Literature Retrieval for Interdisciplinary Syntheses

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ABSTRACT

THIS ARTICLE CONTAINS SUGGESTIONS for retrieval of bibliographic data: (1) by those interested in revealing interdisciplinarity, and (2) by those interested in being interdisciplinary. It is the latter who are most likely to produce interdisciplinary syntheses. Retrieval depends on bibliographic markers of various kinds, some of which divide disciplines. A major bibliographic indicator of interdisciplinarity is occurrence of the same marker on both sides of a disciplinary divide. Bibliographic markers, however, are not reliable for distinguishing lesser kinds of syntheses from high-level integrations of substance. Dialog's RANK command is demonstrated as a means of revealing interdisciplinarity in any field, using various search terms as starting points in LC MARC–Books and the citation databases of the Institute for Scientific Information (ISI). Next discussed are retrieval techniques for persons who are interested in synthesizing work from their own discipline (e.g., library and information science) with work from another discipline. Searchers can begin with authors or subjects from outside their own field and learn how these have been used within it, or they can begin with authors or subjects from within their own field and learn how these have been used outside it. Examples are given for all retrieval techniques. Interspersed are discussions of creativity, the connection of hitherto unconnected literatures, the retrieval and assessment of syntheses, and the nature of library browsing.

INTRODUCTION

A few years ago, in *The Handbook of Research Synthesis,* this author wrote about retrieving literature for a certain kind of review—the meta-analytic in which the aim is to collect all empirical studies on a topic (even unpublished ones), so that the statistical effects reported in them can be compared and, through new statistical operations, integrated (White, 1994). While demanding of skill and effort, such meta-analyses are not necessarily interdisciplinary in nature—in fact, most probably occur within a single specialty or subspecialty, in which different researchers have measured similar things again and again. Given the theme of this issue of *Library Trends,* this discussion will turn to interdisciplinary syntheses, leaving meta-analytic reviews to the earlier piece and to Smith's article in this issue.

Using current online technology, I shall offer some suggestions for retrieval of bibliographic data with two groups in mind: those interested in *revealing* interdisciplinarity—i.e., in tracking and studying it as it already exists—and those interested in *creating* interdisciplinarity—i.e., in incorporating matter from different areas of knowledge in new works of their own. While either group may contain authors doing original work, and either may be served by retrieval specialists such as librarians, the two groups plainly differ. The first take interdisciplinarity as the *subject* of their inquiries (as it is, archetypally, for Klein, 1990) and use bibliographic data as evidence for claims about the nature of interdisciplinarity in some particular case. The second group, in contrast, may take anything under the sun as their subject matter; they are simply *being* interdisciplinary by drawing on authorities from more than one field. For them, bibliographic data are adduced to support claims about the world, in the general scholarly style, rather than serving as evidence of interdisciplinarity per se. Their work might be considered as raw data by the first group, who stand in a "meta" relation to them.

Properly speaking, interdisciplinary *syntheses* are a product of this second group. Although hard to define, such syntheses are easy enough to recognize. An interdisciplinary synthesis might use concepts from one field to describe or explain things of central importance in another (e.g., Harter, 1992; Sandstrom, 1994). Or it might unite parallel but hitherto separate concepts within a new superordinate scheme (e.g., Robertson, 1971). At its best, it might blend concepts from different disciplines so subtly that no mechanistic formula could describe it; it would simply represent a unique fusion of the author's wide-ranging knowledge (e.g., Koestler, 1964; Gardner, 1985; Lakoff, 1987). Whatever the case, it would involve a creative transfer not merely of vocabulary but of a whole frame of mind, so that the subject matter being fused took on a new kind of meaning. Ideally, it would convince the reader that the field providing the frame of mind could not be easily replaced by another one.

Such writings are clearly at the high end of a continuum of integration. Many other writings exhibit certain features of interdisciplinarity

without being syntheses in the strong sense just described. To pursue this matter, however, we need a sketch of what constitutes objective evidence of interdisciplinarity in authors' *oeuvres* or disciplinary literatures.

MARKERS OF INTERDISCIPLINARITY

Literatures are bodies of writings by different authors whose common features are shown by explicit markers. Markers are character strings—usually words, phrases, and numerals—whose meanings, established by convention, are more or less stable over time. Markers may appear in the full texts of writings or in verbal models of writings—that is, in bibliographies, interpreting this term broadly. They include such well-known types as descriptors, subject headings, and keyword noun phrases from natural language.

Disciplinary markers, an important subset, identify writings by the discipline (or field) in which they originate. The names of abstracting and indexing services do this for the articles and papers they cover. Library of Congress or Dewey classification codes, properly interpreted, do it for monographs and serials. Other sets of markers, such as journal titles, article titles, and descriptors, often imply a writing's disciplinary origin without stating it explicitly.

Within this world of literatures and markers, claims about linkages between disciplines—about interdisciplinarity—can be operationally defined. That is, they can be made in such a way that different observers can gather the same evidence on them in the form of classifiable and countable observations. The major indicators of interdisciplinarity along this line are occurrences of the same markers on both sides of a disciplinary divide—especially when these recur and pile up. Such co-occurrences link the disciplines. Crude measures of interdisciplinarity are simply frequency counts of these co-occurrences.

Classification codes do not occur in this way since they *are* disciplinary divisions—mutually exclusive by design—but other markers do—e.g., authors' names. As one indicator of interdisciplinarity in individual authors, we might note whether any books they have published are classified outside their primary disciplinary fields. Thus, a contributor to this issue of *Library Trends* has published books classified in library and information science, his primary field, and in philosophy, a field in which he was trained. His name is a marker that links their LC classification codes:

Z   BD

Patrick Wilson   Patrick Wilson

This could be read as evidence either of Wilson's own interdisciplinarity or, more abstractly, of some degree of commingling of information science

and sociology of knowledge (Wilson, 1977, 1983). Other authors associated with the Z classification who have published books classified in other fields include William S. Cooper (1978) in the P classification and Gerard Salton (1988) in the QA classification. Of course, to establish the extent to which authors are actually commingling fields, we must examine their books. While Wilson, Cooper, and Salton qualify as interdisciplinary synthesizers, not all variegated authors do qualify as such; they may simply be exhibiting diverse interests at different times. The bibliometrician S. C. Bradford published his well-known book on documentation (1948) after one on roses (1946) without synthesizing information science and horticulture.

Possibly the most important interdisciplinary markers are those in which an author in one field cites the work of an author in another, thereby bringing a marker of that work across a disciplinary divide. Porter and Chubin (1985) call these "citations outside category" (COCs). They distinguish two sorts:

1. breadth of citation BY a given article (or journal or research category); and
2. breadth of citation TO a given article (or journal or research category).

These may be designated as outgoing and incoming citations respectively. Assume that article *XYZ* is assigned to a subject category—e.g., economics. It may well cite other works. If so, one may ask, Are any *outgoing* citations made to works classified in some other discipline—across the border, so to speak? Similarly, one can ask whether any citations *incoming* to article *XYZ* are from disciplines outside economics. Instances of either sort are COCs and are explicit indicators of interdisciplinary ties. Explicit interconnections among literatures are strong evidence for the state of interdisciplinarity at any given time. The patterns in which markers co-occur between disciplines are the key (their failure to co-occur may also be meaningful; see Swanson, 1987, 1989).

In the following schema, one can see the play of the markers around article *XYZ*, which is taken as central. The marker for article *ABC* appears on both sides of a disciplinary divide as an outgoing citation from article *XYZ*. The latter's marker then appears on both sides of a divide as an incoming citation from article *MNO*.

Sociology	Economics	Information Science
Article *ABC*	Article *XYZ*	Article *MNO*
	cites	*cites*
	Article *ABC*	Article *XYZ*

By declaring some (operationally defined) category as central and then aggregating "citations outside category" across many writings, one can

determine what fields a given literature draws upon and what fields it con-
tributes to—and in what proportions. (Porter and Chubin's "breadth" adds
a rough measure of intellectual distance between fields, such that economics
would be further from, for example, chemistry than it is from another social
science like sociology.) Over the years, a fair number of authors in informa-
tion science (e.g., Earle & Vickery, 1969; Nicholas & Ritchie, 1978; Hurd,
1992) have tabulated outgoing and incoming citations to reveal broad pat-
terns of intellectual indebtedness within literatures. Counts of outgoing cita-
tions show that some fields (such as economics) draw relatively little on other
fields; others draw much. Counts of incoming citations show that some fields
(such as library and information science) contribute relatively little to other
fields; others contribute much.

Such counts may now be quite easy to obtain—for example, through
Dialog's RANK command—as will be demonstrated below. However, even
when interdisciplinary citations are plentiful, they do not necessarily rep-
resent integration in the strong sense. One must still inquire into the
quality of the interdisciplinarity attained, and it could turn out to be rela-
tively superficial. Some citations might merely be rhetorical grace notes,
as when someone in, for example, library and information science (LIS)
alludes briefly to ideas of the mathematician Kurt Gödel or the philoso-
pher Karl Popper. Some might refer to material from other fields that is
used simply as illustration (e.g., the case histories throughout Klein, 1990)
or as raw data (e.g., the studies in LIS that treat as data the literatures of
other fields such as McCain & Whitney, 1994).[1] Still others might indi-
cate integration only at the level of methodology (e.g., models borrowed
from statistics or mathematics) rather than main substance (Meadows
[1976] calls such borrowing transdisciplinary as opposed to interdiscipli-
nary). Since interdisciplinarity admits degrees, the term *synthesis* will be
reserved here for those writings that integrate fields in the strong sense—
i.e., at the level of main substance.

Unfortunately, *synthesis* in this sense is a difficult concept to
operationalize through markers. Since all learned writings synthesize to
some extent, the relevant task is determining whether the author is work-
ing in one disciplinary tradition or more than one. But this is often a
complex and subtle matter in which different judges may well reach dif-
ferent conclusions. Occasionally, a work is explicitly revealed as an inter-
disciplinary synthesis through its title or subtitle (e.g., Koopman & Hunt,
1988), its table of contents, or the blurb on its jacket, but it must often be
the case that syntheses that are in fact interdisciplinary are not marked as
such in any readily discoverable way, short of reading them (book reviews
sometimes reveal it).

Moreover, there seems to be no *algorithmic* way of differentiating a
true interdisciplinary synthesis from a work that is only superficially in-
terdisciplinary, if one uses as markers solely what it cites; the same set of
outgoing citations could appear with either. As a result, apparently, one

cannot create a search strategy that reliably breaks out syntheses from nonsyntheses in the citation databases of the Institute for Scientific Information (ISI). One can break out reviews of the literature in these databases by asking for them as a document type (Select DT=Reviews) or by taking them from a publication known to publish reviews. But that is not quite the same thing, since many true syntheses would not be considered reviews by their authors or labeled as such when they appeared. We shall grapple a bit more with this problem in the discussion of retrieval techniques below.

A separate problem, even when a true interdisciplinary synthesis is found, is the degree to which it succeeds. Two major reasons for criticism are: (1) attempting to unite the wrong things, and (2) failing to unite the right things. An example of the first is Heilprin (1989) which, in this author's opinion, prematurely tries to ground information science in physical systems theory. As an example of the second, failing to unite the right things, Swales (1986) comes to mind. A plausible effort to unite discourse analysis—Swales's field—with citation analysis nevertheless manages to omit most of the major works in the latter, such as the entire writings of Henry Small. Indeed, a common negative reaction to an attempted synthesis must be that the writer has failed to search the literature adequately or to learn of highly relevant work that should have been taken into account. Probably many people would regard the book *Relevance* (Sperber & Wilson, 1986) as a successful interdisciplinary synthesis, but Wilks (1982) is frankly contemptuous of an earlier presentation (Sperber & Wilson, 1982) because the authors neglect, in his view, the relevant literature from his field, artificial intelligence (AI). Schank (1995) is another AI researcher's dismissal of another well-reviewed synthesis, *The Emperor's New Mind* (Penrose, 1989).

Since intellectuals read what they want to read and cite what they want to cite, no moralizing about how they ought to have searched the literature is likely to change behavior. But ISI-style citation retrieval may be of help to some in that it may lead to useful criticism of the attempted synthesis. It may also help assess the impact of syntheses already published, as will be shown.

REVEALING INTERDISCIPLINARITY

The motive in *revealing* interdisciplinarity (as opposed to creating it) is that one is simply trying to learn the degree to which some complex of fields have made use of each other. Typically, one would be studying fields other than one's own, although that, too, could be studied in this objective way. But, as noted above, one would not be trying to effect a synthesis between one's own field and others; the fields of interest would be used mainly as data rather than substantively.

There are now several labor-intensive bibliometric analyses scattered through the literature that meet this description. While the genre will continue to attract ambitious scholars (e.g., Neeley, 1981; Rogers & Ander-

son, 1993; McCain, 1994), information specialists and end-users should be aware that there is an easier way to gather intelligence on interdisciplinarity— one that may help both groups "make effective, fast, and light-handed use of unwieldy instruments" (White et al., 1992, p. 246).

In the United States, this way makes use of the software of major online database vendors—i.e., Dialog's RANK command or Orbit's GET command (European vendors have similar commands).   In Dialog and Orbit data- bases, it is now possible to form a set of documents with one kind of indexing term (such as a descriptor or a natural language phrase) and then, through RANK or GET, to display the indexing terms that co-occur with the input term in every record of the retrieved set. At the searcher's option, these co- occurring terms may be the same kind as the input term or a different kind. Depending on the database, they may be descriptors, identifiers, concept codes, LC subject headings, LC classification codes, journal titles, authors' names, and so on—a variety of bibliographic markers. By default they are displayed high to low in order of frequency of co-occurrence; they may also be requested in alphabetical order.

This interconvertibility of terms, discussed in White and McCain (1989, pp. 124-28), has always been possible, but with manual methods it is prohibitively slow in large files. GET- or RANK-type software is a fairly recent innovation in the United States that gives searchers considerable new powers (White, 1990; Snow, 1993). The significance of fast interconvertibility in the present context is that, if one has a term ex- pressing the name of a discipline or a specialty, one can use it to form a set of documents online, display the co-occurring terms, and see which, if any, of them cross disciplinary divides. Large-scale profiles of connec- tions between disciplines and specialties are now perfectly feasible.

To demonstrate, Dialog's RANK command, dating from early 1992, will be featured with a variety of bibliographic markers (Readers will be presumed to know the basics of Dialog retrieval. Dialog outputs used as examples are real but edited). The first example shows a capability that probably has not been much exploited by librarians, to say nothing of end-users. That is to convert one kind of marker, LC classification codes, into another, their associated LC subject headings, in the LC MARC– Books database, which covers books cataloged by the Library of Congress since 1968.

The classification code chosen is GN 365.9, which stands for "Bio- logical determinism. Sociobiology." Sociobiology is itself usually consid- ered an interdisciplinary field. In the following presentation we can see something of its components and also its ties (as perceived by subject catalogers) with fields beyond its usual range of connotation.[2]

First we select all documents posted to the classification code (CA). A space is necessary between 365 and .9, and a final truncator (?) is used to eliminate the Cutter numbers of the individual titles:

? SELECT CA=GN 365 .9?

The computer returns in Set 1 the 108 documents that meet this description:

S1   108 CA=GN 365 .9?

We then ask RANK to display the LC subject headings assigned to this set in order of their frequency. The standard Dialog code for subject headings is DE (for "descriptors"), and we ask that they be displayed "continuously" (CONT), one of the available options:

? RANK DE CONT

In the resulting list, "Sociobiology" appears as a subject heading in 104 of the 108 records retrieved; "Social Evolution" occurs in 21, and so on:

Rank No.	No. Items Ranked	Term
1	104	SOCIOBIOLOGY
2	21	SOCIAL EVOLUTION
3	15	HUMAN EVOLUTION
4	12	HUMAN BEHAVIOR
5	12	NATURE AND NURTURE
6	12	PHILOSOPHY
7	8	SOCIAL ASPECTS
8	7	SOCIAL BEHAVIOR IN ANIMALS
9	6	CONGRESSES
10	6	MAN
11	5	BEHAVIOR
12	5	BEHAVIOR EVOLUTION
13	5	HUMAN BIOLOGY
14	5	PRIMATES
15	5	SOCIAL DARWINISM
16	4	ADDRESSES, ESSAYS, LECTURES
17	4	BIOLOGY
18	4	CULTURE
19	4	EVOLUTION
20	4	GENETIC PSYCHOLOGY
21	4	SOCIAL POLICY
22	4	SOCIAL STRUCTURE
23	3	ANIMAL NATURE
24	3	ANTHROPOLOGY
25	3	BRAIN
26	3	COGNITION AND CULTURE
27	3	OPTIMISM
28	3	POWER (SOCIAL SCIENCES)
29	3	PSYCHOLOGY, COMPARATIVE
30	3	SOCIAL SCIENCES
31	2	EQUALITY
32	2	HUMAN POPULATION GENETICS
33	2	NATURE AND NURTURE
34	2	PHILOSOPHICAL ANTHROPOLOGY
35	2	RACE
36	2	SCIENCE
37	2	SEX
38	2	SEX DIFFERENCES
39	2	SOCIAL PSYCHOLOGY
40	2	SOCIAL VALUES
41	2	SOCIOLOGY

The process of generating such lists from an input term vaguely re-sembles breaking forms of radiation into spectra, though these "litera-ture spectra" change over time, unlike those in nature. Once they are more or less settled, however, they are both distinctive and informative.

The lists can be hundreds of items long, especially if one includes the items that occur only once. Therefore, the one above has been lim-ited to subject headings that appear in at least two records. There are slight distractions: "Nature and Nurture" is ranked in two places because of a typo, and some terms, such as "Social Aspects" and "Congresses," are not subject headings but "dash-on" subdivisions.[3] Nevertheless, the list clearly gives leads for tracking different manifestations of subjects within class GN 365.9. For example, one can distinguish writings on human beings and on other animals. One can infer different specialty shadings within sociobiology such as "Brain" or "Sex Differences." And one can look for interdisciplinary crossings of interest, such as the four titles linked to "Genetic Psychology" or the three titles linked to "Anthropology."[4]

The software permits one to save all connections by their rank num-bers. However, when they reappear as sets in their own right, they are no longer combined with (ANDed with) the input term. Thus, if one wanted to retrieve the 12 titles linking GN 365 .9 with "Philosophy," the simplest way would be to enter:

SELECT CA=365 .9? AND DE=PHILOSOPHY

and then display the titles in the resulting set.[5] Whether one would get high-level syntheses in this retrieval is uncertain, of course, but at least one would have a plausible group of works to browse.

In LC MARC–Books, it is also possible to run the above operation in reverse—that is, to start with an LC subject heading (DE) and then to rank all the LC classification and Dewey codes (CA) that co-occur with it:

? SELECT SOCIOBIOLOGY/DE
                          S2   285 SOCIOBIOLOGY/DE
? RANK CA CONT

The ten most frequently occurring class codes follow. Note that LC and Dewey class codes are mixed in the ranking.[6]

Rank No.	No. Items Ranked	Term
1	104	GN 365
2	103	9
3	87	304
4	77	304.5
5	22	306
6	20	301
7	15	155
8	14	HM 106
9	14	301.2
10	14	305

Starting from class numbers (or ranges) or subject headings, librarians could use these capabilities to analyze interdisciplinary aspects of their collections. They could also employ the same means to help end-users find interdisciplinary monographs.

LC MARC–Books is a very valuable database for investigations of this kind because of its universal coverage of subject matter. Comparably valuable for the journal literature are the citation databases of the Institute for Scientific Information. In the next example, ISI's Social Scisearch is used to analyze the subject areas penetrated by articles in behavioral ecology. The input terms were:

? SELECT BEHAVIORAL(W)ECOLOGY OR BEHAVIOURAL(W)ECOLOGY
     OR BEHAVIOR?(2N)ECOLOG?

This produced a retrieval of 295 articles after duplicates were removed. These were ranked by their subject categories (SC) using the "Continuous" option:

? RANK SC CONT

The result is a very clear display of the interdisciplinary nature of behavioral ecology. The ranked subject codes are actually applied by ISI to the *journals* in which the articles appear. Anthropological journals top the list, but articles in psychology journals are in fact more numerous if all types of psychology are considered. As noted above, RANK can present listings alphabetically if that is needed to make subjects easier to find. And, again, sets may be saved by their rank numbers for further processing.

Rank No.	No. Items Ranked	Term
1	60	ANTHROPOLOGY
2	49	PSYCHOLOGY
3	47	ZOOLOGY
4	36	BEHAVIORAL SCIENCES
5	33	BIOLOGY, MISCELLANEOUS
6	17	SOCIOLOGY
7	16	MULTIDISCIPLINARY SCIENCES
8	10	ENVIRONMENTAL STUDIES
9	10	PSYCHOLOGY, CLINICAL
10	9	ECOLOGY
11	9	SOCIAL SCIENCES, BIOMEDICAL
12	7	PSYCHOLOGY, EDUCATIONAL
13	7	PSYCHOLOGY, EXPERIMENTAL
14	7	PSYCHOLOGY, SOCIAL
15	6	ARTS & HUMANITIES, GENERAL
16	6	GENETICS & HEREDITY
17	6	PSYCHOLOGY, DEVELOPMENTAL
18	6	PUBLIC HEALTH
19	5	DEMOGRAPHY
20	5	PSYCHIATRY
21	5	SOCIAL SCIENCES, INTERDISCIPLINARY
22	4	ARCHAEOLOGY

23	4	BIOLOGY
24	4	EDUCATION & EDUCATIONAL RESEARCH
25	4	POLITICAL SCIENCE
26	3	EDUCATION, SPECIAL
27	3	ENTOMOLOGY
28	3	HISTORY & PHILOSOPHY OF SCIENCE
29	3	MARINE & FRESHWATER BIOLOGY
30	3	NEUROSCIENCES
31	3	ORNITHOLOGY
32	3	REHABILITATION
33	2	BUSINESS
34	2	CRIMINOLOGY & PENOLOGY
35	2	ENVIRONMENTAL SCIENCES
36	2	MANAGEMENT
37	2	SOCIAL WORK
38	1	AGRICULTURE, DAIRY & ANIMAL SCIENCE
39	1	GERIATRICS & GERONTOLOGY
40	1	MATHEMATICS, MISCELLANEOUS
41	1	NURSING
42	1	PALEONTOLOGY
43	1	PHILOSOPHY
44	1	PHYSIOLOGY
45	1	PSYCHOLOGY, MATHEMATICAL
46	1	TRANSPORTATION
47	1	URBAN STUDIES

The same set of 295 articles can be analyzed on the basis of journals in which they appear. To produce the following list we simply ask for the journal names (JN):

? RANK JN CONT

Out of 170 journals, only those containing at least three articles are shown. The diversity of fields is still clearly evident:

Rank No.	No. Items Ranked	Term
1	25	AMERICAN JOURNAL OF PHYSICAL ANTHROPOLOGY
2	18	ANIMAL BEHAVIOUR
3	9	AMERICAN ANTHROPOLOGIST
4	7	CONTEMPORARY PSYCHOLOGY
5	7	ETHOLOGY AND SOCIOBIOLOGY
6	7	JOURNAL OF HUMAN EVOLUTION
7	6	HOMO
8	5	ETHOLOGY
9	4	JOURNAL OF SCHOOL PSYCHOLOGY
10	4	TRENDS IN ECOLOGY & EVOLUTION
11	3	BEHAVIORAL AND BRAIN SCIENCES
12	3	HUMAN ECOLOGY
13	3	JOURNAL OF ANTHROPOLOGICAL RESEARCH
14	3	JOURNAL OF ENVIRONMENTAL PSYCHOLOGY
15	3	NATURE
16	3	POLITICS AND THE LIFE SCIENCES
17	3	PSYCHOLOGICAL RECORD
18	3	SCIENCE

The point in producing this latter list is that, in some cases, a librarian or end-user might be interested not only in interdisciplinary linkages but also in the particular journal in which a linkage manifests itself. To such a person, a lead to, for example, the *Journal of School Psychology* might be more useful in deciding whether to pursue a retrieval than a broad subject category like "Psychology, Educational."

Thus far, the input terms have named broad fields of learning—sociobiology and behavioral ecology. But more specialized areas of research can also be analyzed with the RANK command. The next analysis, conducted a few years ago in Medline (File 155), began with the formation of a set of writings on pregnancy, schizophrenia, and low birth weight:

? SELECT PREGNAN? AND SCHIZOPHRENI? AND WEIGHT

Forty records were retrieved and their descriptors ranked. Only terms occurring at least five times in the set are listed below. As an idiosyncrasy of Medline, the abbreviations for standard descriptor subdivisions (such as GE for "Genetics" and CO for "Complications") show up as separate terms; they may be disregarded. Of primary interest are the pointers to different disciplinary components of this literature. The medical, the genetic, the psychological, and the epidemiological are all represented for retrieval:

Rank No.	No. Items Ranked	Term
1	36	PREGNANCY
2	34	SCHIZOPHRENIA
3	27	BIRTH WEIGHT
4	25	GE
5	25	GENETICS
6	21	INFANT, NEWBORN
7	21	SCHIZOPHRENIA—GENETICS—GE
8	20	ADULT
9	18	PREGNANCY COMPLICATIONS
10	16	ET
11	16	ETIOLOGY
12	12	CO
13	12	COMPLICATIONS
14	12	LABOR COMPLICATIONS
15	11	ADOLESCENCE
16	11	DISEASES IN TWINS
17	11	SCHIZOPHRENIA—ETIOLOGY—ET
18	11	SCHIZOPHRENIC PSYCHOLOGY
19	9	CHILD
20	8	DI
21	8	DIAGNOSIS
22	8	INFANT
23	8	PSYCHOLOGY
24	8	PX
25	7	CHILD DEVELOPMENT
26	7	SCHIZOPHRENIA—DIAGNOSIS—DI
27	6	INFANT, LOW BIRTH WEIGHT

28	5	CHILD, PRESCHOOL
29	5	EP
30	5	EPIDEMIOLOGY
31	5	RISK
32	5	SCHIZOPHRENIA, CHILDHOOD
33	5	SEX FACTORS
34	5	TWINS
35	5	TWINS, MONOZYGOTIC

At this point someone might wonder why searchers would not simply "cut to the chase" with terms stating what they want rather than exploring term co-occurrences with RANK. The answer is that, while it is relatively hard to think of—or look up in thesauri—the various terms in which one might need to express an interest, it is relatively easy to recognize terms once one sees them in displays like those shown above. What one sees, moreover, is the correct form of a term for searching as opposed to plausible variants of it (e.g., "Schizophrenia, Childhood," rather than, say, "Schizophrenia in Children"). One can also make use of their associated postings counts in deciding on next steps. In effect, the RANK command presents one with a customized guide to terms—a product all the more valuable because it is based not on the meanings and paradigmatic relationships of the terms as found in thesauri but on their syntagmatic connections in the literature. Those connections assure one that there are writings on the connected topics to be retrieved, even if their worth is still uncertain.

As a final example, consider the following guide to terms for an applied field that is highly interdisciplinary—human-computer interaction (HCI). This field was not defined by a single descriptor or natural-language phrase. Instead, it was defined as consisting of the literature in seven journals. The seven were chosen by a Drexel colleague, Gary W. Strong, who, under National Science Foundation sponsorship, had both teaching and research interests in HCI. In December 1993, we retrieved all the articles in these journals covered in the INSPEC database. The counts are as follows:

No. of Articles	Journal Name
1,081	INTERNATIONAL JOURNAL OF MAN-MACHINE STUDIES
347	BEHAVIOUR AND INFORMATION TECHNOLOGY
64	HUMAN-COMPUTER INTERACTIONS
104	INTERACTING WITH COMPUTERS
71	ACM TRANSACTIONS ON INFORMATION SYSTEMS
245	HUMAN FACTORS
428	ACM SIGCHI BULLETIN
2,340	

We then rank-ordered the descriptors in the 2,340-article set by frequency of occurrence. There were 698 different descriptors—far too

many to present here. The top twenty-five are given so as to indicate major ramifications of the field. They are a mixture of disciplines, specialties, and applications, exhibiting considerable diversity (ironically, a National Science Foundation official who saw the top 100 found them *not diverse enough,* but then he wanted to expand the empire for HCI studies).

Rank No.	No. Items Ranked	Term
1	768	USER INTERFACES
2	756	HUMAN FACTORS
3	226	INTERACTIVE SYSTEMS
4	218	MAN-MACHINE SYSTEMS
5	157	EXPERT SYSTEMS
6	125	PSYCHOLOGY
7	114	COMPUTER GRAPHICS
8	95	COMPUTER AIDED INSTRUCTION
9	95	SYSTEMS ANALYSIS
10	94	ARTIFICIAL INTELLIGENCE
11	82	KNOWLEDGE ENGINEERING
12	79	KNOWLEDGE BASED SYSTEMS
13	75	HYPERMEDIA
14	75	SOFTWARE ENGINEERING
15	73	INFORMATION RETRIEVAL
16	71	NATURAL LANGUAGES
17	70	SOCIAL ASPECTS OF AUTOMATION
18	70	TRAINING
19	68	PROGRAMMING
20	66	ERGONOMICS
21	61	BEHAVIOURAL SCIENCES
22	61	WORD PROCESSING
23	56	COMPUTER SCIENCE EDUCATION
24	55	KNOWLEDGE ACQUISITION
25	54	DATABASE MANAGEMENT SYSTEMS

In bibliometrics, the next step in understanding human-computer interaction might be to map it in two or more dimensions based on co-occurrence data for each of these terms with every other term on the list. This is now a specialty at several institutions (White & McCain, 1989), but it is still labor-intensive. If the HCI data were partitioned by, for example, five-year periods, it would be possible to track changes in the field over time.

CREATING INTERDISCIPLINARITY

All the techniques someone might use to reveal interdisciplinarity can also be used by someone who wants to create it. The main difference is that the latter searcher will include his or her own discipline in the synthesis. Probably few readers of *Library Trends* are trained in the fields used in the illustrations above (except, perhaps, human-computer interaction). Nor is this author so trained, but that did not prevent me from rapidly gathering data on them, and it would not prevent others, whatever their backgrounds, from doing the same. However, in the illustra-

tions to come, it will be assumed that the substantive field I share with most readers of *Library Trends* is library and information science.   The LIS literature is home ground, in other words, and our interest lies in assimilating relevant work from other disciplines (we can reveal, but scarcely influence, other disciplines' use of LIS).   Moreover, the center for investigations of this kind is not merely a home discipline but one's own reading and thought—a set of specific ideas on what may be synthesized—and that should help to narrow the focus of online inquiries.

Until those ideas are present, of course, there is little firm advice on retrieval to give. To meta-analysts of the sort discussed in White (1994), one can say, *Increase recall,* on the hunch—probably justified—that their means for doing so are not yet exhausted. But to the researcher who would be interdisciplinary, one can say only, *Read outside your field and make connections,* which leaves open so many possibilities as to be inane. One is really saying, *Be creative*—advice that the creative do not need and the uncreative cannot take. The essence of individual creativity lies in what Arthur Koestler (1964) called "bisociation," the productive association of ideas hitherto unconnected, and that "Eureka" experience is precisely what no adviser can guarantee.

This uncertainty extends to the disciplinary provenance of the ideas. From any disciplinary vantage point, some fields are always easier to connect than others (LIS and text linguistics, yes; LIS and cosmology, no). But the creative rarely begin by wanting to integrate specific fields as a main object; they are simply struck by something usable from another literature—perhaps one they have already read. From there, if they want to go beyond writings immediately at hand, they can simply follow leads through the usual strategies—i.e., consultation of other people, searching in subject indexes, forward or backward citation chasing, or browsing (Wilson, 1992b, White, 1994). Whether their subsequent reading stays within or crosses disciplinary lines is usually of little concern. Also of little concern are what lines they cross as long as they keep up their intellectual momentum.

Whatever the scope of their search, however, they must have some sense of what they are looking for. Even if merely browsing, they must be able to recognize clues, and this presupposes a definite, but highly individualized, motive that shapes their powers of recognition. Creativity in connecting ideas cannot be divorced from personal emotions. Feelings like love or rivalry or fear of pain, arising from very specific circumstances, are needed to teach the mind what to seek.

These forces may be seen at their most dramatic in the movie *Lorenzo's Oil,* where the incurable illness of a beloved child leads his parents, Augusto and Michaela Odone, not only to medical writings they would otherwise never have known, but also to a scientific breakthrough, a dietary therapy, based on a kind of oil, for adrenoleukodystrophy (Odone

et al., 1994). Biographical detail is lacking, but they may also underlie Don R. Swanson's series of breakthroughs in connecting hitherto unconnected medical literatures for therapeutic ends (Swanson, 1990) (by odd coincidence, the first of Swanson's therapies also involves dietary use of an oil, in this case a fish oil, to treat Raynaud's syndrome). While knowing something of online searching, this author could never have made the discoveries that the Odones or Swanson made, because nothing in my own situation would have led to seeing what they saw in various scientific literatures even if I had looked where they looked. Only persons schooled by a specific problem, it seems, are sufficiently motivated to distinguish and interpret clues at the forefront of knowledge, and such fortunate conjunctions of persons and clues are rare. This implies that creativity, whether disciplinary or interdisciplinary, cannot be reduced to algorithms that anyone can carry out, despite impressive recent work in that direction (Swanson, 1993; Beghtol, 1995; Gordon & Lindsay, 1996). The literatures are always there to connect, the fruitful linkages always potentially exist, but the persons who can actually make the connections, even with computer assistance, are not interchangeable, though there may be more than one.

The point needs emphasis because, as we have seen, present online technology allows us to *reveal* interdisciplinarity—to examine its components or to track its development—as never before. Researchers who want to measure it objectively may now be able to support their claims with bibliographic data both specific and broad-based, and they can reduce the necessary data-gathering steps to something like algorithms. But that is not the same as a technology that allows one to *be* interdisciplinary in the sense of successfully synthesizing ideas from different literatures. At most, the technology now available for studying the interdisciplinarity of any field can also be marshaled on the prospective synthesist's own behalf, perhaps to test whether any other writer has thought in a similar vein.

To answer questions like, *Have any of my ideas been anticipated? Is there any predecessor on whose work I can build?* the best resources are the citation databases of ISI. Not only do these databases cover the full range of learning, enabling one to branch out in multidisciplinary fashion; they also allow one to check the citation records of particular authors and works. The latter helps those who are prompted to synthesis by works they already know—those who have already attained a certain level of cross-disciplinary literacy.

Many creative persons, of course, care little about reading in other disciplines; they may regard literature searches in general as roadblocks to the flow of their ideas (if necessary, they will put in the citations to others after their own work is written). But assuming one is engaged by an author from another field and wants to move toward synthesis, the

fundamental literature-searching operation in the ISI databases is to de-
clare one's own field with a subject category (SC) label and then to see
whether the author of interest has been cited within it. The object is to
discover colleagues in one's own field who may have already used this
author, because their work, too, should be considered for incorporation.
They are the ones who may have already laid claim to ideas or upon whose
work one should build. They and other disciplinary colleagues are also
likely to be the synthesist's most critical readers.

FINDING WRITINGS IN LIS

One's ideas begin to show in picking the cited author (CA). (In LC
MARC–Books, CA has a different meaning—LC and Dewey classification
codes.) Take, for example, a search in Social Scisearch:

? SELECT SC=LIBRARY AND CA=PHILLIPS M

The full SC alluded to is "Information Science and Library Science," but
"Library" or "Info?" is sufficient.[7]   With "CA=Phillips M" I am asking for
all articles in Social Scisearch that cite anyone named Phillips whose first
initial is M (ISI allows only surnames and initials in searching). With the
ANDed combination, I am asking for any writings in LIS that cite any-
thing by Martin Phillips, a British text linguist, whose work I found through
browsing. Phillips (1985) used the computer to map words that co-occur
in "text windows" in the chapters of books of various kinds, including
scientific textbooks, and his revelation of hidden structure seems obvi-
ously relevant to segments of LIS such as co-word analysis and automatic
indexing. The search is rather imprecise and produces some false drops,
because more than one "M Phillips" is cited even in a relatively small
field like LIS. But it does show that Phillips (1985) has been incorpo-
rated into LIS research by R. M. Losee and S. W. Haas at the University of
North Carolina. A similar search on another British text linguist, Michael
Hoey, shows that his book, too (Hoey, 1983) has been used by research-
ers in LIS, notably by Timothy Craven at the University of Western Ontario.

For precision's sake, it would have been better in these two cases to
search on cited works (CW) rather than cited authors (CA). However, to
do that kind of search properly, one must know not only the titles of the
cited works but also the ways in which the titles are abbreviated by ISI. In
the case of Phillips (1985), one would enter:

? SELECT SC=LIBRARY AND CW=ASPECTS TEXT STRUCTU

Often a given work has more than one abbreviation in the ISI databases,
and so it is wise to consult the CW index (with an Expand command)
before forming sets. If one lacks the title (or the patience to track it
down), a cruder search by cited author's name, like those above, may be

the only recourse. Searches by author bring up the citation record of a total *oeuvre* as opposed to that of a particular work.

The most valuable index for this type of investigation may be the one that gives cited references (CR) in full:

? EXPAND CR = *some work*

The CR index allows one to check for different forms of cited authors' names, different forms of the title of cited works (including journal titles), erroneous entries, and so on. But one must browse this index for quite some time to learn its structure. The inconsistent practices of academic citers and ISI data entry persons give it a number of idiosyncrasies that affect searching. To examine the citations to Hoey (1983), one might enter:

? EXPAND CR=HOEY M, 1983?

Its ISI-abbreviated title as a cited work is "Surface Discourse," but one would very likely not know that in advance.

In examining various online indexes, such as those for cited authors, cited works, and cited references, it is usually desirable to combine ISI databases through Dialog's OneSearch capability. This makes use of ISI's full multidisciplinary potential. Essentially, one wants to see citations to authors in various journals. But the journals of a discipline may be split between ISI databases. For example, Social Scisearch covers most of the journals in LIS, but some are covered only by Scisearch. The latter will be left out of a search that does not combine both databases (when journals are covered by both, duplicate retrievals can be eliminated with Dialog's Remove Duplicates command). And even when the journals of a field are not split between ISI databases, an author's citation record may span more than one database. Nonduplicate citations to some authors appear in all three of ISI's databases— Scisearch, Social Scisearch, and Arts & Humanities Search. Noam Chomsky would be a notable example.

As a potential synthesist, I am interested mainly in the citation records of some authors in linguistics and cognitive science. These fields are generally thought to overlap with LIS, and so the chances that one will find connections are not remote. One might believe, for example, that work by cognitive theorists such as Eleanor Rosch, George Lakoff, Paul Grice, Teun A. van Dijk, or Dan Sperber and Deirdre Wilson can shed light on certain parts of LIS. The goal thus becomes to learn the uses to which their writings have been put. More than once I have used the strategies given here to discover the impact of these authors. They have in fact been cited in various LIS journals, but one cannot point to much in the way of genuine synthesis. An exception is Harter (1992), which

brings Sperber and Wilson's (1986) relevance theory into LIS for discussion and debate.

This is to approach interdisciplinarity through known authors and works. A variant strategy for those who know authors is cocited author retrieval (White, 1986). The names Eleanor Rosch and George Lakoff, for example, jointly imply work on human categorization, especially prototype theory. To seek writings in LIS that cite them jointly, enter:

? SELECT SC=LIBRARY AND CA=ROSCH E AND CA=LAKOFF G

One can also confine the search to particular cocited works—for example, to anything that cited both Sperber and Wilson (1986) and Harter (1992).

To connote a complex subject area, multiple pairings of cocited authors or cocited works can be used. This seems a possible approach to the problem, mentioned earlier, of retrieving syntheses algorithmically. Recall that, although reviews can be broken out in ISI databases by selecting them as a document type:

? SELECT DT=REVIEWS

there is no corresponding way to break out syntheses. However, if one created a profile of authors or works from different disciplines and then retrieved documents in which those authors or works were multiply cocited, that might occasionally turn up syntheses. This strategy is discussed as "combination of all possible pairs" in White (1986, pp. 95-96).

Those in LIS not attracted to these fancier strategies should recall that they can explore interdisciplinarity through ordinary subject searching. For example, some years ago a follow-up on the use of the word "Categorization" in LIS produced sixteen documents in Social Scisearch:

? SELECT CATEGORIZATION AND SC=LIBRARY

whereas a similar search on "Prototype(w)Theory" produced nothing, suggesting that prototype theory had not penetrated LIS at that time.

Again, after the union of "Text(w)Linguistics" with "Discourse(w)Analysis" produced a 284-document set in Social Scisearch, the command

? RANK SC CONT DETAIL

resulted in the following list, in which the top fifteen ranks are shown. Note that "Detail" in the command causes fuller data to be presented: the total number of items in the file with the various SC codes, and the percentage of ranked items, out of 284, that would be retrieved if a particular SC were ANDed into the set.

Rank No.	No. Items in File	No. Items Ranked	Percent Items Ranked	Term
1	44917	102	35.9%	LANGUAGE & LINGUISTICS
2	28126	38	13.4%	COMMUNICATION
3	144657	36	12.7%	EDUCATION & EDUCATIONAL RESEARCH
4	448633	36	12.7%	PSYCHOLOGY
5	699591	15	05.3%	ANTHROPOLOGY
6	205192	13	04.6%	POLITICAL SCIENCE
7	111129	13	04.6%	SOCIOLOGY
8	48184	10	03.5%	REHABILITATION
9	33304	8	02.8%	PSYCHOLOGY, SOCIAL
10	30316	7	02.5%	GERIATRICS & GERONTOLOGY
11	102139	7	02.5%	INFORMATION SCIENCE & LIBRARY SCIENCE
12	175544	7	02.5%	PSYCHIATRY
13	59425	6	02.1%	PSYCHOLOGY, EXPERIMENTAL
14	63694	5	01.8%	PSYCHOLOGY, CLINICAL
15	11507	5	01.8%	WOMEN'S STUDIES

At Rank 11, we see that seven articles linked to text linguistics or discourse analysis would be retrieved from LIS journals.

FINDING WRITINGS OUTSIDE LIS

In the previous section, the examples were aimed at helping one learn the extent to which writings associated with other disciplines have been used within LIS. In language introduced earlier, we have been looking for LIS writings that send *outgoing* citations to other fields. We know the identities of these other fields in advance; we can characterize them by authors, works, or subject terms. It is the LIS writings that are unknown but desired, and the examples show different ways of calling them up.

This is not to imply that the synthesist will want to call up only these writings; obviously that could be foolishly parochial. Useful writings are useful writings, whatever field they come from. But someone in LIS would not want to miss LIS writings, even if only to reject them as being off target.

The other fundamental operation for literature synthesists is to start with a known work or subject term or author's *oeuvre* in the home discipline, here LIS, and then to learn the extent to which it has penetrated other fields. Technically, this means looking for *incoming* citations to LIS. However, it may be clearer to say that it is now the writings outside LIS that are unknown but desired.

In Scisearch (alone among ISI databases) there is a relatively new means of using known authors or works to search outside one's field. That is the use of research fronts (RF). They appear in Scisearch as one of the indexing fields on a full bibliographic record and may be thought of as a special kind of subject indexing. Following is a research front from LIS, taken from the record for Richards (1984), which, of course, must already have been retrieved:

Research Fronts: 85-0608 004 (INFORMATION RETRIEVAL SYSTEMS AND USE OF CITATION ANALYSIS TO ASSESS THE IMPACT OF JOURNALS AND RESEARCH)

This means that Richards cites into a cluster of documents numbered 85-0608 and labeled (or subject-indexed) as shown by ISI. The clusters comprise earlier documents that have been repeatedly cocited (above some threshold) by later documents—evidence that both groups are related in subject matter. The "004" means that Richards actually cites four documents in the cluster. The identity of the cited documents in RF clusters is not revealed by ISI, but all the citing documents that create the cluster—the so-called "research front"—can be retrieved. For example:

? SELECT RF=85-0608

would retrieve all the articles citing at least one document in that cluster. Since this often leads to a somewhat miscellaneous assortment of articles, it is definitely a way to transcend disciplinary lines, and it may bring serendipitous retrievals.[8]

If the research-front method of searching seems too indirect, one can be more straightforward. Suppose one wants to know how Don R. Swanson's work has been used outside LIS. He is indeed cited in medical and pharmaceutical journals, but most of those journals are covered only in Scisearch. Thus, to explore interdisciplinarity in his case, one should combine Social Scisearch, where much of his citation record will appear, with Scisearch, which may contain the most important information for a synthesis.

A further complication in this case is that more than one "Swanson DR" is cited in learned journals, and so one must try to extract citations to the "right" Swanson, the information scientist at the University of Chicago, by building up sets from the Cited Reference index (this is also a problem with many other authors having non-unique surnames and initials—e.g., William S. Cooper or Howard D. White). I cannot guarantee I have formed exactly the right final set, but, such as it is, it contains 390 citations (CRs), from journals whose Subject Categories (SCs) appear as follows when ranked (the top eight only are given):

Rank No.	No. Items Ranked	Term
1	249	INFORMATION SCIENCE & LIBRARY SCIENCE
2	18	PSYCHIATRY
3	15	COMPUTER APPLICATIONS & CYBERNETICS
4	12	CARDIOVASCULAR SYSTEM
5	12	PHARMACOLOGY & PHARMACY
6	10	MEDICINE, GENERAL & INTERNAL
7	10	NEUROSCIENCES
8	7	MEDICINE, RESEARCH & EXPERIMENTAL

Swanson's record of acknowledgment outside LIS is extraordinary, and of course it is precisely the articles from medical literatures implied by this list that one would want to retrieve and consider for a synthesis. A

synthesist might also be interested in ranking other data from the 390-item set—the authors who cite Swanson, their journals, and so on. Naturally, the simplest way to get the full range of articles citing Swanson would be simply to print out their bibliographic records, but RANK provides a way of quickly displaying their features in informative "views." Occasionally, such a capability might prompt one to focus on subsets of the total set that would otherwise be overlooked.

It should be clear by now that we have a fairly reliable means of learning the impact of a particular author or work on other fields. As a general means of evaluating an author or work, citation counts are well known and widely used. But current online technology also allows us to count "citations outside category" more readily than Porter and Chubin could in 1985. This opens interesting possibilities for evaluation of syntheses. For example, Sandstrom (1994), an LIS author, creates links between contributors to the LIS literature and contributors to the optimal foraging literature. Over the next decade, one will be able to observe the impact of Sandstrom's ideas. It will be easy to get a total citation count for her article, but one can also report, by using the technique just illustrated with Swanson, whether the citations she receives are solely from LIS or from other fields as well, such as anthropology or cognitive psychology. Put another way, Sandstrom is a new synthesis that cocites many authors who have never been cocited before; her article gives each pair, such as Paul B. Kantor from LIS and Bruce Winterhalder from behavioral ecology, a cocitation count of 1. Now, assume that at least some of those cocitation counts grow. Who will be doing the incrementing, people from LIS or people from some branch of optimal foraging theory? Given the relative isolation of LIS from other fields, it would be remarkable if theorists on optimal foraging were to follow Sandstrom in including scholarly communication behavior in their explanatory design, but it could happen, depending on where those theorists forage themselves. It seems most likely, of course, that the counts will be incremented by Sandstrom and others in LIS.

This suggests a specific way of assessing interdisciplinary syntheses: are they cited outside the author's home field? The answer bears on their success, a matter raised earlier. No one would claim that citation outside the author's home field—or inside it, for that matter—is the sole criterion by which a synthesis should be judged. But it is one criterion: a synthesis that is well cited can be called influential, and if a fair number of positive citations come from disciplines other than the author's, so much the better (consider whether a professor going up for tenure would rather have those citations or not).

Earlier I was somewhat critical of two syntheses—i.e., Swales (1986) and Heilprin (1989). Despite my reservations, both are valuable pieces of work, well worth having. However, their success as cited influences can be qualified in quite specific terms. A check in Scisearch and Social

Scisearch (March 1996) shows that Swales (1986) has been cited five times in his own field (twice by Swales himself) and five times outside it. All but one of the latter citations are by M. H. MacRoberts and B. R. MacRoberts in their controversial critiques of citation analysis. Heilprin (1989) has been cited six times in LIS (once by Heilprin himself). These findings strengthen me in my reservations, in that the citation-analytic techniques displayed earlier will reveal other syntheses to have had greater influence both inside and outside their own disciplines.

CONCLUSION: HUMAN MARKERS

Most of the operations described earlier are intended to provide, through online retrieval, a set of novel bibliographic records that is small enough to browse. Usually, browsing of this kind takes place at the computer screen or with printouts on paper; it requires little physical movement. But browsing in libraries does involve movement; we must transport ourselves to various parts of the stacks. That is because, in the time-honored system, the subject-classification space of books and serials has been made to coincide with the space in which we live rather than being tucked into some fold of cyberspace. Thus, in Dewey- or LC-classified stacks, the markers that may appear on both sides of a disciplinary divide are *ourselves in person* rather than symbols representing us. Needless to say, our appearances are not simultaneous; anything from a few seconds to years may elapse between them. But these mark an aspect of our nature as walking bundles of subject interests. And if those interests were trained in a particular discipline or specialty, we generally can find one or more corresponding literatures in the stacks, the writings on which our disciplinary identities rest.

In environments where people with disciplinary identities are the rule, it is possible to study whether those who browse do so only in the part of the stacks that is their disciplinary home or go to parts corresponding to other disciplines. Browsing, of course, usually leaves little or no trace, but when people borrow items as a result of their stack visits, we can learn from circulation records the classification codes of what they borrow and note the range of disciplines represented. By cross-tabulating what they borrow with their own disciplinary IDs, we can report the patterns of interdisciplinarity for each discipline in a particular locale, as Metz (1983) did for Virginia Polytechnic Institute. But this kind of study, though based on behavior in libraries rather than on bibliographic connections, once again simply reveals interdisciplinarity in others, including many with whose work one has no particular ties. It is not grounded in the interdisciplinary relations of one's own field, nor is it likely to help one effect a new synthesis.

In contrast, if we identify library and information science as our home field, we have the Z classification as our stacks; as long as we browse there, we are on our own intellectual turf. We can, if we choose, work toward

syntheses of writings we find there, or we can move out to other fields. The question then becomes, Where do we browse when *we* are being interdisciplinary? The question at this point can only be answered on an individual basis, so I will speak for myself. In the stacks, it is not just symbol strings like "Patrick Wilson" that link the Z classification with the BD classification; it is also me, walking between them, visiting them on winter nights, pulling down books in both places. More plausibly, I link the Z classification with certain sections of the BF classifications and P classifications, where I have not merely interests but some coalescing ideas. I may also be seen browsing elsewhere, but there is next to no chance that a synthesis will result: wrong person.

Most readers can replace these autobiographical notes with equivalents of their own, and that, of course, is the point: we know where *we* start from. But there are other big questions: Who from other disciplines is coming to join *us*? Who is entering the Z classification from other directions? And do those strangers have ideas for connecting LIS with something else? Is there an interdisciplinary synthesist in the house?

NOTES

1   It would be a service if someone reviewed the bibliometric studies of interdisciplinarity, which extend beyond those scattered through the Klein (1990) bibliography. Katherine W. McCain allowed me to use her personal collection of these studies, which greatly assisted the writing of this article.

2   I am indebted to Pamela E. Sandstrom for motivating the analyses of terms in sociobiology and behavioral ecology that are used in this article. They were performed in January 1996 as exploratory follow-ups to Sandstrom (1994).

3   Since form subdivisions such as "Congresses" and "Addresses, Essays, Lectures" are searchable, one might use them to break out collections of works by different authors in the hope of finding multidisciplinary points of view, and perhaps symposia, in a given subject.

4   The method just shown can be used with individual authors. To see a single multidisciplinary genius portrayed in subject headings, invoke Dialog's BOOKS databases through OneSearch, form a set on "Morris, William," and then enter

? RANK DE CONT

5   If *bundles* of terms are saved using their rank numbers, they must all be ANDed with the input term to reproduce the set sizes in the ranked display. There is more than one way to do this.

6   RANK displays the after-decimal numbers of the Dewey codes correctly, but, by a design flaw, it breaks off the after-decimal numbers of the LC codes from their root numbers—for example, the 103 "9's" in second place actually belong with the 104 occurrences of "GN 365" as *GN 365 .9*. This problem does not affect retrieval: that is, the LC root numbers have the proper decimals attached when the bibliographic records are printed out. LC class codes without decimal subdivisions are, of course, unaffected.

7   To see full SC labels, which allow one to capture the literatures of disciplines and specialties as defined by ISI, enter:

? EXPAND SC=*some field*

8   To seek greater homogeneity, one can confine the retrieval to articles citing *multiple* documents in the cluster. For example, the following would retrieve Richards (1984) and any other articles citing *four* documents in the cluster:

? SELECT RF=85-0608 004

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