Library Support for Interdisciplinarity … [short title]

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Library Support for Interdisciplinary Scholarship in Colleges and Universities: Lessons from the Recent Literature

When librarians understand how knowledge is produced by scholars in an interdisciplinary field and among members of an academic community, they are better able to create information models for collections and services that address actual information needs and recognize the range of information seeking behaviors. Interdisciplinarity may assume several institutional guises: formally in programs of research and instruction, and informally in communication and joint efforts between faculties and individuals, and in the preparation of course syllabi. The recent literature on information seeking, as undertaken by interdisciplinary scholars in the humanities, social sciences, and sciences, is reviewed and contextualized within the functional areas of librarianship with the aim of identifying practices that will support the interdisciplinary inquiry of both students and faculty.

Introduction

Information seeking behavior, broadly defined to encompass the identification, location, retrieval and provision of information, or more precisely, the modes of inquiry and the research strategies favored by interdisciplinary scholars within the main knowledge domains of the sciences, social sciences and humanities, has generated sufficient studies to suggest that a literature review is timely, and that some useful approaches to service can be identified.

There have been relatively few attempts to link this body of research on information seeking to recommendations on how librarians can best serve the interdisciplinary needs of both new and advanced scholars; indeed, library service issues are rarely mentioned in monographs on practice and problems from the perspective of interdisciplinary researchers. These texts tend to concentrate on validity, communication, promotion, tenure, research funding, and publication as predominant areas of concern.

Hur-li Lee's description of the social influences at play around the creation of a women's studies research hub reveals the secondary role that the library often takes within a university community when the prestige of an academic program is under negotiation [1]. Studies of information seeking behavior, particularly those with humanities scholars as the primary focus, explain why scholarly inquiry apparently succeeds in an academic environment which seems ill prepared to address interdisciplinary information needs. Knowledge production within and across disciplines, because it affects research strategies adopted by the knowledge producers, must be understood by librarians to ensure that the library evolves as a social environment that actively promotes and invigorates interdisciplinary inquiry, and is central to discussions of interdisciplinarity in an academic community.

The Intellectual Organization of Interdisciplinarity

Rustum Roy defines interdisciplinary activity as "a day-to-day interactive mode of research (or study) where, in order to do the best work, each researcher's work demands the use of ideas, concepts, materials, or instruments from one or more disciplines" [2, p.285]. This definition is used in this article when addressing the interaction of library services and collections with the information seeking behavior of scholars. Interdisciplinarity differs from multidisciplinarity. Multidisciplinarity describes a situation where the separate disciplinary components are coordinated by investigators with different skills to address a common research problem or policy issue.

Although a discussion of the conduct of interdisciplinary teaching and research within institutions, as distinct from information seeking behavior, is beyond the scope of this review, there is one basic question that has a direct bearing on library practice.To what extent has interdisciplinary inquiry become

central to the academic life of an institution? It is not only a matter of surveying the number of interdisciplinary programs and courses, but also of determining the extent to which the interdisciplinary approach pervades the traditional disciplines and the minds of those who have been disciplined. The disciplines are embodied in departments which structure the allocation of resources, including the funds assigned to the development and maintenance of library collections.

Territorial metaphors have been used to describe the disciplines. It is commonplace to refer to the boundaries of a discipline. Each discipline has a history, and perhaps even a common memory of a Golden Age when consensus ruled and all the constituent elements were in balance [3, p.55]. Disciplines have been compared to nation-states or fiefdoms, their faculties to armies, their journals to dialects, and their professional societies to religions [2, p.285].

More recently, academic tribe has been used to describe the members of a discipline, thereby moving the metaphor from the spatial to the ecological, and providing a better alignment with the process of hybridization when applied to the borrowing and lending of concepts, methods and theories between disciplinary specialties (or sub-disciplines) in order to effect the creation of a new combination or interdiscipline. Hybridization has been suggested by Mattei Dogan and Robert Pahre as a more appropriate generic term than interdisciplinarity which they consider a utopian ideal encompassing the knowledge of two or more disciplines. They define two types of hybrids: institutionalized hybrids as manifested in new fields of study, cross-departmental programs, and research organizations; and informal hybrids which exist at the level of interpersonal contact and discussion of topics across disciplines [4, p.192].

For the immediate purpose of discussing the manifestations of interdisciplinarity in the academy, I will adopt hybridization: the concept makes a useful distinction between interdisciplinarity's overt institutional existence in departments, programs and institutes, and interdisciplinarity's more covert informal existence as an exchange of ideas among faculties which may influence course content and student assignments.

As a much discussed example of an institutionalized hybrid, women's studies can be sustained as either a program with affiliations with several established disciplines within the traditional university structure, or as a field with the characteristics of a discipline, and by inference, with the benefits of the resource allocation that status as a university department provides. In both manifestations, women's studies attest to the changing nature of academe and the pervasiveness of interdisciplinarity. When they evolve into a discipline with departmental status, but with an interdisciplinary mode of inquiry, women's studies joins company with such fields as gerontology, child development, and area studies for which this has long been a reasonable and necessary goal to ensure survival and intellectual growth. However, it is as a field with roots in many disciplines that women's studies best exemplifies the current receptivity to hybridizing tendencies within the modern academy. Thus, institutional hybrids, such as women's studies, can be sustained either as programs with a critical presence within one or more traditional disciplines or as departments with interdisciplinary characteristics. If the field of women's studies is representative,

interdisciplinary scholars must still be debating the strategies that are best able to ensure growth, vigor and long term survival in a challenging economic environment.

The second type of hybridization has a less overt identity: informal hybrids in the form of interdisciplinary research topics and networks of interpersonal contacts that may have a potential to evolve into institutionalized hybrids. Shadow structures representing boundary-crossing affiliations of researchers and teachers critique the disciplined pursuit of knowledge of discourse communities within departmental structures [5, p.145]. To fully ascertain the pervasiveness of academic interdisciplinarity, it is necessary to measure the extent to which scholars with formal ties to departments actually undertake this shadow work.

Using Citation Indexes to Discover Knowledge Work

The analysis of citations in a journal article or research paper has been used to establish the extent to which an author in a specific field acknowledges an intellectual debt to the work of researchers within or without the source author's home discipline. Citation analysis can address the problem encountered when researchers are interviewed and under report their use of research from exogenous disciplines and their exposure to a range of material types.

In an investigation of communications patterns indicated in core anthropology journals, Jin M.Choi uses the term centrifugal tendency to indicate the extent of intellectual dependence, subject convergence, or cross-fertilization of a discipline with other disciplines, and the term centripetal tendency to indicate the extent of self-sufficiency of a discipline. The centrifugal tendency is measured by dividing the number of citations made to other disciplines by the total number of citations made and multiplying by 100; the centripetal tendency is measured by dividing the number of citations made to the discipline itself by the total number of citations made and multiplying by 100 [6, p.69]. Choi's study concluded that 70% of the intellectual needs of anthropology were supplied by other disciplines; for Choi this strong centrifugal tendency defined anthropology as a receiver discipline which evolved over time and engendered disparate sub-disciplines of varying tendency [6, p.81-82]. In addition to demonstrating a strong out-citation tendency in a discipline, the anthropology study revealed a shift in subject dependency over a twenty-year period; from arts and literature in 1963 to biology and education in 1983 [6, p.78].

Less surprisingly, Choi's study revealed that sub-disciplines vary in the tendency for out-citation: in 1983, linguistic anthropology revealed a strong centrifugal tendency while that of archaeological anthropology was weak by comparison [6, p.79]. Julie M. Hurd's analysis of journal citations in the research papers of chemistry faculty confirms Choi's finding on the varying out-citation rates among subdisciplines. Biochemists cited 85% of their references to science journals outside chemistry, as compared to organic chemists' out-citation rate of 24% [2, p.294].

Carole L. Palmer and Laura J. Neumann used an analysis of citations in the published papers of scholars in a humanities research center to expand the subject areas and types of sources reported by the scholars during interviews. The citation analysis revealed a greater influence from the social sciences, and citations to unreported sources such as archival materials, theses, manuscripts, and exhibition catalogs [7, pp. 95-96].

Although citation analysis is a viable corrective to self-reporting of interdisciplinary interest and is relatively easy to undertake, it should be used with caution. When faculty members publish articles in journals excluded by the Institute for Scientific Information (ISI), an alternative to citation indexes must be used to compile profiles. Even direct examination of an article is problematical when an author fails to cite every source used in research. Citation analysis that depends upon assigning single subjects of varying levels of discernment, as in Choi's use of LC subject headings obtained from OCLC, or Hurd's use of descriptors from *Ulrich's*, may result in either an over or underestimation of centrifugal tendency, and will impede efforts to compare the results of citation studies. The category conceptualized and delineated for a research subject must be defensible before any rate of out-citation can be estimated [8, p.365].

Citations alone may not always be trusted to provide evidence for substantive information transfer between disciplines. Howard D. White describes superficial citations as "rhetorical grace notes" [9, p.243]. In a study of interdisciplinarity within a scientific research institute, Palmer reports that both the subject and intention of the citing publications were used as evidence, with multidisciplinary, fusion (interdiscipline), and problem-centered journals identified as strongly indicative of the scientists' boundary-crossing research interests [10, p.244]. An even stronger indicator is the publication rate of scholars from one discipline in journals published under the aegis of another discipline [11] ; evidence for the transfer of information across boundaries is provided that is less prone to misrepresentation.

Information Seeking Behavior

Interdisciplinarity may manifest itself as an institutional hybrid in traditional departments and in programs and courses with several disciplinary affiliations, or as an informal hybrid whose shadowy manifestation in research topics and interpersonal contacts may have to be revealed using citation and publication analyses. Once the librarian has evidence that interdisciplinarity may be more pervasive than formal structures suggest, the information seeking behavior of interdisciplinary researchers (and the allocation of resources to serve this population) seem less peripheral.

The Ellis Model

The behavioral model proposed by David Ellis, which describes the information seeking activities characteristic of knowledge domains, is grounded in empirical data derived from transcribed interviews with researchers at the University of Sheffield [12]. Although a varying number of categories were defined for each domain model by the colleagues who used his interview guide, Ellis assures us that the underlying pattern of activities is the same and that the differences are more one of emphasis than of behavioral variance. He is also careful to note that the models do not define interactions and the interrelationships between the categories or the order in which they are carried out. The exact relationship of the categories depends upon circumstances associated with an individual's information seeking in a particular place at a particular time. The categories Ellis defined for chemists are: i. starting: identifying references by asking colleagues or consulting literature reviews, indexes, abstracting services, ii.Chaining : following chains of citations or other forms of references between materials, iii.Browsing : scanning journals, tables of contents, online printouts, iv.Differentiating : using known differences between sources (e.g. the reputation of an author, journal hierarchies, topicality) to filter the amount and nature of information, v. monitoring : following past sources, or using current awareness services, vi.Extracting : selectively identifying relevant material in an information source, vii.Verifying : checking the accuracy of information, and viii.Ending: information seeking at the end of a project, as in the preparation of a paper for publication [13].

The categories defined for chemists may be applied to the information seeking behavior of physicists, social scientists and literary scholars by adjusting the number of categories, shifting emphasis on a particular type of activity within each category, and recognizing that the pattern of activities may change from one domain to another. Both physicists and social scientists used backward chaining to locate references in the literature, but scientists, unlike social scientists, were familiar with citation indexes and would use them for forward chaining [13, pp.360-361]. Although browsing, defined as semi-directed or semi-structured searching, was identified as a discrete category by chemists and social scientists, it was undertaken by physicists within other categories of their information seeking [13, pp.361-362]. When monitoring, the scientists relied on journals while the social scientists used books and journals equally [13, pp.362-364]. Ending was a minor category for chemists, and was not even identified as a discrete category by the other groups [13, p.365]. Verifying was a minor activity for the social scientists that they could subsume under the chaining category [13, pp. 364-365].

Ellis presents his grounded theory approach as a more realistic alternative to the information retrieval model that focuses on the retrieval effectiveness of computer-based systems. He describes the information retrieval model as one in which the information need of a user, as a request to a retrieval system, is matched against representations of documents; the resultant references to texts are the objects to be judged relevant or not by the user. To Ellis, the retrieval model is a misleading abstraction at best, and a parody of information seeking behavior at worst [12, pp.471-474].

Lokman I. Meho and Stephanie W. Haas, when applying the Ellis model to scholars in the interdisciplinary field of Kurdish studies, suggest that the category of "accessing" be inserted between starting and chaining, to recognize access problems as barriers to information gathering, The barriers they identify pertain to activities such as borrowing, photocopying, interlibrary loan requests, subscriptions, interpersonal contact, and travel to distant repositories [14, p.21]. In addition, they suggest that consideration of the ideological perspective of sources is an important aspect of differentiation [14, p.22].

While applicable across disciplines, the Ellis model is based on evidence provided by skilled researchers who have developed confidence over time, and are using finely honed approaches to information seeking within their disciplines. What is missing are feelings of anxiety and frustration that many interdisciplinary scholars express who are new to a field of inquiry, particularly if the scholars are newly minted faculty who require advice and encouragement, but have few mentors with whom they can discuss ideas.

The Kuhlthau Model

The Information Search Process (ISP) is a model developed by Carol C. Kuhlthau using an empirical approach similar to the Ellis model [15]. The population of the initial study was a group of high school seniors who were asked to keep a journal to records thoughts, actions, and feelings while researching an assigned term paper, and to answer a questionnaire on library use. Six participants were then asked to participate in a case study that included a taped interview during the course of the assignment. Four years later, a majority of the original participants, who were now enrolled in college, were given the same questionnaire, and four members of the original case study group were interviewed again. Two additional studies were conducted to test the model with populations of high school seniors and with a wide range of academic, public and school library users.

The tasks appropriate to the stages of ISP are i. Initiation: recognizing a need for information, ii. Selection: identifying and selecting the general topic to be investigated and the approach to pursue, iii. Exploration: investigating information on the general topic in order to extend personal understanding, iv. Formulation: identifying and selecting ideas in the information from which to formulate a specific focus, v. Collection: gathering information relevant to the specific focus, and vi. Presentation: completing the search and presenting or otherwise using the findings [15, pp.366-368]. Kuhlthau's contribution to the modeling of information seeking behavior is her recognition that each stage of the sense-making process involves an interplay of three realms: the physical -our actions, the affective - our feelings, and the cognitive - our thinking about process and content. Feelings of uncertainty, confusion, and frustration and vague, unclear thoughts dominate the first three stages; feelings of clarity and confidence, and clearer and more focused thoughts arise with the fourth or formulation stage of ISP.

Kuhlthau's study concludes with the admission that for the majority of participants, including the college students, the identification of task fails to match their thoughts and feelings. At the stage when a specific focus was expected to form, most participants were involved in the task of gathering and presentation; they had reached the presentation stage without clearly focused topics. An interesting parallel to this late formulation by students is identified by Palmer and Neumann among a community of humanities scholars who admitted that relationships began to emerge during the process of writing, and that the crafting of the work created a situation conducive to the maturation of ideas [7, p.100].
Don Spanner's survey of interdisciplinary scholars at the University of Western Ontario revealed that 91% of his respondents expressed difficulty adapting to the disciplinary culture of a non-affiliate field [16, p.356]. While a student population clearly lacks the sophistication and skill level of university researchers, Kuhlthau's disclosure of the cognitive and affective experiences of information seekers suggests that similar feelings of uncertainty and frustration will be experienced by many interdisciplinary scholars, and ought to be acknowledged at each stage of the information seeking process.

Relevance Judgments are Fundamental

The concept of relevance is fundamental to any discussion of how cognitive and affective experiences infuse each stage of the Ellis model. Relevance judgments must be made at all stages of the process: from starting through browsing to extracting. Stefano Mizzaro explains that there are many kinds of relevance according to where each relevance is positioned as a point in a four-dimensional space, the values of each of the four dimensions being: i. surrogate - a representation of a document; document - a physical entity; information - what the user receives upon reading a document, ii. query - the representation of an information need of the user in a system language (e.g. using key words and Boolean operators); request - the representation of the information need of the user in a human (natural) language; information need - a representation of the query in the mind of the user; problem - that which needs to be solved, iii. topic- the user's subject area of interest; task - the activity which will be executed using the retrieved documents; context - everything not pertaining to topic or task, but affecting the search and evaluation of results (e.g. time and/or search costs, redundancy) : the topic, task, and context being conceived as components of the previous two dimensions, iv. the various time instants from the problem's incubation to its solution which take into consideration any reformulation of a query, re-expression of a need, or altered perception of a problem which can affect a judgment of relevance by a researcher or librarian at a point of time [17, pp.811-812].
With the various relevances in mind, Mizzaro conceives that more than one relevance judgment is required. Is the judge a user or non-user of the information? What is being used by the judge to assign a value of relevance, i.e. is the entity a document or its surrogate, or is the entity a query to a system or a

request using natural language? At which point in time is the judgment being expressed? Obviously, feelings of confusion and frustration can arise when the judgment on relevance rendered by a librarian, as the user's surrogate, does not match that of the user, and when a citation or abstract, as a document surrogate, is judged relevant but proves to misrepresent the content of the retrieved document [17, p.812]. Marcia J. Bates recognizes the pitfalls of rendering judgment. She makes a distinction between the content relevance of a document, when terms in a query match terms in a document, and the utility relevance of a document, when the user as judge assigns actual value to the document retrieved. She points out that while a content relevant document may have no utility value, another document, without apparent content relevance, may turn out to have utility relevance [18, p.701].

Lynn Westbrook reminds us that topicality alone may not provide sufficient evidence of relevance, particularly in interdisciplinary research outside the physical sciences; the value of a document or document surrogate may have to judged by semantic clues establishing its familiarity, authority, disciplinary perspective, theoretical (and ideological) perspective, intended audience, currency, language, and clarity; and by non-semantic clues indicating features such as material format and the use of illustrations [19, pp.36-37]. Don R. Swanson refers to the points of access or searchable attributes, such as title words, index terms, descriptors, subject headings or classification symbols, as document "handles". It is the capability of these handles to encode the problems or theories inherent in a document that ensures the document's relevance for the information seeker [20, p.113]. The richer the document surrogate, the closer a relevance judgment will match the one applied to the whole document. However, both the quantity and the quality of the words in the surrogate must be considered. Scott Stebelman's cross-database analysis of retrieval performance demonstrates the affect of word quality on the relevance of a surrogate. When compared with the other databases in the study, the database set which was enhanced with both subject descriptors and abstracts registered the highest recall by search topic, but had the lowest percentage of citations judged relevant by subject specialists [21, p.566].

Using the language of an ethologist, Pamela Effrein Sandstrom offers an optimal foraging theory to explain the searching behavior and "prey" selection of an individual scholar [22]. Given the primacy of relevance as a concept throughout the information seeking process, it seems reasonable that scholars will continue to use those hunting and gathering strategies proven successful by past experience. Just as Kuhlthau introduces the affective and cognitive dimensions to an information seeking model, Sandstrom reminds us that each scholar must weigh the cost of a search strategy with its benefit. Minimizing risk means narrowing the variation in outcome in order to increase a payoff. Sandstrom describes the gathering behavior characteristic of the informal approach, when it involves reciprocal contact with colleagues, as low risk / high return; and the solitary hunting behavior, characteristic of both the informal approach of footnote chasing and the formal approach of searching subjects in databases, as high risk / low return [22, p.441].

When Ellis analyzed the category of starting, which encompasses activities characteristic of the initial search for information for a new or unfamiliar project, he discovered that similar strategies were adopted at this stage by scientists and social scientists: starter references from colleagues, personal contacts, reviews or review type literature, with somewhat greater attention to formal literature searching tools by the scientists as compared to the social scientists [13, p.360]. In her study of humanities scholars, Rebecca Green confirms the primacy of informal approaches over the use of formal bibliographic tools, i.e. a preference for footnote tracing of current literature and review articles, colleague recommendations, personal collections of research materials, the browsing of library collections [23]. Green's study would suggest that footnote chasing, to use Sandstrom's hunting metaphor, (or following a citation path, to use the foraging metaphor) may be so productive that it approximates, for a solitary humanities scholar, the low risk / high return behavior of scientists' conversation and correspondence.

Information Seeking : Starting the Process

Formal Bibliographic Tools

While determining the relevance of documents or document surrogates is a common thread among all disciplines, establishing the appropriate terminology, translating this terminology into descriptors for electronic and print indexes, and coping with the design of databases and search interfaces are challenges with increasing intensity across the knowledge continuum from the physical sciences to the humanities. The literature on information seeking behavior, at least as it relates to the initial stage of the process, seems to confirm that for humanists the formal use of bibliographic tools is the high risk / low return enterprise that Sandstrom describes. As we move across the spectrum of knowledge domains from the humanities to the social sciences to the sciences, there appears to be fewer affective and cognitive problems associated with their use. The less control there is over primary evidence, which for humanists are documents and artifacts, the harder it is to utilize information technology [24, pp.503-504]. Thus, it should come as no surprise that a scholar, who has become accustomed to informal research strategies yielding a high return of utility relevant information, will resist interacting with formal tools that present obstacles of vocabulary, and in the case of electronic databases, unfamilar and confusing search interfaces.

Susan Davis Herring discovered a notable lack of interdisciplinary research on the design and development of search engines in a field of inquiry which is so clearly interdisciplinary and which has a potential to serve the needs of interdisciplinary researchers. In her study, she found that few of the authors of articles and conference papers on search engines reached beyond the boundaries of computer science and information science to explore cognitive science, ergonomics or psychology [25].

A challenge specific to interdisciplinarity, as it applies to information seeking across knowledge domains, is the use of familiar word-forms to label

original concepts: referred to as "delphic" language by Fred W. Riggs. Palmer explains the problem inherent in delphic language by citing a humanist who was familiar with the term *volunteerism* as meaning a grass-roots activity, but unfamiliar with its use by political scientists to describe strategies of political action [26, p.134]. The existence of many meanings of a word, or polysemy, impedes communication across boundaries: Spanner cites the word *modern* and its cognates as used in the fine arts and in anthropology [16, p.356]. While scientific terms are considered less ambiguous than the natural language terms used in the humanities and the social sciences, David W.Weisberger cautions that fields in the natural and physical sciences lack commonly accepted and applied nomenclature and terminology standards [27, p.242]. The necessity to assess a term in the context of its use lends further weight to the value of citation chaining as a low risk / high return strategy. It also adds to the challenge of developing effective means of terminology exchange among domains.

The accumulated data from the Getty Online Searching Project on humanities scholars' use of Dialog databases are reported in six published studies [18, 28-32]. Quite apart from questions relating to the relevance of the content and time depth of the databases chosen for the Getty Project, what emerged at the end of the project was an appreciation that online searching would never become integrated into any ongoing humanities research program until basic indexing and interface problems were solved. One fundamental problem is the absence of many terms, as represented in the scholars' search statements, from database indexes. The terms favoured by the Getty scholars were names of individuals, names of works, geographical terms, dates and time periods, and conceptually broad terms such as the names of disciplines as objects of study. The lower-case subject terms , commonly located in thesauri and routinely used by scientists when searching databases, were part of only 57% of the Getty natural language search statements [31, p.337]. When the terms chosen by the scholars were strung together without an understanding of Boolean logic and with no proximity operators, as was most often the case, the results were disappointing. One recommendation emerging from the Getty Project was that a helpful interface could be designed that would allow for filling in a labeled box for major term types such as historical period or geographical area with the Boolean combination of facets done automatically [31, p.339]. Another recommendation was that a capability to use classification codes to create sub-files from large databases, based on broad concepts such as historical period or geographical area,would better address the needs of humanities scholars by approximating the utility of specialized subject bibliographies [31, p.336].

Scatter

For interdisciplinary scholars there are additional challenges associated with the concept of scatter. Scatter is defined as the range and dispersion of

resources available on a topic. Interdisciplinary fields are described as high-scatter: the number of subjects is greater, the problems to be solved are more varied, and the organization of the literature is more loosely structured.
The impact of scatter, among scholars who use journals, is clearly demonstrated when we consider the implications of Bradford's Law. Samuel Bradford's original three zone model conceives a nucleus of a few journals rich with content-relevant articles, a surrounding ring (or zone) with a larger number of journals producing the same total of articles, and finally an outer ring with an even larger number of journals, but again with the same total of articles as in the core and the first ring [18, p.704]. A model using only three zones will be insufficient to delineate the information gathering behavior of a scholar in a high-scatter field for whom unfamiliarity is a valuable characteristic. With reference to utility-relevant articles defined as those which are content-relevant but unfamiliar, Bates proposes a converse of Bradford's Law as suggested by the findings of the Getty Project. While content-relevant articles may remain constant in each zone, the nucleus will be a poor source of utility-relevant articles due to their familiarity to the scholar, while exploring outward through the zones around the nucleus will increase the opportunity of locating articles in the larger universe of journals which are both content-relevant and unfamiliar.

Bates suggests the application of Bradford's Law and its utility-relevance converse to the location of citations to the research literature using formal bibliographic tools: moving outward from a core of discipline-focused databases encompasses an increasing number of electronic or print resources, and provides a constant number of unfamiliar, relevant references in the marginal zones [18, p.705].

Information Seeking: Browsing and Monitoring

Ellis describes browsing as the semi-directed or semi-structured searching in an area of potential interest, and monitoring as maintaining awareness of developments in an area using tried and true sources [13, p.361]. He discovered that scholars in the humanities and social sciences browse and monitor collections of books and journals and scientists browse and monitor journals. While these activities are especially significant for scholars who value serendipity, defined by *The Concise Oxford Dictionary* as "the faculty of making happy and unexpected discoveries by accident", an interdisciplinary scholar in a high-scatter field is confronted with a dilemma: high recall is likely required when serendipity is valued, thus increasing the probability that the scholar with be overwhelmed by a need to browse and monitor scattered content-relevant information which then must be filtered for its utility-relevance.

Just as the protocols of online searching present obstacles for scholars in the initial stage of information seeking, the digitized environment is not browser friendly. Databases are used for locating specific information, but are not amenable to the scanning of texts no matter the knowledge domain. For humanities scholars in particular, characteristic modes of reading, scanning, re-reading and reading for writing, including what Andy Clark, quoted by Blaise

Cronin, calls "thinking *via* the act of writing" [33, p.11], will be more difficult if the texts displayed on the screen lack functions which accommodate the modes of scanning and consultation during composition. If technology complements or enhances customary modes of inquiry, it will be adopted. As Marlene Manoff observes in the case of literary studies, the topics within a field should not have to be chosen because they can be most easily accommodated by computers [34, p.198].

Scholars often refer to the problems they encounter browsing in the library stacks when only a single shelf location can be assigned to a monograph treating several topics. Fortunately, this problem can be alleviated by the assignment of multiple subject headings to the monograph's catalogue record, and the enhancement of catalogue records with tables of contents searchable by keyword. Paul Metz's analysis of circulation data suggests that library classification schemes need not be obstacles for locating and using exogenous materials. Evidence of cross-reading by social scientists, and to a lesser extent by scientists, was greater than the exogenous tendencies revealed by journal citation counts [35, p.69]. Quite apart from the challenge that current trends in interdisciplinary inquiry present to established knowledge classifications, a library classification system routinely juxtaposes subject areas in close physical proximity unmatched by any current or anticipated classification of knowledge. As Metz observes, "classification schemes enjoy an enviable independence of changing disciplinary boundaries"[35, p.72].

Information Seeking: Differentiating

Ellis defines differentiating as the activity that uses the differences between the sources as a filter on the nature and quality of the material examined [13, p.362]. For a researcher this may mean familiarity with both a core of relevant peer-reviewed journals and with the cognitive authorities in the field. The authorities may constitute an invisible college of respected colleagues, present papers at conferences and publish articles in the core journals. An interdisciplinary field may so scattered that it is impossible to distinguish a core literature, and so undeveloped that authorities, or any group that might constitute an invisible college, have not yet emerged. When high recall and serendipity are valued, the interdisciplinary scholar may be reluctant to apply filters.
An interdisciplinary scholar accepts information overload caused by the need for high recall and looser filters to ensure that unfamiliar, utility-relevant documents or document surrogates are not overlooked. Patrick Wilson distinguishes two types of overload: the upkeep overload required to maintain currency which can be associated with the monitoring stage of information seeking, and task overload when information is gathered and then judged relevant for a particular research project [36, p.193].

One faculty member quoted by Spanner observes that interdisciplinary inquiry results in "three times the information and there is no time to look at everything ... Instead of being enriched by the information that is there, you are actually poorer ..." [16, p.359]. The problem is greatest for the scholar who works

alone; a characteristic of much research in the humanities and social sciences. A researcher who is part of a multidisciplinary project team, where information seeking tasks may be allocated, should feel less overwhelmed.

Interdisciplinary scholars' non-use of information may be caused by ignorance of the availability of information or how to access it, or the result of a conscious decision not to make use of it. Wilson has outlined reasons why relevant information about phenomena might be deliberately ignored. Among those which might serve as reasons for differentiating information sources are: territoriality - when certain phenomena are ignored with the assumption that the phenomena in question are or should be another specialty's concern; unmanageability - when phenomena are intractable, beyond one's level of competence, understanding, resources etc.; and the aforementioned oversupply - when the addition of phenomena would result in overloading at a time when more than enough work is at hand [37, p.47].

Researchers who do not require that all relevant information be used, and who adopt rules or habits of prioritization as a strategy, challenge a fundamental tenet of library practice which looks upon the non-use of relevant information as a mistake or accident [37, p.50].

Library Practice

As described above, interdisciplinary scholars not only contend with the same information seeking challenges as their discipline-focused colleagues, but must resolve unique dilemmas. Keeping in my mind that service and collection building ought to be determined as much by the knowledge structure of the community as by its institutional structure, it is time to discuss library practice: the services that librarians can offer to this community as users of library collections, how a collection can be developed to address their needs, and which information skills librarians should teach students which will complement classroom lessons on the nature and methods of interdisciplinary inquiry.
In the Spanner study, the interdisciplinary scholars at the University of Western Ontario shared their preferred methods of information seeking and reliability of sources. When most-to-least favorite methods of locating references were ranked, browsing citations in journals took first place, and using databases tied with colleague recommendations in second place. All faculty in his sample browsed and found browsing useful. When asked to comment on the most reliable information sources, references in publications were cited by 60%, formal bibliographic tools by 29%, and communications from colleagues by 15% [16, p.355]. In the Meho and Haas study, 94.4% of the scholars in Kurdish studies who used government information reported that they located citations to government publications in other works, 72.2% asked or received information from colleagues, 61.6% used online library catalogs, 50% used electronic indexes and databases, and 33.3% used printed indexes [14, p.13].

Using Online Databases

The Getty Project, from the perspective of the period 1988 to 1990, did not envisage a promising future for the integration of online searching by humanities scholars: among a group of twenty-eight scholars over two years, only five individuals seemed unambiguously receptive [30, p.21]. Only one searcher made specific mention of the power of Boolean logic as a tool for combining two or more concepts [30, p.16]. Their lack of enthusiasm can be explained in part by the irrelevant subject areas covered by the Dialog databases to which they had access, the above-mentioned frustrations with interface and terminology, the lack of European and primary source material, and the shallow time depth.

One serious drawback to the use of formal bibliographic tools, both electronic and print, relates to peripheral journals in subjects without long established bibliographic control. An analysis of the indexing of articles from 86 women's studies journals published in 1988 revealed that 53 journals were inadequately indexed or not indexed at all. Even further discrimination existed among constituent fields in women's studies; the analysis of 6 lesbian studies journals revealed that 5 were not indexed and 1 inadequately indexed - and not by a women's studies index, but by the *Alternative Press Index* [38]. A study of scholarly Afro-American journals revealed that only 66% of possible citations from 13 titles published in 1997 were indexed by a combined repertoire of 11 indexing and abstracting services [39]. Another drawback specific to journal coverage is the common practice of dropping and adding titles to be indexed, or transferring the title to another service provided by the same vendor.

The scholar must not only be aware of journal indexing coverage, but also must note if any non-journal sources are covered by a bibliographic tool. Is access restricted to journal articles or is indexing extended to book chapters, patents, technical reports, dissertations, conference papers and other resource categories associated with the term "gray literature" or "fugitive literature"? The inclusion of errata, letters to the editor, continuing commentary on previously published research, all of which may be categorized as ephemera, could report vital information and enhance the value of a service for a researcher [40, pp.65-66]. Given the absence of core journals and an invisible college or comparable group of cognitive authorities, the interdisciplinary scholar may need to use databases to identify seed documents and authors who have potential value as contacts. Green recommends the use of formal bibliographic tools as a strategy to locate seed documents which can be used to initiate chaining in journals and citation indexes. However, when the citations identified from the seed documents were searched in the formal tools, it was discovered that 27% of the cited documents were outside the scope of *WorldCat*, *Dissertation Abstracts International*, and four subject-oriented abstracting and indexing services, and 62% outside the scope of the reference works once *WorldCat* was excluded [23, p.222]. The lack of overlap between informal and formal searches was also noted by Joan B. Fiscella. She discovered that most of the relevant items in a pragmatic bibliography, i.e. a focused bibliography based on citation chaining, colleagues' advice, and browsing and monitoring, were missing from the structured bibliography on the same topic compiled from database search results [41].

The specificity of coverage is also a factor to consider. Green reports that in one-tenth of the instances, when seed documents provided specific citations to journal articles or newspaper articles or chapters within books, the formal bibliographic tools identified these potentially important sources broadly as the title of a monograph, journal, or newspaper [23, p.222].

While the studies on information seeking establish the universal appeal and effectiveness of informal methods, they indicate that scholars will use online databases when a clear benefit is in the offing, but not as their first choice, and usually in combination with other strategies. When care is taken with the selection of databases and the various parameters of each database are clearly explained, the interdisciplinary scholar may be convinced of their value for identifying unfamiliar, relevant references not revealed through the customary practices of browsing and citation chaining.

Swanson identifies multistage interactive searching as one of the strengths of online searching. It is the less the success of a single search that matters than the success of a series of searches modified by the acquisition of new knowledge, the reformulation of a query, and the subsequent revision of a search strategy [20, p.116]. Mizzaro recognizes this multistage interactivity when he conceives of relevance judgments as altering at points in time [17, p.812].

Online citation indexes could serve to introduce the reluctant scholar to the power of database searching. The use of a seed reference for chaining, one of the favorite information seeking strategies among scholars, is replicated in an electronic environment which can be limited to a single domain or encompass arts and humanities, social sciences, and sciences. To the extent that they are independent of vocabulary and subject expertise, citation indexes avoid the pitfalls associated with the translation of natural language into a valid controlled vocabulary or the mastery of Boolean logic to create a search string that will yield precise results. Citation indexes expedite the identity of exogenous influences within a specific discipline by allowing for the combination of subject categories, cited authors, and abbreviated titles of cited works. As with other formal bibliographic tools, their main drawback for interdisciplinary scholars is the need to establish their scope. A known reference can be from a wide spectrum of sources, but the journal articles which cite this seed document, while crossing many disciplines, are still limited to those from titles selected for analysis by the ISI.

The disjunction between the formal methods recommended by librarians and the informal information seeking behavior of an established interdisciplinary scholar, especially one who is fortunate to work within an invisible college, might disappear with the younger generation who as undergraduates acquired mastery in an overwhelmingly online environment. Laura M. Bartolo and Timothy D. Smith compared the effectiveness of manual and online searching for interdisciplinary topics by requiring that two classes of senior-level journalism students locate and evaluate judicial decisions relating to mass media - one class using printed legal reference sources, the second class using LEXIS, a full-text database. When faculty were brought in to judge the decisions identified in the preliminary bibliography, they assigned a mean score of 18 % for relevance to the decisions

listed by the manual search group, and a mean score of 94% for relevance to those listed by the online search group. When they judged relevance in the final bibliography, which required students to evaluate and describe the decisions as landmark court cases, faculty assigned a mean score of 20% to the manual group and 49 % to the online group [42, p.349].

Scholars accustomed to chaining, browsing, and interpersonal contact might be persuaded to explore the potential of digitization at a stage of enhancement greater than the one reported in the Getty Online Searching Project. The introduction of hyperlinks between online index and abstract citations and full-text, and between electronic document reference lists and full-text strongly evokes the origin of *text* from the Latin verb *texere* - to weave; the weaving of document surrogate, document, and document reference knits several stages of the information seeking process into a seamless whole.

The Integrative Review of Research

According to Harris Cooper, when researchers undertake a synthesis for the purposes of publishing a review, half claim the goal of identifying all or most relevant material [43, p.10]. Large databases like Medline or PsycINFO will exclude unpublished research, but they will compensate for an over-reliance on citation chaining which locks the investigator into a network of authors who share biases and who fail to communicate outside a prescribed circle. Databases are even more useful for the generation of meta-analyses: a category of integrative research reviews which focuses on the statistical analysis of a collection of results from individual studies for the purpose of integration, with a potential for valid generalization. If the abstracts in the database state methodologies and results then the high recall, using a search strategy with terms appropriate to the topic, can be qualified with terms or "hedges" which will identify only those documents with empirical content appropriate for meta-analyses [44, p.49].

Research syntheses demand a significant investment of time and labor away from perhaps more career-enabling activities. Librarians have special skills to identify and evaluate sources and search databases that are invaluable at the initial retrieval stage; as well, they can ensure that source selection and search strategies are fully documented in published reviews. However, as with other specialized services, participation in this activity is only feasible where a library's staff size, organization, and available skill sets come together to provide an optimal environment.

Helping the Browser

When librarians try to extrapolate practical guidelines for information service to interdisciplinary scholars, they should note one important characteristic revealed by the surveys which focus on the behavior of this population: browsing is of paramount importance.

In her study of the library as an environment for women's studies research, Lee observes that since collections form a context which can influence

information seeking, collections should be designed with careful attention to the access needs of information seekers [1, p.30]. When Hurd studied interdisciplinary tendencies among a group of chemists, she concluded that the chemists would derive more benefit from the broader collection in a divisional science library than from a departmental library which would serve only part of their information needs [2, p.296]. The high value assigned to serendipitous discovery, as suggested by the browsing habits of interdisciplinary scholars, might influence the organization of a collection, e.g. a central collection on campus as an alternative to satellite libraries dedicated to research fields; or recommend that journals be arranged by discipline, with a separate current issue display, instead of a non-classified arrangement combining back files and current issues in a single alphabetical sequence by title.

Palmer and Neumann conclude that the eclectic reading undertaken by a humanities scholar to build a knowledge base is a systematic process; grounding the new or unfamiliar field in discipline-based journals, textbooks, and canonical works from many subject areas [7, pp. 103-104]. When librarians create meaningful categories of information, they acknowledge that disciplinary boundaries are important for interdisciplinary researchers. It is the very existence of these boundaries that provide the definitions of interdisciplinarity and validate the pursuit of interdisciplinary inquiry. For Liona Salter and Alison Hearn, "an understanding of disciplines sets the context for an appreciation of interdisciplinarity" which they define "as the sum of all the challenges offered by researchers to their own disciplines or to the structure of disciplines in general" [45, p.174]. As well, any attempt by librarians to anticipate the myriad possibilities arising from the practice of interdisciplinarity knowledge is ultimately futile [46].

Women's studies, as the example of a field which can exist as a discipline which has adopted an interdisciplinary mode of inquiry, and as a feminist methodology which critiques long established disciplines from within, is reflected in a library's collection organized by the *LC Classification Outline*: the stack ranges around HQ 1180 representing the core discipline of women and feminism; and to use one example among many, the shelves around HD 6053, in the heart of economics as it were, accommodating the critical analyses of women in the economic sphere. A library's organizational scheme may also scatter the many discipline-based and multidisciplinary / theme issue journals in women's studies thereby requiring of the serials browser the same creative act of integration in the absence of a true interdisciplinary focus.

Current Awareness Services

An open-ended question in a survey of faculty and graduate students at the University of California, Berkeley asked for suggestions on how the quality of library service might be enhanced. Patricia Davitt Maughan reports that online current awareness services were among those recommended, but in fact were already available and publicized by the library [47, p.362].

A library initiated online service that promotes current awareness is often difficult to assess since there is little consensus as to its usefulness for all categories of interdisciplinary scholar. Selective dissemination of information (SDI) is a service which provides content relevant, and presumably unfamiliar, documents or document surrogates to a researcher based on a profile describing a specific research interest. SDI has been reported as beneficial for scientists in high-scatter fields typical of interdisciplinary inquiry, but actually detrimental to the efficiency of scientists in low-scatter fields [48, p.157]. Will the same dichotomy apply to all knowledge domains? The studies on information seeking in the humanities suggest that even scholars in high-scatter fields would not trust an electronic intermediary. A survey of women's studies faculty revealed that seniority can affect both the use and perceived value of current awareness services. While 21% of the respondents often used a table of contents service and the use was equally divided among ranks, more full professors had tried it and rejected it than had the two lower ranks combined [49, p.268].

Collection Development and Evaluation

Library services designed to facilitate information seeking are complemented by the development of monograph and serials collections that serve the needs of interdisciplinary researchers.

The instructional programs specifically directed to interdisciplinary information seeking skill acquisition cite both monograph and serial sources appropriate for discourse synthesis and consensus, i.e. sources that represent the body of knowledge in a field or discourse community at a given moment in its development. While textbooks best exemplify this achievement of synthesis and consensus, Raymond G. McInnis outlines a continuum of reference tools which achieve the same effect: from dictionaries, glossaries and handbooks that provide substantive subject information, the specialized encyclopedias, integrative research reviews and meta-analyses that provide substantive / bibliographic information, and finally the analytical tools, such as annotated bibliographies and citation indexes, which break down the bibliographic structure of discourse into its discrete units [50, pp.31-32]. One faculty respondent to a survey on the information needs in women's studies expressed a need for "This Year's Work in the Field" type of summaries, if "done by top-notch people so that they are really more than a list and really discuss works within a larger framework..." [51,p.200]. Palmer and Neumann also cite the importance of discipline-based textbooks and handbooks for those scholars "attempting to enter a new community of discourse" [7, p.104]. Given the under-citation of these sources in the literature and the deficiencies inherent in web browsers for locating appropriate syntheses, the librarian is the most informed guide to exemplary works of synthesis and consensus.

The development of a core collection of journals in an interdisciplinary field is particularly challenging. Each title represents a commitment of funds over several years. Its very interdisciplinarity may make it vulnerable to cancellation if renewal threatens core disciplinary journals. A new journal in a field may be

acquired without the guidance of a critical review, will need time to establish its authority, and will likely be excluded by indexing services until its reputation and viability has been established. Jeffrey D. Kushkowski, Kristin H. Gerhard, and Cynthia Dobson describe two quantitative methods for identifying established journals in an interdisciplinary field [52]. To locate core journals in the field of industrial relations, the Simple Index Method (SIM) used five online abstracting services to rank 55 relevant journals receiving 10 or more citations in order by total article citation, for the years 1991 to 1995. The Discipline Impact Factor (DIF) method used the ISI *Social Sciences Citation Index* to measure the number of times a source was cited in the literature of industrial relations in order to identify and rank 49 most-cited core titles. The DIF is determined by dividing the number of times that a journal was cited in a set of 4 leading journals in the ISI *Journal Citation Reports* category "industrial relations and labor" in the period 1993 to 1995 with the number of citable articles (or source items) the same journal published from 1990 to 1995. Each method efficiently generates a list of core titles, but lack the qualitative dimension provided by annotated bibliographies of serials, critical reviews, or the evaluations of scholars who are authorities in the field. There was also a striking lack of overlap: only 8 titles from the SIM list were included in the DIF list and only 34% of the titles indexed by the five databases were source titles analyzed by *SSCI*. While the SIM included both research and practitioner journals, the DIF method used only those research titles selected by the ISI for analysis in the citation index.

Using citation impact to identify core titles must take into consideration a recent service phenomenon: the convenience of full-text access from researchers' desktops encourages the use and citing of articles from the major publishers of electronic journals and thus raises the impact factor of these titles in citation indexes. The very journals of most value to interdisciplinary scholars, including those published by small presses and academic presses, may be overlooked. Newly acquired journals are at risk of cancellation as more funds are reserved to support aggregate databases or a publisher's suite of electronic journals. In circumstances where the commitment to support databases is consortial, the local funding environment, which promotes the development of unique and specialized collections, is further depleted. Monograph acquisition is especially compromised when the funds allocated for books are residual to the funds needed for print and electronic subscriptions. The growing inadequacy of local collections shifts the burden to interlibrary loan or commercial document suppliers, and may transfer the cost of information provision from the institution to an individual researcher.

Challenges arise when traditional collection evaluation methods, both user-centered and materials-centered, are applied to interdisciplinary fields [53]. An assignment of relevant call number ranges or subject headings to such a field for a materials count, or any accurate definition of a user community for the purpose of evaluating satisfaction with both local and distant collections and interlibrary loan will be difficult without an information model of the interdisciplinary field in general and as the field is manifested in a campus institute, program or course.

Myoung Chung Wilson and Hendrik Edelman created an information model for The School of Communication, Information and Library Studies (SCILS) at Rutgers University [54]. Their analysis of the sources cited by the SCLIS faculty in their publications revealed that 46% came from subject areas not considered disciplinary fields associated with the School and thus not budgeted for the selector assigned to the School. Concurrently, they discovered that few materials were used in the Z classification that had been supported at the comprehensive research level, and that much material used by faculty and graduate students was shelved in a library collection outside the School. Bryce L. Allen and Brett Sutton created an information model of an interdisciplinary research unit by mapping the intellectual structure of the faculty through interviews on their regular journal reading patterns, an analysis of their use of the library's article photocopy service, and the listing of journals cited in the articles published by faculty as recorded in citation indexes [55]. Allen and Sutton stress the importance of using more than one data collection method to assess the evolving information needs of a user community.

Resource Allocation for Collections

As reported by Westbrook's survey respondents, the problem of library support may not stem from any unwillingness on the part of librarians to acquire materials, but the lack of commitment by the institution to provide funds for collections and resources [51, p.199].

The pressure on the library acquisitions budget brings this discussion back to the status of interdisciplinary inquiry. The debate on the positioning of interdisciplinary fields within the academy is at its liveliest in women's studies. The argument that departmental status may result in the ghettoization of feminist perspectives and present fewer opportunities to engage and critique traditional disciplines from within [56, 57] is questioned by those who maintain that departmental status provides an explicit intellectual validation by the institution, and ensures participation in hiring, promotion, and tenure [58, 59]. The departmental designation will likely provide a departmental budget line, and recognition of its service and collection needs; a subject specialist or other staff member may be assigned as a liaison between the department and the library, and a specific fund may be allocated to the department in the acquisitions budget. If an interdisciplinary program's presence and continuing viability on campus is associated with the activity and interests of one or two instructors with homes in established departments, it is more difficult for the library to develop and maintain a representative collection.

When the Percentage Based Allocation (PBA) model is adopted, the amount of money a university provides a department for instruction and research determines the amount allocated for library support to a department [60]. The PBA model is intended to establish a clear alignment of materials funds and university priorities, and is based on the assumption that the university budget is apportioned according to a well conceived academic plan. While the model, based as it is on pre-existing institutional statistics, seems simple to introduce and

administer, it still has not supplanted the use of formulas among those institutions that use some method to allocate the library acquisitions budget.

Although the link between departmental status and collection support is less explicit in formulas, the annual data used to calculate the allocation usually reflect the comparative strengths of departments by including such factors as the size of faculties, enrolment levels, student credit hours, and the number and level of courses. Metz's evidence on cross-disciplinary use of monographs suggests that at the very least a formula should include circulation data as indicators of the demand made on the library's subject collections. If interdisciplinary resource needs are to accommodated in a formula-based scheme, it may be necessary to slice the budget into thinner segments by creating a separate fund line for each interdisciplinary program, or to set aside one part for interdisciplinary purchasing. Even in those instances when established courses are cross-listed and taught by existing faculty, it is unlikely that a new interdisciplinary program can be introduced and maintained without any impact on the library budget.

Bibliographic Instruction

Spanner alludes to the possible "trickle down" effect on students as the curriculum shifts to encompass interdisciplinarity [16, p.359]. However, the proliferation of first-year seminars, general education courses without disciplinary prerequisites, and undergraduate programs in such hybrid fields as area studies, women's studies, gerontology,child study has not generated a significant body of literature describing librarian-initiated programs to guide the information seeking behavior of interdisciplinary students.

Edmund F. SantaVicca's ambitious program of interdisciplinary bibliographic instruction for students in linguistics, adopts a system of parallels (or lack of same) between two or more disciplines [61]. The model of parallel logic is based on progressing through six logical planes: i. Comparative definition and organization of disciplines as perceived by those operating within the disciplines and revealed in sources such as textbooks, overview articles, interviews, ii. Introduction and explanation of classified arrangements of indexing and abstracting services and key bibliographies as these reinforce the discipline's organizational scheme, iii. Assignment by the instructor and formulation by the instructor or student of a topic and a thesis statement, iv. Interdisciplinary application of logical methods for accessing classification systems and subject headings in order to minimize unproductive search strategies and maximize the yield of relevant information , and v. Boolean logic and other manipulations of online systems as these reinforce parallel logic and the concepts already presented.
SantaVicca's emphasis, at the first plane of the model, on the comparative relationship of disciplines, and how an individual's approach to pursuing information on a topic is contingent upon that individual's perception of the topic, nicely complements William H. Newell's contention that it is important for students in interdisciplinary courses to reflect on how each discipline contributes to an analysis of a topic, i.e. the discipline's questions, concepts and theories.

When students learn to think like a member of a discipline, rather than to focus on what the discipline's practitioners have to say about a specific topic, they are educated and empowered, rather than merely trained and indoctrinated [62, p.216]. Scholarly disciplines are defined as much by characteristic forms of discourse and argumentation encompassing shared methodologies, criteria of validity, terminology, and rhetorical conventions as by any consensus on what constitutes the subject matter of a field.

SantaVicca's assurance, at the fourth plane of the model, that individual logic can be superimposed on arbitrary classifications of knowledge is supported by Bryce Allen's study analyzing the responses of philosophy and psychology students to questions arising from interdisciplinary topics [63]. Allen concludes that a scholar's disciplinary background will affect the use of vocabulary when responding to open, unstructured questions; but it is not possible to predict how the background of a scholar will affect the more structured statements that express an information need. Since it is not possible to select an index or thesaurus based solely on our knowledge of an individual's academic discipline, a wide range of reference sources should be offered without imposing any preconception about the information seeker's cognitive structure and vocabulary choice.

A second bibliographic instruction program described in the literature, while less developed than SantaVicca's model, offers a focused approach to developing interdisciplinary skill sets. Paula R. Dempsey requires students in an interdisciplinary master's program to identify experts in an area of interest, then gather and maintain a log on a wide range of reference sources that provide evidence of their authority [64]. This focus calls for some reflection on the production and dissemination of knowledge similar to SantaVicca's first plane. Since the class time devoted to the instructional part of the program is limited to a single three-hour period, there is no opportunity to compare classification systems and thesauri, or progress to the stage of topic and thesis definition as in SantaVicca's program. Dempsey's students map their information seeking strategy by locating evidentiary sources in specialized encyclopedias, periodical indexes, *Dissertation Abstracts*, citation indexes, and government documents, in the process exploring beyond the narrow confines of core journals and books into unfamiliar but productive areas. Dempsey's map does acknowledge one very familiar and superficially productive area- the World Wide Web, thereby providing an opportunity to compare and contrast the use of descriptors, controlled by the standards of a thesaurus or subject-headings list to retrieve relevant citations from a research-oriented database, with the automated indexing used by web browsers to locate resources of varying provenance and doubtful cognitive authority.

In the area of bibliographic instruction, the practices suggested by SantaVicca and Dempsey to facilitate interdisciplinary inquiry are widely accepted at present; they reflect the values and goals of librarian proponents of information literacy, and lifelong learning. They sit comfortably within one professional orientation: librarians as generalists; or "specialists in generality" (if one adopts Michael F. Winter's critical perspective) [65, p.354]. However, just as the writing across the curriculum movement has evolved from a focus on building

generic composition skills to a focus on writing *in* the disciplines [66, p.336], bibliographic instruction should not be restricted to teaching generic information seeking skills. Librarians ought to learn about the social environment that engenders and sustains knowledge within and across the disciplines, and how this "ethnography of knowledge production" [65, p.344] affects the behaviors of information seekers in the humanities, social sciences and sciences. At the very least, librarians will better understand the divergence from what they determine as best practices , based on their education and experience, when addressing and critiquing the customary information seeking practices of scholars.

Conclusion

It is not surprising that Meho and Haas recommend that access be defined as a separate category in the Ellis model of information seeking behavior. The literature shows that librarians see themselves as enablers: they want to solve problems for interdisciplinary scholars and create conditions conducive to interdisciplinary inquiry based on their interpretation of the studies on information seeking behavior. The challenges to providing access may be easy to surmount with a minor change to an established local policy or procedure, or they may require a significant commitment of funds, staff and skills, or they may be beyond the immediate control of a library: for example, when requesting changes to an online database's search screen or expanded and consistent coverage by a journal indexing service. Certainly there is ample evidence of the willingness of librarians to provide an optimal environment where interdisciplinary inquiry may thrive. Perhaps the interdisciplinarity of library and information science as a research field makes its practitioners particularly receptive to this mode of inquiry.

However, challenges beyond the immediate purview of librarianship must be understood and resolved. Susan E. Searing concludes her article on the challenges specific to interdisciplinarity with a suggestion that Julie Thompson Klein's three "explanations" may serve as a useful framework for understanding the library's choice of appropriate response [66, p.337]. The normal explanation holds that cross-boundary inquiry is a usual characteristic of knowledge growth and can be brought into the disciplinary order; the exceptional explanation holds that, since disciplinary boundaries are obstacles to cross-disciplinary inquiry, the inquiry will need to be accommodated in programs, centers or hybrid fields; and the oppositional explanation holds that the very premise of disciplinarity must be contested by the creation of alternative structures for counterdisciplinary knowledge production. Within mainstream institutions either the normal or exceptional explanation may prevail and hence determine the library's response. More likely, these two explanations with coexist in a college or university: manifested in informal hybrids implanting interdisciplinary courses and assignments within the normal knowledge work of departments, and in institutionalized hybrids accommodated by interdisciplinary departments, programs and centers. Too often the library's response is ad hoc; and likely constrained by the exigencies of time and budget. Librarians need to keep themselves informed about how interdisciplinary knowledge is produced in

general and, most importantly, how it is interpreted and sustained by the academic plan of their own community. An accurate and comprehensive information model created by librarians in consultation with instructors and researchers will ensure that appropriate service modules and resources are provided for new and evolving courses and pedagogies.

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