DISTINCTIVE CHALLENGES OF LIBRARY-BASED INTERDISCIPLINARY RESEARCH AND WRITING: A GUIDE

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Abstract: This article examines the current challenges of library-based interdisciplinary research and writing within the larger context of the theory and practice of interdisciplinarity. Based upon experience with college seniors researching and writing year-long interdisciplinary projects and informed by the literatures on library science and interdisciplinary studies, the essay identifies the underlying sources of those challenges, the implications for the teaching of interdisciplinary subjects, and the consequences for interdisciplinary scholarship at a critical time in the maturation of the field. The paper employs a pragmatic approach informed by the foundational literature of the field.

Introduction

As if the intellectual challenges of completing the interdisciplinary process (Newell, 2007) were not enough, library-based interdisciplinary research and writing have their own scholarly challenges as well. In research, these challenges emerge in all the major activities of a library-based research

project: computer searching for sources, compiling an annotated bibliography, and reviewing the literature. In writing, they show up in constructing the argument, structuring the project, and then writing it. These challenges are examined in some detail, the underlying sources of those challenges are identified, and the implications for interdisciplinary scholarship are sketched out. This examination is based on experience with college seniors researching and writing year-long interdisciplinary projects supplemented by a review of the literatures of library science and interdisciplinary studies. It is designed to assist instructors in explaining to their students how to carry out interdisciplinary research and to provide guidance to students. Since most interdisciplinary faculty members were not trained in interdisciplinary research in graduate school, it may also be of interest to them as scholars. The analysis and argument of the text are embedded in a step-by-step approach to library-based interdisciplinary inquiry.

A. Interdisciplinary Research
The Computer Search

The first major step in library-based interdisciplinary research is to locate sources. Even more than with disciplinary research, interdisciplinary scholars need to start broadly and then narrow the focus towards more specialized sources as the topic takes shape. In general this means starting with books and then moving into the journal literature, though the natural sciences, some social sciences, and recent professional fields such as Web design start out relying more heavily on journals or online publications.

The organization and classification of books in libraries reflect the dominant disciplinary paradigm for generating knowledge,[1] and serve the needs of disciplinary scholars better than those of interdisciplinary scholars. Both the Dewey decimal and Library of Congress classification systems categorize knowledge largely according to how Western academic disciplines divide knowledge. The Dewey decimal system (used primarily by public and smaller libraries) is organized hierarchically by disciplinary subject matter (moving from the general to the specific) into categories, sub-categories, specialized topics, and levels of sub-topics, which facilitates browsing. The Library of Congress system (used by large research universities) has more categories (by using letters instead of numbers at the most general levels); it is slightly more recent (early 20th instead of late 19th century), hence more reflective of the way knowledge has developed; and it is enumerative, i.e., based on the number of books written on various topics.

Both systems, however, permit disciplinary scholars to quickly focus in on the books associated with their topic, and then to find books on related topics by browsing nearby shelves.

Because interdisciplinary scholars (as well as a growing number of disciplinary scholars) are interested in topics that cut across disciplinary lines (Klein & Newell, 2002) and in connections among topics addressed by different disciplines, they need to find additional ways besides call numbers to identify relevant books. Call numbers in both systems are inevitably reductionist in that they reduce the book to a single subject for purposes of locating it on the shelves, as well as disciplinary in that they largely follow the disciplinary organization of knowledge.[2] Yet even disciplinary books usually address more than one subject. Interdisciplinary scholars need to be able to identify those books that address, however cursorily, more than one of the subjects comprising their topic. These books are likely to bring out contrasts in disciplinary perspectives on the topic. They may also identify, or at least provide hints regarding, linkages among those subjects. Luckily for interdisciplinarians, catalog entries for books often list more than one Library of Congress subject heading pertaining to the contents of the book. These subject headings, unlike call numbers, reflect at least some of the diversity of topics within a book (though they are applied very sparingly [Searing, 1992, p. 14; Hubbard, 1992, p. 34] and still organize knowledge according to the disciplines). Once the various subject headings pertinent to the interdisciplinary topic under investigation are identified, advanced subject heading searches (e.g., for one subject heading *or* another) will identify the range of relevant books in a way call numbers or simple keyword searches cannot.

Subject headings (like call numbers) are assigned by library experts from specific fields, who look through the books to decide what they are about. The designated subject headings bring together works whose authors use different terminology or jargon (Klein & Newell, 2002, p. 152)—such as works from different disciplines. A keyword search for the jargon used in a relevant book will tend to identify other books on the same topic written from a similar point of view or perspective, which is necessary but not sufficient for the needs of interdisciplinary scholars. Fiscella (1989, p. 77) points out (following Becher (1987, p. 261) that "key terms can shift across disciplines." Savvy interdisciplinary scholars, seeking a wide range of perspectives on the topic, use the subject headings established by library experts instead of trying to think of all the possible jargon that is relevant (and reinventing the wheel).[3] This search strategy gets the interdisciplinarian to consider how different people look at these same concepts and about how the concepts are related.

Subject headings and descriptors, like classification schemes, are examples of "controlled vocabulary" provided by what Fiscella (1989, p. 80) calls "subject-oriented access works." In general, controlled vocabularies "reduce the need to infer every synonym or form of a term that might describe a particular concept." Another category of subject-oriented access works of particular interest to interdisciplinarians are the indexes, databases, and other collections[4] organizing much of the disciplinary scholarship upon which interdisciplinarians must draw. Each of these reference works has its own thesaurus[5] or classification system based on standardized terminology from that field. Many are still restricted to a single discipline and are organized according to its jargon, but new databases increasingly cross disciplinary lines and their thesauri offer controlled vocabulary that connects works from the contributing disciplines.

Each time interdisciplinary scholars move to a collection of the work of another discipline in search of a different perspective on the same topic, they need to check the thesaurus or classification system for that collection to find the term(s) to search for. In the discipline of psychology, for example, a lot of work is done on "gender differences": a keyword search for it in **PsycINFO** will yield something like 10,000 hits. But a check of the **PsycINFO** thesaurus will reveal that it is not a valid subject heading and that use of "human sex differences" instead will produce more like 60,000 hits. The controlled vocabulary of Library of Congress subject headings connects *different* catalogs, databases, and indexes (whether disciplinary, cross-disciplinary, or comprehensive), whereas the classification schemes of thesauri connect different disciplines within a particular cross-disciplinary database or index. In both cases, they provide a bridge between the terminologies of different disciplines. One can do a keyword search within a particular discipline, but one then needs to expand it through a subject-heading or classification search to find other disciplines and their terminology before conducting a keyword search in another discipline on the same topic. Many databases allow researchers to search a keyword within a particular field, such as a subject heading, when the exact subject heading is not initially known. This is a way to do a more precise search without the knowledge of exact controlled terminology.

In addition to relying on controlled vocabulary, interdisciplinary scholars can also connect the scholarship of different disciplines by building on the connections discovered by previous scholars. Once one has identified a key work in the field under investigation, one can use a citation index to identify a wide range of subsequent works citing that publication, since citation

indexes typically cover an entire academic area (e.g., *Science Citation Index*, *Arts & Humanities Citation Index*). Fiscella (1989) concludes that the controlled vocabulary of subject headings and thesauri are most useful where a canon (or "recognized scholarly community") has been established, whereas citation index searches are most useful where an interdisciplinary field has developed a common language "which in turn is recognized not only by the scholarly community working in those areas but also by those who identify and index that literature" (p. 83). In an interdisciplinary field that is being proposed or only recently explored, one would expect two largely separate and non-overlapping literatures, one best searched through subject headings and the other through citation indexes, so the best access strategy would be to search both ways. Since interdisciplinary studies draws from disciplines in exploring topics that transcend the disciplines, interdisciplinary scholars end up going back and forth between two systems for classifying knowledge, specialized ones developed by the disciplines and more generic ones developed by librarians and by commercial information providers, such as the creators of general indexes like EBSCO's Academic Search or Gale's Expanded Academic Index. The disciplinary systems develop technical disciplinary terms used by authors in titles and abstracts, and they organize information in discipline-specific databases (for books) and indexes (for journal articles). Those systems can be accessed using keyword searches. The library systems use subject headings, thesauri, and citation systems developed by professional librarians and information managers, and organize information in electronic catalogs as well as in indexes and databases according to classification systems also developed by librarians; they are best accessed using controlled vocabulary searches. The trick is to use the library systems to bridge the disciplinary systems.[6]

The Annotated Bibliography

The next major step in conducting library-based interdisciplinary research is to inventory the sources found (largely) through computer research. Again, in the interest of providing context for the topic and shaping it as the research process continues, most bibliographies (especially those involving the humanities and social sciences) will start with books and add journal articles later.

Bibliographies for disciplinary research projects feature annotations that typically identify the focus and approach of the book, and what makes it of interest; and, if a bibliography is divided into categories, it is most often by

type of source (such as primary documents or maps). For interdisciplinary research, the annotations also need to identify the perspective(s) from which the book was researched and written (e.g., sociological, feminist), and the bibliography should be categorized by sub-topics to facilitate the literature review that follows. Thus, a project on the environmental influence of disease might have sections on sub-topics such as environmental health, disease distribution, infectious disease, public administration, public health, and culture and health. Disciplinary scholars generally draw their research from books that reflect the perspective of their disciplines, so perspective is not necessarily a salient feature of a book meriting mention in the bibliography. The point of interdisciplinary scholarship, on the other hand, is to construct a more comprehensive understanding of the topic by drawing on diverse perspectives of disciplines (as well as interdisciplines and schools of thought) and integrating their insights. Wolfe and Haynes (2003) sum it up: "Good [interdisciplinary] research does not mean that writers must read every source related to their topic that exists, but they should be acquainted with all of the major schools of thought or perspectives on the topic at hand" (p. 135). The perspectives on which an interdisciplinarian draws tend to define the topic more narrowly as they focus on one aspect of the complex whole (Newell, 2001) that is of interest to the interdisciplinarian. To the interdisciplinary scholar, the added challenges of the annotated bibliography, then, are to identify perspectives and sub-topics in addition to the information gleaned by disciplinary scholars and to ensure that a sufficient number of sources are included for each perspective and sub-topic.

Disciplinary scholars don't need to worry so much about perspective because their discipline determines the range of perspectives from which it is acceptable to view the topic. The discipline decides what questions are interesting and why, what are the reigning theories, what constitutes appropriate evidence to bring to bear in answering a question, what procedures one must follow (and tools and methods one must use) to obtain that evidence, what's a good answer to a question, etc. Everyone in economics knows that when one writes on the economics of education, one focuses on costs and benefits to the person getting the education (since that person makes the relevant decisions), treats it as investment in human capital, looks at it through the lens of neoclassical economic theory, and relies on statistical manipulation of quantitative data to test hypotheses. In disciplines such as English/literature and anthropology that are fractured into competing schools of thought, the school of thought (e.g., modernist, postmodernist, feminist) largely determines the perspective.

One might presume that perspectives are not determined by disciplines since academic scholars enjoy academic freedom. Thus, they should not be fettered by their job title or location within the institution, or by the institution with which they are affiliated. But departments make decisions about promotion, tenure, and annual salary adjustment; institutions pay that salary and make decisions about sabbaticals; and one's discipline or school of thought determines whether one gets to present papers at which conferences, whether those papers get published in journals, whether one is invited to contribute to edited volumes or to give talks at departmentally-sponsored lecture series, and whether research grants are awarded. Control of the perquisites does not determine what conclusions one must arrive at in publications, but it does constrain one's approach—in short, it enforces one's adherence to a perspective, and it provides a context for understanding why and how certain models or paradigms become dominant and are addressed even in the act of disagreeing with them.

Identifying the perspective from which a book is researched and written is not always a straightforward task. Since the perspective of one's discipline is taken for granted and not problematic, most authors do not consciously state their perspective in the introduction (as they often do the focus and approach of the book). Consequently, the interdisciplinarian must look for clues that can be found in a variety of places in the book. If one is lucky, the authors or editors may set out their perspective on the topic in the introduction—e.g., my work comes out of the study of American politics, I'm a professor of political science at Harvard University, and I teach courses in American politics. More often, though, authors introduce only the topic itself, and one is left to try to infer their perspective from what they say about the topic. If the book provides it, the quickest and easiest source of information on perspective is the author's biographical sketch. The preface is another reasonable place to look for clues on perspective, since it typically explains how the author came to write the book, but one cannot count on finding it there since many disciplinary authors find perspective unremarkable. Similarly, one might find clues in the acknowledgments. For American academics, one could consult the National Faculty Directory, though since it is not yet available online, the resource remains inconvenient to access. If all else fails, of course, one can always go to Google and type in the author's name (in quotation marks), scanning down for a link that is likely to give at least the person's institutional affiliation and job title.

The bibliography (aka references or works cited) is the most consistent source of information on the author's perspective. One can scan down the list, asking

what disciplines (art history), schools of thought (Marxist), or interdisciplines (women's studies) are represented by these titles, and how many are showing up in each category. Let's say that in a book on American political ideology there are something like 40 books from American politics, 25 from political sociology, two from women's studies, and one each from history, psychology, and economics. (There's no need to actually count the number of titles in each category, since all that's required are crude generalizations like "a lot," "a few," or "none.") It's nice that the author at least acknowledged the last four fields, but they are likely not fundamental to the author's project. It's one thing to claim in the introduction what approach is being taken, but one can tell in the bibliography from what perspective(s) the author is actually drawing, i.e., which professional literatures are relied on primarily.[7]

For edited collections, identification of the perspectives of contributors is as critical as is identification of those of the editors. Researchers are guided by the predominance of that discipline or interdiscipline in the bibliography, the author's title (e.g., Professor of Physics), or information in the preface or introduction. Often there will be a list of contributors that gives basic biographical information on each, or there should be at least some information on a contributor at the beginning or end of a chapter. As with books in a bibliography, one can categorize contributors by perspective, tally the number in each category, and get some sense of where the book as a whole is positioning itself. If it is a volume in a series, there may be an early page that talks not about the book but about the series of which it is a part.

Shifting from identification of perspectives to the organization of the bibliography into sections by sub-topic, the task is to make sure that the bibliography sets up the literature review. As discussed in the next section, the literature review for an interdisciplinary research project needs to be divided into sections; actually, it is a series of literature reviews, each focused on a sub-topic of the overall topic being researched.[8] By organizing the bibliography by sub-topic, one can determine which ones are not adequately represented and locate additional sources (perhaps from ones cited in the sources at hand). Since more than one discipline, interdiscipline, or school of thought may address a particular sub-topic, one must also pay attention to the range of perspectives represented in each section of the bibliography.[9] Instead of ignoring a second book with a similar title, the researcher might determine that it is coming at the same topic from a different perspective; e.g., books on the same environmental policy may be written by political scientists or by natural scientists, and each perspective is important. Thus, an interdisciplinary bibliography is not complete until the annotations in

each section are scanned to make sure that all relevant perspectives are adequately represented.

The Literature Review

The next major step in library-based interdisciplinary research is the literature review, which is the most difficult research tool to master because it is here that the distinctive challenges of interdisciplinary research are most evident. If one thinks of a literature review as a rough survey of the major features of an intellectual landscape—the major topics, the biggest issues raised about those topics, the most important positions taken on those issues, and the key authors taking those positions—then the interdisciplinary literature review is faced with the challenge of surveying topics, issues, authors, and positions from different landscapes, and sometimes even constructing a landscape out of topics and issues that cut across discourse communities. After all, an interdisciplinary research project addresses an issue or problem regarding a complex topic through the integration of insights coming out of perspectives of disciplines, interdisciplines, or schools of thought, many of which often address only an aspect of the topic and may focus on subsidiary issues.

The term "literature review" is actually a misnomer, in that an interdisciplinary research project typically requires several (let's say five or six) separate literature reviews, one on each of the topics comprising a different facet of the complex topic under study. If all went well in the annotated bibliography, the key topics were identified and a number of key books were found on each topic, representing each of the relevant perspectives on that topic. The tasks for each literature review are to skim through parts of the books on that topic:

- determining if the topic identified in that section of the annotated bibliography is really the topic on which that literature review should focus;
- adding or subtracting books from that section of the bibliography based on what is found through skimming, and adding journal articles where they feature the seminal work;
- collecting basic information and taking notes for such purposes as:
  - identifying the issues (let's say half a dozen for each of five to six topics)—not the authors' argument, but what they are arguing about,

- o naming key authors (maybe two to four per issue) and the perspectives from which they are writing,
- o labeling the overall position of each author on that issue (not elaborated),
- o listing the books or (rarely) journal articles (perhaps one or two for each author) in which they set out that position;
- and then writing a paragraph on each issue in which the information cited above is set out succinctly.

Since it is easy for a literature review to degenerate into A says and then B says and then C says, a new interdisciplinary scholar (or a scholar new to interdisciplinary research) would be well served at first to follow a template where each paragraph starts out by identifying (in a sentence or two) a particular issue raised about the topic of this particular literature review. In the next sentence, identify (without elaboration) the key authors writing on that issue. After that, it is desirable to devote a sentence or two to each author, identifying without elaboration the position taken and the key publication or two in which that position is best set out. The paragraph can either stop at that point or conclude with a one-sentence characterization of the status of the debate on that issue.

When preparing a literature review for an interdisciplinary research project, one is interested in issues that may cut across disciplinary lines. In that case, the scholars from different disciplines writing on different aspects of the issue typically do not read each other's work. The interdisciplinary scholar may be the only one who realizes that a larger "conversation" is in progress in which the overall issue is being "debated." It is the job of the interdisciplinarian to identify the larger issue of which those aspects are a part, and bring them together in a literature review (and then in the written project). This task of issue construction may be complicated by incompatible terminology used by the different disciplines or interdisciplines.

There may be no debate over a particular issue because the opposing positions focus on different topics. For example, the interdisciplinary scholar interested in fiction for adolescents and looking for debate over gender roles may find that almost all the authors write from a liberal feminist perspective. That's because those authors find traditional gender roles problematic in adolescent fiction. Conservatives have no trouble with traditional roles, so they see no need to raise the issue in print (though they may react to the problematizing of traditional gender roles by trying to get those books removed from the shelves of public and school libraries). What may interest

conservatives are family values, so to find the conservative perspective on gender roles one needs to go to the literature on family values, not to the literature on adolescent fiction. In the language of Boolean logic, one needs to look at the union, not the intersection, of the literatures on adolescent fiction and conservative views on gender roles, i.e., look for conservative views on gender roles *wherever* they are expressed since they don't show up in the literature on adolescent fiction. Interdisciplinary scholars ask what there is in this entire conservative perspective that has potential bearing on the topic of fiction for adolescents, they look not just at what those authors have chosen to write on that topic but what they could have written on it, and they apply that perspective to the topic, since its adherents don't necessarily do it. Of course, one cannot infer right-of-center positions from left-of-center critiques of those positions because conflicting ideological positions are almost certainly distorted in the critique.

If one chooses issues that presume mainstream norms or values are problematic by letting leftwing authors frame the issues, then one is going to have trouble finding the opposing (mainstream) perspective. If authors come out of a perspective that sees the status quo as acceptable or even desirable, then those authors will not be inclined to write about that status quo in the literature under examination unless they bother to take the time to defend it from critiques. To them the concerns of the left, for example, are non-issues. Even when they defend the mainstream against critiques, one gets a distorted understanding of their perspective because they did not frame the issue. To understand the mainstream perspectives, one needs to turn to other literatures in which they set the terms of the discussion, to literatures that focus on the issues of interest to them. When one finds their issues and compares them with some leftwing issues or those identified with a minority position, one needs to ask what they have in common. What is a more basic issue that is responsive to the combined sets of concerns?

In literatures on topics such as Web design management and customer service that have an applied, as opposed to a theoretical, focus, there may not be many issues to find. Even if experts once disagreed about how a task should be accomplished, those differences of opinion may have been resolved. (Consider how much disagreement remains over the differential calculus, for instance, since the day of Newton and Leibnitz. It is now a body of knowledge that is totally non-controversial—it's become what is called "received wisdom.") Such how-to books will still have differences in emphasis, which one can identify by looking at how much space they allocate to the various sub-topics, but one needs to decide whether those differences

in emphasis have any significance for the project. By putting more emphasis on a sub-topic, an author assigns it more importance, places a higher value on it, and focuses more attention on it. What's the implicit message here? After looking through several such books, one begins to see that they can be clustered on the basis of what they emphasize. Ask what the authors in a cluster have in common: Are they all from economics, all feminists, or all from the third world? Once it becomes evident what they have in common, one can probably figure out why they place different emphasis on certain sub-topics. If these differences in emphasis are relevant to the project, then by all means they should be included in the literature review. If not, the next step is to turn to the disciplines on which they draw, and see what issues those disciplines raise for the project. Management and marketing, for example, draw frequently on psychology, economics, and sociology, and sometimes on anthropology and geography. Those disciplines are much more theoretical in their approach and raise lots of issues, some of which will inevitably be relevant for the interdisciplinary project.

While the section headings from the annotated bibliography may be a reasonable first approximation of the appropriate topics for the lit reviews, one needs to be responsive to what topics are actually discussed in the literature. The topics one presumed to be the focus of the literature may be stated too narrowly, perhaps slanted towards one's own interests. Instead of looking *for* information, interdisciplinary scholars benefit from looking *at* the information, in order to be open to changing how one thinks of a topic based on what is found in the literature. That means not only listening intently to what other scholars are saying, but also paying close attention to what they are talking about. It may be necessary to pull back and generalize those topics. The need to generalize topics is particularly strong when the topic crosses disciplinary boundaries so that aspects of the topic are addressed by different groups of scholars who don't read each other's work. If one were to state the topic the way a particular discipline does, it would cut off contributions from the other disciplines. Instead, one needs to find a more general way of stating the topic that is responsive to all the contributing disciplines.

If interdisciplinarians find themselves arguing that only one book is needed from a particular perspective with which they disagree because the others written from that perspective are "all the same," then a red flag should pop up. All perspectives need to be taken seriously, including those one doesn't like, such as perspectives that are politically right-of-center, sexist, or modernist. There is no need to embrace them uncritically, but one needs to look for the kernel of truth in them, for their insights that

ring true to intelligent people with whom one disagrees. Saying they all look alike is reminiscent of Ronald Reagan quipping, "If you've seen one redwood, you've seen them all," or of whites in the 1960s who observed that all blacks looked the same to them. Today we find such claims abhorrent. When one observes that all adherents of a particular perspective look alike, it is undoubtedly because one is looking through the lens of the opposing perspective. Like claims about redwoods or blacks, the statement betrays an ignorance of the competing perspective. When one lumps together people from a competing perspective and says that the differences among them are unimportant, the effect is to say that "all that counts is what I believe is important." The interdisciplinary scholar can still have convictions, but one must learn to bracket them, to set them to one side, while trying to understand the other perspective. To do that, one needs to take off the lens of the preferred perspective to put on the lens of the competing perspective. One must look at those authors in their own terms in order to understand them as they see themselves. Then the differences among them will become apparent, differences that count within that perspective. Only when those differences become apparent can one begin to make productive use of that perspective instead of caricaturing it.

B. Interdisciplinary Writing
Developing the Argument

The thesis of the project should be stated in everyday language, removing all jargon (Wolfe & Haynes, 2003, pp. 154-155). Otherwise, one's understanding of the issue or problem will be unduly influenced by the discipline through which the jargon was developed. Precise disciplinary terminology becomes appropriate if not essential, however, in writing individual chapters to show how that discipline or interdiscipline restates the issue or problem. In doing so, one should be clear about how the generic problem or issue has been narrowed or focused in the process. If the thesis cannot be stated in jargon-free language or if one is doing no more than translating jargon into everyday language, then it might be asked if the project is really interdisciplinary (or instead if it is dominated by the discipline in which the jargon was developed). For the same reasons, neutral terminology should be used to state the steps in the argument, the synthesis, and the conclusion. See Klein (1996, pp. 22-27) for the role of pidgins, creoles, and trading zones in creating neutral terminology.

Part of setting out a thesis is providing a rationale for the use of an

interdisciplinary approach. Not all problems require an interdisciplinary solution. Klein and Newell (1997) report that most interdisciplinarians point to the breadth or complexity of an issue as the rationale for an interdisciplinary approach. Newell (2001) argues that complexity alone justifies it. In any event, Wolfe and Haynes (2003) assert: "When identifying the topic at hand, interdisciplinary writers must explain and justify why a problem, issue, or topic needs multiple disciplines to address or solve it" (pp. 153-154).

In constructing an interdisciplinary argument about the phenomenon that is the focus of the project, one is likely to encounter a variety of disciplinary explanations of it. For a project examining the upturn in the diagnosis of attention deficit/hyperactive disorder, the interdisciplinary scholar will find at least half a dozen candidates for the precipitating factor: drug companies wishing to sell a new drug, psychiatrists wishing to supplant clinical psychologists, educators seeking ways to control disruptive classroom behavior so they can respond to reduced funding by "doing more with less," a change in the cultural construction of childhood, a change in the demands placed on children in an increasingly competitive society, or parents who feel they both need to work to meet their target lifestyle and thus who have less time to devote to children with problematic behavior. The challenge confronting the interdisciplinarian is not to select one and reject the rest, but to arrange them in a way that makes sense. Do some logically precede others, so that one initiates while others are intervening or intermediary; i.e., is there a logical sequence? Do they operate on different levels, such that the same cause is given different names on different levels? For example, a trend in families may have a counterpart trend in educational institutions and another counterpart that mirrors it in the culture as a whole. As connections are identified between points made by authors in different disciplines, ask if those connections suggest a way of organizing those points that brings out the relationship between them. The goal is what social scientists call a model, which identifies a number of variables and specifies something about the relationships between them. As Driebe and McDaniel (2005) put it: "In science, as in art or literature, to gain insight into the real world we make an artificial world, which serves as a model that we can manipulate and probe" (p. 20). More generally, one is working towards a synthesis of the causes proposed by different disciplines, one that can form the basis for a more comprehensive interdisciplinary understanding (and ultimately for a policy based on that understanding).

It is easy to be captured by the materials from which one draws. If several sources all treat the topic the same way or put it in a certain light, it's easy

to be swept up by group think and unconsciously assume that one has to write about it that way, too. For example, one might buy into the implicit assumption that all traditional art historians were alike because most recently published art history scholarship tends to lump them all together. Again, one must keep in mind that interdisciplinarians write for a different purpose than any of the disciplinarians on which they draw. Ask what treatment of the topic makes sense for an interdisciplinary approach—problematize other approaches to the topic, instead of accepting any given perspective uncritically. Wolfe and Haynes (2003) recommend that the interdisciplinary scholar "explicitly [discuss] limitations of a paradigm, school of thought, theory, or disciplinary approach" as well as its "insights or merits" (p. 143).

As connections between disciplines become apparent, the interdisciplinary scholar should try to make them as precise and nuanced as possible, avoiding broad-brush assertions such as casually claiming that two disciplines are using different terms for the same thing. Even if the denotative meanings of terms from different disciplines were to be exactly the same (and they seldom are), their connotative meanings are necessarily quite different because they come out of different intellectual contexts. Think of the meanings of terms from different disciplines with Venn diagrams in mind; the challenge is to identify as precisely as possible the area of overlap but also the areas of non-overlap. The more precisely one draws the nature and extent of the connection between ideas from different disciplines, the more sophisticated the integration one can construct on the common ground formed from those connections. Wolfe and Haynes (2003) point out that the interdisciplinary scholar must "identify how different disciplinary terms actually connote the same meaning" as well as "demonstrate an awareness of the differences in how the disciplines at hand define key concepts" (pp. 150-151). Since the unique contribution of an interdisciplinary approach lies in the integrated understanding it provides, this is a serious matter.

In an interdisciplinary project, one cannot start from a single, coherent, agreed-upon set of assumptions and proceed in a logical, linear fashion from premises to conclusion as in most disciplinary projects, because the starting points are themselves contested. There are different sets of assumptions and values held by each of the disciplines on which the project draws; and Wolfe and Haynes (2003) point out that these assumptions must be "made explicit and compared" (p. 154). One bootlegs in evaluative judgments (via what psychologists call the primacy effect and recency effect) about the relative importance of the disciplines through the order in which they are presented. To make genuine use of the valid insights of each of the disciplines, not

playing favorites or rejecting any of them, students of interdisciplinarity try to see what is of value in each and then pull those insights together to create some sort of larger understanding that is responsive to each of them.

In a sense, one needs to understand each discipline's contribution in the context of all the others. Because interdisciplinary study is about the relationships between parts and whole (text and context) as well as the interrelation of parts, interdisciplinary scholars cannot fully appreciate the whole (or the context) until the parts (or the texts) are understood, but neither are they ready to appreciate the parts apart from the whole. So how does one break into the loop? Parts and whole (or texts and context) cannot be presented simultaneously, so one is forced out of the linear reasoning that works so well in a disciplinary (or single-perspective) context. One starts to think instead about multiple passes through the material at increasing levels of sophistication (starting with a very general, impressionistic assessment of the contribution of each discipline, then in more depth each time), spiraling in through the disciplines from the general towards the specific, repeatedly bracketing the main line of argument to reach back for new parts or jump ahead to an emerging understanding of the whole, or a dialectical process of oscillation between different parts and the whole (as well as between one part and another part). Within that framework, one increasingly understands what each discipline has to say in the context of what the other disciplines have to say, gaining more depth or sophistication of understanding with each pass.

Structuring the Project

There are a number of different effective strategies for structuring a book, monograph, or long article coming out of an interdisciplinary research project. Some start by constructing a comprehensive theory and then applying it to the interdisciplinary topic. There are two strategies of theory construction, deductive and inductive. The deductive strategy first sets out a comprehensive theoretical framework into which one can place the various perspectives on the sub-topics and issues addressed in the project. The inductive approach to theory construction examines the various perspectives on the topics and issues one by one and gradually constructs a comprehensive theoretical framework from them. Either way, the theory is then applied to the topic of the project. Others prefer to start with the concrete and particular and move to the abstract and general. They start with the sub-topics and issues themselves to introduce readers to the overall topic or to establish its importance, and let the need for theory emerge from those substantive

discussions before they try to develop (either deductively or inductively) that theory. To decide which works best for a particular project, writers decide whether readers need a theoretical framework to help them make sense of the sub-topics and issues, or whether they must first grapple with sub-topics and issues before they can appreciate the need for a theoretical framework. Writers should determine whether the primary contribution of the project is likely to be a theory or substantive insight, and place it last.

There are at least three basic alternative models for structuring an interdisciplinary project: the hourglass, the wedge, and linear-with-digressions. The most popular model is probably the hourglass. Projects with an *hourglass* structure move from broad to narrow and back to broad, from context to text and back to context; they present the topic and its sub-topics and issues in the most general terms so the reader can see their larger significance, narrow the focus when they are examined in detail within a case study or focused on the specific topic, and then broaden again at the end to set out the larger significance of those specific findings. The *wedge* starts with a purely descriptive presentation of facts and information about the topic (which may include personal experience or narratives/case studies of the experience of others that have emotional content or otherwise bring home its human significance), then expands in scope from description to explanation by examining available theories and then developing a more comprehensive theory to explain those facts and information, and finally expands in scope again from explanation to implications by placing the more comprehensive theory in larger contexts. The *linear-with-digressions* model has an overall line of argument from which the writer repeatedly reaches back to bring in other perspectives or issues or subtopics. It oscillates between progression and digression, between moving the overall line of argument forward, and reaching back to a different discipline or perspective to get more material for the next step in the argument.

If the topic relates to a new field or one that scholars are just starting to explore, the challenge of the interdisciplinary project is probably to propose a theoretical framework rather than apply well-established theory, in which case the wedge structure might be considered. The wedge structure might also be useful if one is engaged primarily in exploration, or if the appeal of the project to readers is mostly emotional or personal. But if its appeal is likely to be intellectual or academic, with a focus on persuasion, one should consider using the linear-with-digressions structure. And if the significance of the project is likely to reside in the implications of its findings for some larger contexts, so that the topic is ultimately a means to an end more than an

end in itself, then the hourglass structure may be appealing. When in doubt, the hourglass can safely be considered the default structure.

But how does one go back and forth between general and specific, theory and application, abstract and concrete, text and context without losing coherence? How can one avoid putting one perspective ahead of another, and thus privileging it (if in no other way via the primacy and recency effects)? One can end up deciding that some disciplines will contribute more to the project than others, but that should be only after they've all received a fair hearing. Presenting one after another without regard for the psychological effects of the order in which they are presented does not give them all a fair hearing. Unfortunately, the linear format of the physical project itself (in which pages are numbered and read sequentially, so that page 2 follows page 1, and readers normally start at the beginning and read towards the end) doesn't fit the logic of interdisciplinary exposition. One might be tempted to think about structures like choose-your-own adventure or hypertext, but those offer an easy way out of a gritty problem; they say, I won't impose priorities and values on these disciplines, but I'll let you do it; yet *no* one should be doing that. After all, the very interdisciplinarity of the project means that the conventional expectations of the reader (based on a single-perspective approach to a topic) are not being fulfilled. Since the disciplinary approach has been rejected, it is incumbent upon the interdisciplinarian to explain what approach is being taken.

The "context" of the topic can take a number of different forms. It can refer to placing social behavior in economic, political, cultural, geographical, historical context; to placing chemical phenomena in geological, biological, and evolutionary context; or to placing theatre in the context of film, art, and music. It can also refer to placing individual behavior in the context of family, peer group, community, nation, race, gender, and culture; placing phenotypes or species in the context of eco-systems; and placing characters in the context of comparative literature or other media. It can place the study of a particular social phenomenon such as raves in the context of other sub-cultures, youth cultures, countercultures, music scenes, drug scenes, social deviance, or minority groups. In general, to identify the relevant contexts for the topic, scholars ask what larger categories or groups it is a part of, an instance of, an example of. It is productive to start with those larger categories—e.g., sub-cultures in general—before trying to apply the concepts and theories, approaches, questions, underlying values, and strategies found in the literature to the particular sub-culture of interest. In general, all interdisciplinarians face the problem of taking something

written for one context and applying it to another context. The difference is one of degree—just how much a concept or theory needs to be altered to fit the new context.

Where in the project should one integrate? Since one cannot expect readers to hold a large amount of information in their heads without knowing what they're supposed to do with it, one somehow needs to integrate as one proceeds. Suppose there are five perspectives on the topic. As soon as the second perspective is presented, its insights can be integrated with the insights from the first perspective. The resulting synthesis is tentative and partial, but it highlights the connections between those two perspectives. Once the third perspective is presented, its insights can be integrated with the synthesis of the first two. The first synthesis may well be modified, perhaps even reconsidered altogether, but the new synthesis is more comprehensive and a closer approximation to the eventual synthesis, and it highlights the significance of the contributions of the third perspective. Readers have to remember only the synthesis from the end of the preceding chapter or section, not the complete contents of two previous chapters or sections, in order to integrate their insights with those of the present chapter or section. By the time the last perspective is presented and its insights are integrated with those of the other perspectives, it may have only a modest impact on the overall synthesis, but it should be clear what contributions each perspective made to the final synthesis. The final synthesis was feasible because it did not require readers to hold too much in their minds at once, and readers were less likely to lose interest or concentration along the way.

Writing the Project

A distinctive challenge of writing interdisciplinary projects is that everything needs to go first. The reader needs to see all the other parts before any one part can be appreciated; moreover, it would be helpful to see the whole in order to appreciate the significance of any one part. One might say that readers need to finish reading an interdisciplinary project before they are ready to start reading it. More realistically, they need to have at least some familiarity with each of the different parts and some sense of the whole before they are ready to appreciate any one part in detail. This places a heavy and distinctive burden on the introduction of an interdisciplinary work. Think of the introduction as providing a quick and dirty overview of the entire project—not just of the topic and the issues surrounding it but also of the overall line of argument. When the introduction is understood that

way, it becomes apparent why it needs to be written last. It also frees one up to focus on the chapter now being written by providing the reassurance that the introduction will provide some background on this chapter and how it relates to the other chapters. What one cannot do is expect readers to hold all the pieces of the argument in their heads before they find out what they are supposed to do with them. People retain information best when they can synthesize it with information they already know; they do a poor job of retaining it when they don't know which pieces of information are most important; and they do an even worse job of thinking critically about that information when they don't know what they're going to end up doing with it. So the introduction needs to provide a framework in which the reader can place the facts, topics, issues, and parts of the argument before they are pulled together in a synthesis.

Much foreshadowing and referring back is required in an interdisciplinary project to anticipate connections to later chapters and create connections to previous chapters. Everything cannot be presented all at once, but the reader can be alerted that material will be covered in a later chapter that has bearing on a particular point in this chapter, and one can spell out the bearing that material in this chapter has on a topic, issue, position, or argument in a previous chapter. When the chapter to which one needs to refer has not been researched and written, experienced writers temporarily make the best guess possible about what will go into it and make connections accordingly. They do as much of this cross-referencing, interweaving, and inter-connecting as possible in the rough draft, though the majority of it will inevitably be done when the entire rough draft is revised.

One could even make a case for using the first person singular throughout an interdisciplinary project in order to draw the reader into the interdisciplinary reasoning process and to highlight the constructivist nature of the interdisciplinary approach. (The rhetorical advantages of the first person singular need to be balanced out, of course, with the protocols in the main disciplines or fields upon which one is drawing.) A rhetorical strategy that distinguishes interdisciplinary writing is the use of meta-discussion, in which one steps back from what is being said to examine the process by which the topic has been studied or the terms in which it is normally presented within that perspective. In short, one has to spend some time talking about the disciplines and how they function, about not only what it is they had to say but why they say it.

Moreover, unlike disciplinary projects where readers are already interested in the perspective, disciplinary readers of interdisciplinary projects have to be

sold on the utility, even the legitimacy, of the other contributing perspectives. Readers from contributing disciplines have rather focused interests, and they are being asked to become interested in what the project says about some larger, more comprehensive issue. Their first reaction is likely to be, "Why should I care?" One way to respond is to draw readers into that larger issue by helping them visualize themselves in that situation in that time and place by letting them experience it vicariously, which one can appropriately narrate in the first person singular, or through the experiences of others. Every author has the challenge of drawing in readers, but interdisciplinary authors have a special challenge because of the way interests get structured in the academy. Techniques such as the use of personal examples that draw the reader into a perspective are a plus in disciplinary writing; they become essential in an interdisciplinary context. The interdisciplinary writer is presenting an unfamiliar way of thinking as well as a substantive argument, so techniques such as asking questions help to engage readers in the process instead of merely presenting the results of that process. Questions can draw the disciplinary reader not only emotionally into the issues related to the topic (into the process of thinking about the topic), but also intellectually into the interdisciplinary process. Questions at the end of a later chapter need not be different from those in earlier chapters, so much as inviting reconsideration further along in the thinking process. Questions based on personal experience can also serve as a touchstone to which one can keep returning in order to ground abstract or complicated ideas in the reality of lived experience.

There are a number of standard styles for bibliographies and footnotes such as APA (American Psychological Association), MLA (Modern Language Association), and Chicago Style (*The Chicago Manual of Style)*. To make the project as credible as possible in the eyes of disciplinary experts, adopt the style used by the majority of the sources. Once the appropriate style for the project has been identified, put *all* citations in that format, even sources drawn from disciplines that use another style. If one uses a software package such as Reworks or Citation Machine, it will automatically convert all citations to the chosen format. Consider that citations provide an additional vehicle for conveying the interdisciplinary scope of the project.

C. Synthesis and Reflection: A Return to Questions of Integration

Library-based interdisciplinary scholarship involves much more than the application of standard research tools and writing activities to the interdisciplinary process. In research, standard tools must be significantly

adapted; their usage becomes greatly complicated for interdisciplinary scholars. In part, these departures from disciplinary research reflect the disciplinary-based classification and storage of knowledge by libraries, but they more importantly reflect the added dimensions and complex nature of the interdisciplinary process itself.

Computer searches must move back and forth between specialized classification systems developed by disciplines and accessed through keyword, title, and call number searches on the one hand, and more generic classification systems developed by libraries and accessed through subject heading searches on the other hand. Given the under-assigning of subject headings as librarians classify books and the inherently discipline-oriented understanding of knowledge on which subject headings are based, adapting the computer-search tool to interdisciplinary ends is necessary but not sufficient. The interdisciplinarian must also have a basic knowledge of potentially contributing disciplines and their relevant concepts and theories in order to improvise and apply ad hoc search strategies as well. Thus, even for librarians, computer searches that are straightforward and potentially complete for a disciplinary project become anything but routine for an interdisciplinary project; indeed, they are inevitably incomplete without some knowledge of each of the contributing disciplines.

Annotated bibliographies must be adapted by adding reflection on represented or underrepresented perspectives to citations and by organizing the bibliography into sub-topics. These adaptations are necessary because interdisciplinary studies draws insights from disciplines that are each characterized by a distinctive perspective and that each redefine the interdisciplinary topic differently as well as more narrowly. The location of information on perspectives, and the form and specificity of that information, varies considerably from book to book. This variation reflects the disciplinary agenda of most authors that takes perspective for granted. Likewise the topics on which authors focus reflect their disciplinary agenda; and the non-trivial task of recognizing those topics as sub-topics of the larger interdisciplinary topic being researched is another challenge in adapting the annotation bibliography tool to interdisciplinary research. One can think of each discipline as adding another dimension to the interdisciplinary process and of those dimensions as reflected in the organization of the bibliography and the contents of its annotations.

A literature review becomes a series of separate literature reviews, one for each topic subsumed under the overall interdisciplinary topic being researched. The problem of recognizing and identifying sub-topics studied

from the perspective of individual disciplines, interdisciplines, or schools of thought, which were initially confronted in compiling the annotated bibliography, is rejoined in the literature review. Part of the challenge of the literature review is to look more closely at the sub-topics examined in the disciplinary literatures to clarify what relationship they bear to each other and to the interdisciplinary topic being researched. Sometimes each discipline carves out different sub-topics, other times several disciplines will focus on the same or closely related sub-topics, and occasionally they may even focus on the interdisciplinary topic itself (though their approaches to it will inevitably differ). Thus, the categories of the literature review (i.e., the focus of individual literature reviews) may change as they are researched. Even more challenging is the task of looking within those sub-topics to identify the key issues under discussion, again to determine their relationships to each other and to the interdisciplinary topic. And again, some issues will be confined to a particular sub-topic, others will cut across sub-topics, and occasionally an issue will relate to the interdisciplinary topic as a whole. Particularly challenging are issues that cut across sub-topics, since the interdisciplinary scholar is faced with the challenge of constructing a "discussion" of that issue among scholars from different disciplines who do not read each other's work and may not even be aware of each other's existence. These sub-topics and issues must be understood separately as well as jointly, in relation to the disciplines and to the interdisciplinary topic, so the interdisciplinary topic can be situated fully in the context of disciplinary knowledge. If each discipline adds a dimension to the interdisciplinary process, then the matrix of disciplinary topics and issues reflects the complex interaction of those dimensions.

In writing, the complexity of the interaction of the disciplinary dimensions of the interdisciplinary process transforms standard writing activities. The complexity of the writing process stems fundamentally from the need to move among disciplinary parts as well as back and forth between those parts and the interdisciplinary whole, which often entails moving between text and context, general and specific, theory and application, abstract and concrete, or among meta-levels (e.g., self-reflexivity about interdisciplinary process) as well. As a result, the linearity of the disciplinary "line of argument," sequential organization, and "narrative thread" all have the potential to become too simplistic. Thus, the challenge of interdisciplinary writing is to provide coherence while embracing complexity.

Constructing the argument involves a host of special challenges such as escaping undue disciplinary influence, finding precise and meaningful

linkages among disciplinary contributions, and, of course, moving between parts and whole as well as among the parts. Domination of the argument by one discipline can be avoided by using neutral language to state the thesis, the steps in the argument, the synthesis, and the conclusion, by exposing and critically evaluating as many disciplinary assumptions as possible, and by keeping in mind how the objectives of one's research differ from those of the disciplinary authors on which the project draws. Constructing meaningful linkages among disciplinary contributions involves arraying the disciplines' variables, insights, explanations, etc., to bring out their respective strengths. Making those linkages as precise as possible is aided by paying close attention to the connotative as well as denotative meaning of disciplinary terminology. Moving between parts and whole involves finding ways to understand each increasingly in the light of the other by using strategies such as multiple passes through the material at increasing levels of sophistication, spiraling in, dialectics, and repeatedly bracketing the main line of argument to reach back or jump ahead. In general, constructing the argument requires close critical attention to disciplines, creative use of their contributions, nonlinear techniques of organization, and a clear sense of one's interdisciplinary mission. If the interactions of disciplinary contributions are complex, then constructing the argument requires the interdisciplinary scholar to make sense of that complexity.

Structuring the project requires choosing (if not constructing) a structural form other than a linear progression or sequence, since the project must move among parts and between parts and whole as well as between general and specific, theory and application, abstract and concrete, text and context. The interdisciplinary scholar must keep several issues in mind in structuring the project: (1) Do readers need a theoretical framework to help them make sense of the sub-topics and issues, or must they first grapple with sub-topics and issues before they can appreciate the need for a theoretical framework? (2) Is the primary contribution of the project likely to be theory or substantive insight? (3) Should the context come first (suggesting an hourglass structure), or should readers be drawn into the current discussions of the topic before placing them into context (suggesting either a wedge structure or a modified linear structure that oscillates between progression and digression)? (4) Is the appeal of the project primarily intellectual and academic or emotional and personal? Since the order in which disciplinary contributions are presented sends an implicit message (through primacy and recency effects) about their relative importance, an unusual structural burden is placed on the introduction to provide context for the rest of the project.

Context can take on a range of meanings, depending on the topic. Since readers can keep in mind only so much unstructured complexity at once, integration needs to take place incrementally throughout the project. If the challenge in constructing an argument is to make sense of the complexity resulting from the interaction of disciplinary contributions, then structuring the project requires the interdisciplinary scholar to embody that sense in the organization of the project.

The actual writing of the project requires a dynamic and self-reflexive form of exposition that takes writing-to-clarify-thinking and writing-to-engage-the-reader to a whole new level. The introduction needs to engage readers in the argument and its conclusion and in the synthesis and its application as well as in the topic and its issues in a way that interconnects and contextualizes without implicitly privileging any part. Subsequent chapters need to make extensive use of recapitulating, foreshadowing, cross-referencing, interweaving, partially integrating, and stepping back a meta-level to make explicit the processes of thinking and organizing that lie behind the text. Multiple drafts of the entire project become essential, indeed integral to the writing process and not merely desirable, because individual chapters must move the overall exposition towards a synthesis and conclusion that only becomes fully apparent once the draft is finished. The completed project must be written in a way that not only interests disciplinary readers in the interdisciplinary topic but also validates the legitimacy of interdisciplinarity and draws readers into the interdisciplinary process. If the challenge in structuring the project is to embody a sense of the complexity produced by the interaction of disciplinary contributions, then the actual writing of the project requires the interdisciplinary scholar to breathe life into that complexity through words.

D. Conclusion

The disciplinary knowledge on which interdisciplinarians draw is embedded knowledge. It is embedded in library and disciplinary classification schemes, in physical books and journals, in the topics disciplinarians choose to study, and in the issues they identify within those topics. When knowledge from different disciplines is brought together by the interdisciplinary scholar, those disciplinary contributions produce complex interactions. That complexity is embedded in the argument developed to integrate that knowledge, the organizational structure employed, and in the writing process itself. One might say that interdisciplinary scholarship not only applies

interdisciplinarity; it embeds it such that the intellectual challenges of inter-disciplinarity are manifested as problems of scholarly practice.

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Notes

[1] As Hubbard (1992) puts it (in unabashedly modernist terms): "… subject indexes are isomorphic with the natural landscape of a discipline, and hence serve as what can only be termed 'maps' of a discipline's 'topography' or 'terrain.…' "

[2] For a critique of call numbers and subject headings from the perspective of interdisciplinary collections, see Searing (1992).

[3] An alternative strategy uses citation indexes such as those of the Institute for Scientific Information that identify all journal articles within the humanities, social sciences, or natural sciences that have cited a particular article. Bates (1996) points out, "Making these links through citations instead of subject terms is particularly valuable because the same theme or issue is often discussed in different vocabularies from one discipline to another. By following up citations to works of proven value, there is no need to know another field's vocabulary in order to locate the information" (pp. 161-162). Unfortunately this strategy is limited to connections among disciplines already explored in the journal literature, and the nature and extent of the connections vary widely.

[4] In recent years, more topical databases have become available that cut across disciplines. See Fiscella and Kimmel (1999, p. 301) and Klein and Newell (2002, pp. 151-153).

[5] See the discussion of subject headings under "Challenges to Interdisciplinary Research" in Fiscella and Kimmel, 1999, pp. 295-296.

[6] Plans are afoot to link thesauri of the indexes of different disciplines, though the utility of such linkages remains to be seen. See Fiscella and Kimmel, 1999, p. 304.

[7] See White (1996) for a discussion of interdisciplinary "markers" such as incoming and outgoing citations.

[8] Even the "interdisciplinary" bibliographies in journals such as *Signs* and *American Quarterly* turn out to be multidisciplinary.

[9] Wolfe and Haynes (2003) also recommend that "a range of (more than one) perspectives from within the (at least one) discipline [be] included," since disciplines are "malleable" and "successful scholars demonstrate an awareness of the conflicting or varying disciplinary perspectives on the subject matter at hand" (p. 133).

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