledge, and create non-use scenarios that are costly. In this case, the problem was exposed because we could not find and use known material. Sources previously available through the database product now appeared to be missing from the bundled resource. Here a situation of non-use occurred because a known item was missing, resulting in a visible hole. For a “knowing” user, this complicates decision-making and increases cost. Costs include increased time to locate the material, increased need for librarian mediation, and any negative effects on future decisions with respect to this bundled resource due to questions of reliability. Still, there are solutions to accessing materials when the library user knows that they require a particular source. The larger problem occurs when the library user does not know that a source is missing, or that a bundled resource has material they might need.

There are disruptions in the day-to-day currency of bundled electronic resources, and it is likely that they will continue to be part of the electronic materials landscape for the foreseeable future. This phenomenon is highly significant in the scheme of library and information services, but it is likely that it is only one aspect of the long-term consequences of the shift to hybrid or full electronic collections. It is imperative that we gain an understanding of the downstream effects, including those durable trends that will affect the functionality of libraries over time (i.e., trends that pervade, and require response and adaptation in services). The role and success of the library will help position the university in their quest to compete in the academic marketplace. A new conceptual framework will

**TABLE 2. Occasions of discontinuities—intermittent holes and masked information.**

<table>
<thead>
<tr>
<th></th>
<th>Permanent</th>
<th>Temporary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Publisher</td>
<td>Cessation of publication.</td>
<td>Journal “pulled” for self-marketing or distribution through another channel.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Back issues not yet digitized.</td>
</tr>
<tr>
<td>Aggregator/Vendor</td>
<td>Loss of content due to change in licensing/distribution agreement.</td>
<td>Error in database (e.g., misspelling).</td>
</tr>
<tr>
<td></td>
<td>Embargoes limit access to previous years only, i.e., no access to current issues (Krumenaker, 2001).</td>
<td>Error in IR system design.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Problem with interface design.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lack of cross-referencing previous names.</td>
</tr>
<tr>
<td>Library</td>
<td>Change of vendor making some sources unavailable.</td>
<td>Item not (yet) listed in the library catalog.</td>
</tr>
<tr>
<td></td>
<td>Subscription cancellation.</td>
<td>Error in database (e.g., bad link).</td>
</tr>
<tr>
<td></td>
<td>Change of service in consortia agreement.</td>
<td>Systems staff “unaware” of resource; communication breakdown.</td>
</tr>
<tr>
<td>Faculty</td>
<td>Cancellation of journal from approval list.</td>
<td>Lack of training/skill for finding extant literature.</td>
</tr>
</tbody>
</table>

**TABLE 3. Origins of misplaced information in two formats.**

<table>
<thead>
<tr>
<th></th>
<th>Print</th>
<th>Electronic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporary</td>
<td>Materials “in process” or at the bindery, Materials are not on the shelf (checked out, etc.).</td>
<td>Access missing due to processing activity (e.g., subscription renewal problem). Publisher “pulls” journal to sell/distribute on own, library (proactively) retains access.</td>
</tr>
<tr>
<td>Permanent</td>
<td>End date will show in the catalog record (cessation of publication or library cancels subscription). Materials simply “go missing.”</td>
<td>There is no access point in the library system. Publisher “pulls” a journal to sell/distribute, library does not recapture access.</td>
</tr>
</tbody>
</table>
TABLE 4. Implications of intermittent holes and masked information.

<table>
<thead>
<tr>
<th></th>
<th>Use</th>
<th>Non-use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Masked Information</td>
<td>Increased cost to the user. Increased cost to the library (i.e., it takes longer to retrieve the source material, and likely requires intermediation).</td>
<td>The user may choose not to pursue or use the source. This may influence future decisions whether to use that electronic resource.</td>
</tr>
</tbody>
</table>

ground the formulation of evaluation measures that will support selection and information service decision-making.

Developing a set of measures that will allow evaluation across both collections and services will support long-range planning and decision-making; and it is likely that such evaluation will uncover use barriers that can be addressed in the short term, as well.

This research suggests that evaluating both use and non-use of electronic collections will supplement other acquisitions and service measures. Invisible holes in collections can lead to occurrences of non-use that affect scholarly communication. Incidents of non-use due to masked (or screened) information can directly influence user decision-making about what, when, and how to use electronic information resources. For the user who does not know that source materials are missing or missed, their use/non-use situation is dictated by what they do not see, whether that source is hidden (masked), omitted, or gone. As Mueller and Schement (1996) found, non-use may be multidimensional, and those delineated factors need to be situated along continuums of information need. The use/non-use framework is not intended to connote an either/or behavior, but represents a range of behaviors that users adopt to interact with electronic systems (Table 4).

Discontinuities in electronic resources raise the stakes for science and technology education and national research and development endeavors. Valued research may be missed, reducing authors’ opportunities to communicate their work. Users may miss sources important to the development of their understanding of their topic or discipline, and so to the development of their research. This is important for graduate students not only in terms of their education, but also for their future participation in that discipline.

For undergraduates who may tend to use only what they see (Lee, 2000), source selection decisions based on quality will be limited by the availability of feature information. This may be especially problematic now that many electronic products are a blend of bibliographic and full text content. Users continue to be unaware of differences in the range of electronic materials [SS3, personal conversation, May 3, 2002], and confusion about which sources are contained within the multiple electronic resources compounds these problems.

In addition, this is particularly important for interdisciplinary researchers, who require “informing” and supported access to materials that are most frequently organized according to disciplinary boundaries (Palmer, 1996). As the boundaries of disciplines blur with respect to research that blends or adopts methods and tools from another, these researchers must have access to the foundation information upon which the current theories and methods are based. Bates (1996) has found that “When failures, changes, and gaps anywhere in this extensive scholarly communication apparatus can be identified in interdisciplinary—in contrast to conventional—academic fields, these differences could reasonably be expected to have a substantial impact on the conduct of research (p. 159).”

Boundary-crossing researchers who adopt methods and tools from a different discipline must have access to appropriate information on those theories and methods. Access to the historical string of ideas and recorded knowledge is necessary to support the appropriate selection and application of such “borrowed” concepts and tools. Addressing the needs of interdisciplinary researchers will require extra care, as selection decisions about materials in either print or electronic format are likely to be different for different disciplines (Hollemann, 2000).

Ultimately, collections must be dynamic. That is, to support the changes in research or programmatic (curricular) focus within the university, library collections must be manageable in ways that are currently nebulous. For example, while de-selection decisions for paper materials were often based on an assumed lack of need, we cannot simply apply that approach to electronic collections management because we do not know enough about the non-use of these materials. Attempts to standardize collections management processes are limited by current models of scholarly communications that change frequently and are yet to solidify. This further constrains local control over library services. The lack of a coherent system of analysis for electronic collections measurement and evaluation must be addressed, and this new system must be different from the traditional data-collection and decision-making processes. A new approach will require collection of data beyond—but in synthesis with the use statistics currently offered by the vendors.

To fully understand how users are making sense of electronic bundled resources, it is crucial that use be evaluated in tandem with non-use. To fully understand how
electronic resources are understood and used, we need a picture of the combination of behaviors. We need also to pay special attention to identifying materials that are lost or missed. Mueller and Schement (1996) used such an approach to uncover patterns of choice about telephone service. This study is important for its proposition that a rich and multidimensional framework is needed to examine the extent and complexities of the sociotechnical circumstances facilitating or constraining use. Their findings suggest how a reframing of analysis can uncover factors of non-use outside of standard assumptions about access; theirs revealed economic barriers, the use of substitutes, and feature preferences. Examination of the dimensions of non-use can promote discovery of choice dynamics that might not be considered in a traditional user study framed on use alone.

Addressing Materials Management Challenges

This study described some of the social arrangements that have contributed to the current state of materials management in academic and research libraries. It examines reported losses or gaps in content in bundled electronic resources in the fall of 2000, and also reviews some of the features that can functionally mask information. An understanding of how the intermittent loss of material leads to non-use situations is as important as studying use behaviors for scholarly communication research, which needs to track the influence of organizational relationships across the publishing-to-information access chain on work practices in research, teaching, and learning. Such an understanding will also help evolve context-oriented collections and collection management models for libraries that seem caught between becoming providers of common publications and the center of their university’s institutional knowledge base. By framing the events in a way that allows anticipation, libraries can design materials management systems that can be responsive to content disruptions. Discontinuities in collections are only one manifestation of the shift toward electronic collections. This effect is representative of the kinds of changes that need to be measured and evaluated. As Packer (2001) states:

There are still no clear, correct answers or solutions, but we should at least be certain we understand the level and nature of the unplanned distortions that we are introducing into our materials collections and allocation mechanisms, so we can begin planning to serve better all our constituents (p. 221).

The choice between obtaining electronic vs. print materials presents trade-offs for information availability. Librarians know these trade-offs well; they stem from questions regarding values about format and content, value-added services, and the economics of convenience. Consideration of just-in-time needs and remote access demands are weighed against the materials they must then forgo. For bundled electronic resources, these considerations must include overlap, how best to protect perpetual access to materials when subscriptions end, and the design of materials management systems to account for the differences that set the electronic publishing market apart from the print. This may require that collection development and acquisition policies be reviewed differently in light of the current scenario where the publishing market changes without notice.

For example, some libraries have decided to cancel print subscriptions entirely when an electronic counterpart is available; however, electronic journals do not always contain the complete contents of the print version (Metz, 2000). In fact, many license agreements state specifically that they will attempt to provide the total content of the journal, but in the event that they do not, the print format is the version of record. Similarly, there is a lack of current and accurate documentation available to librarians and library users on the value features (i.e., database descriptors) for the content. Materials management systems can capture this sort of information, which will support decision-making that will support the library mission, while also providing focused access to content. A framework of evaluation based on use and non-use of electronic materials will identify and measure impacts of the changes in the information access model. That is, because the electronic service delivery in academic and research libraries is dependent on the publisher-to-access chain, it will be important for librarians—in the context of their roles in the university setting—to have additional tools beyond vendor statistics with which to articulate the impact of these electronic systems and services on the intellectual environment of the school.

Libraries, in their role as curator of institutional memory, document the strengths and special contributions of the university. In their function as collection developers, libraries reflect (and match) the needs of the institution for research, teaching, and learning. In these respects, libraries may need to reassert some control in two directions: shaping the products and services being offered, and planning for the research and educational needs within their particular schools. The choice of some libraries to acquire electronic resources specifically made up of “second tier” journals will clearly shape the work of students and have some impact on scholarship as a whole. Libraries, by their collection choices, have new power in their influence and role in knowledge creation [SS3, personal conversation, May 3, 2002].

Conclusions

Ironically, increasing electronic access to information could result in less intellectual access to knowledge. If effective use of electronic sources requires the context of expert knowledge to recognize what is present and what is missing, even reference librarians may not be able to assist nonexperts in using these sources. Compounding the problems of not knowing the breadth of the electronic collection, are the frequent and rapid changes in the state of the collection. Imagine a physical library with no circulation control or catalog. As the collection holdings fluctuate, the
library’s value to its users varies dynamically. The result is not only the loss of a consistent shared repository for knowledge, but also the lost of intelligibility of new knowledge created from divergent understandings based on the ever-changing collection. This study conceptualized these problems as intermittent “holes” and unintentionally masked information that arise from a dependence upon electronic resources bundling.

This study described some of the social arrangements that have contributed to the current state of materials management in academic and research libraries. Publishers move electronic materials to market, which are then organized through a multilayered system that uses licensing to control distribution. Academic and research libraries have embraced the consortia system in response to pricing models and other external demands. The access model requires libraries to divest some local control, but provides user communities with constant access to remote collections. Institutional collections that depend on the relationships between the system service-providers may have some or all of these issues, but every collection is vulnerable to intermittent holes. Starting with experiments in electronic publishing and access to full-text content, collection development decision-making has shifted to a mode where cost controls dictate the substitution of electronic materials and services for print. These concepts were developed by identifying patterns that shape the use and non-use of bundled electronic resources. The examples presented here are not exhaustive, but representative of the daily events that libraries and library users experience with bundled electronic resources. Further, a use/non-use framework is not intended to connote an either/or behavior, but instead represents a range of behaviors that users adopt for interacting with electronic systems.

There is not yet a set of measures that allow evaluation across both collections and services that will support long-range planning and decision-making. It is also likely that such evaluation will uncover use barriers that can be addressed in the short-term, as well. It is apparent that non-use of electronic materials is multidimensional, and those factors need to be delineated along continua of information need. The situated nature of information use in the changing library landscape requires that we develop a coherent approach to uncovering and understanding unforeseen (or unplanned) outcomes and their impact. Discontinuities in electronic collections can be considered through an examination of the use/non-use framework.

Authors, teachers, and researchers rely on the (known) knowledge structures of their discipline to support their work. And, though it is clear that faculty often develop their own collections of materials (Covi & Kling, 1998), they exist with the support of infrastructure provided by academic libraries and publishers. Because an author cannot own or anticipate need for all the material they might need for their work, shared archival collections serve a cohesive function in the production of new knowledge. The current trend toward “just-in-time” research and information access therefore requires increased reliability in the provision of access through library connections. Tenopir found that, although there are indicators that researchers are accessing materials in electronic format that were produced within a year, they appear to be continuing to use traditional sources for older materials (C. Tenopir, NJ ASIS & T Talk, March 28, 2001). As these materials become available electronically (whether by additions to archives by vendors or accumulated over time), it will be imperative that such archival access be preserved—particularly as libraries discontinue the print versions of these sources.

The differences between using electronic resources and print resources will have unintended consequences for people who depend on reliable access to scholarly collections. Invisible holes in collections can lead to gaps in shared knowledge that affect the ability of scholars to communicate and exacerbate differential ability to utilize electronic resources. Incidents of non-use due to masked (screened) information can directly influence user decision-making about what, when, and how to use electronic information resources. Consideration of the use and non-use paradigm is important in the design of materials management systems because focused access to content will provide users with the context necessary to maximize the use of collections. The time is right for a systematic study of the impact of changes in consistent access to materials.

Problems such as these unanticipated discontinuities must receive systematic study. The issues brought to light here support a framework for problem examination or service planning, as there are implications for materials management, bibliographic instruction, and future library use. Such a framework should provide a means to consider what content might be included in hybrid collections; what interface system will best provide access to that content; and what sorts of considerations might best be undertaken by the vendors. Providing access to information is central to the mission of libraries. Materials management is necessary to support the library access model, which will become increasingly dependant on focused access to collections. This study offers a starting point for people who want to examine some of the ways that the provision of electronic information materials may be contributing to the “narrowing of access to scholarly information” (Billings, 1996).

Acknowledgments

The authors wish to acknowledge the valuable discussions with Myoung Wilson of the Rutgers University Libraries, and Sue Searing of the University of Illinois Library. We are also grateful for the comments of the GSLIS Writing Group at the University of Illinois, Urbana-Champaign and anonymous readers.

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