Analysis of Interdisciplinary Faculty Job Postings by Institutional Type, Rank, and Discipline

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> **Abstract:** *The disciplinary department structure of universities is slow to respond to increasingly interdisciplinary problems. Initiatives focus on faculty hiring (joint appointments, cluster hires and/or interdisciplinary centers). To understand the qualifications sought for interdisciplinary faculty, we analyzed 3,512 faculty openings from* The Chronicle of Higher Education. *Only 6% of positions described interdisciplinarity (ID), and many were vague. Doctoral institutions emphasized interdisciplinary departments or colleges, while baccalaureate colleges had institution-wide interdisciplinary identities and stressed ID teaching. Natural sciences highlighted ID research and collaboration, while social sciences and humanities emphasized ID teaching and scholarship. Senior rank positions called for ID collaboration experience, while junior rank positions described ID teaching responsibilities. Implications for academic leaders as both graduate educators and hiring employers are discussed.*

Interdisciplinary approaches are necessary for attacking the most critical social and technological challenges facing the nation and the world today, such as energy and environmental sustainability, globalization, health care, and poverty (Brainard, 2002; National Institutes of Health, 2006; National Science Foundation, 2006). In higher education settings, it is often the departmental structure that is identified as the most significant barrier to faculty interdisciplinary collaboration (Committee on Facilitating Interdisciplinary Research, 2004; Sa, 2008). To

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counteract some of these barriers, institutions have experimented with interdisciplinary research centers (Mallon, 2006), seed funding, university-wide steering structures, and faculty hiring and evaluation (Sa, 2008). The focus of this paper is interdisciplinary faculty hiring. However, these other mechanisms are closely related: interdisciplinary centers are a special incentive for faculty hiring and recruiting because they bring like-minded people and common resources together (Mallon, 2006). They may assist in faculty hiring and retention in a variety of formal and informal ways, many of which are based on a network of resources and colleagues.

Most of the literature on interdisciplinary faculty hiring focuses on promotion and tenure of junior faculty. The challenges facing interdisciplinary faculty arise from the additional time necessary to work across disciplines, the demands of working across two organizations (as in a joint appointment), and the disciplinary orientation of review criteria and peer reviewers. Interdisciplinary scholarship often takes more time due to communication and negotiation with collaborators and reviewers (Committee on Facilitating Interdisciplinary Research, 2004; Pfirman, Collins, Lowes, & Michaels, 2005a). When faculty are jointly appointed across two organizations, there may be a high administrative expectation for faculty meetings and committee work, as well as expectations for "face time" in each department (Pfirman, Collins, Lowes, & Michaels, 2005b). Finally, review committees are often composed of individuals representing various disciplines, who may devalue contributions outside the discipline and question contributions to team projects (Payton & Zoback, 2007). The resulting conventional wisdom is that interdisciplinary endeavors should be delayed until tenure (Mallon, 2006). Nonetheless, doctoral students express enthusiasm for both faculty positions and interdisciplinary research (Golde & Dore, 2001). While enthusiasm for interdisciplinary scholarship is high, and a handful of publications offer best practices for mitigating the early career risks (Committee on Facilitating Interdisciplinary Research, 2004; Payton & Zoback, 2007; Pfirman et al., 2005b), there are few empirical studies addressing the pervasiveness or success of interdisciplinary faculty.

The purpose of this analysis is to understand how and to what degree interdisciplinary trends are represented in new faculty hiring, and to identify recommendations for faculty hiring and interdisciplinary graduate education. The research questions used to guide this analysis

were: (1) What percentage of all faculty openings is described by the posting institution as interdisciplinary?, (a) How are these distributed across <u>institutional types</u>?, (b) How are these distributed across <u>disciplines</u>?, (c) How are these distributed across <u>faculty rank</u>?; (2) Which specific interdisciplinary duties and preparation are desired by academic employers?, (a) How do these differ by <u>institutional type</u>?, (b) How do these differ by <u>discipline</u>?, (c) How do these differ by <u>faculty rank</u>?; (3) Where are new interdisciplinary faculty appointed, e.g. in centers, traditional departments or jointly?; and (4) Does motivation for interdisciplinary hiring come from the institutional level? In other words, do institutions with many natural science openings also have many social science and humanities interdisciplinary positions?

To address these, we built and analyzed a database of academic job postings appearing on the *Chronicle of Higher Education's* web site (www.chronicle.com/jobs). This public web site advertises thousands of academic positions each month across a range of disciplines and institution types, categorized so that faculty positions could be easily extracted. Thus, the results of this broad analysis will be relevant to interdisciplinary faculty openings across disciplines and institution types, and of interest to a wide range of faculty, administrators and graduate students involved in interdisciplinary initiatives. Specifically, the results of this analysis will instruct hiring institutions as to how to write clearer, more detailed interdisciplinary faculty job postings and suggest learning outcomes for interdisciplinary graduate programs and postdoctoral training.

Literature Review

In the literature, the challenges of interdisciplinary faculty hiring are most often described in terms of whether new hires will be able to meet promotion and tenure expectations (based on the assumption that universities should not hire faculty and then doom them to fail). The challenges facing interdisciplinary faculty arise from the additional time it takes to work across disciplines, the demands of working across two organizations (as in a joint appointment), and the disciplinary orientation of review criteria and reviewers.

Additional Time for Integration, Translation, and Coordination

Many scholars explain that interdisciplinary scholarship takes more time than disciplinary scholarship (Caruso & Rhoten, 2001; Committee on Facilitating Interdisciplinary Research, 2004; Metzger & Zare, 1999), and some even suggest longer tenure clocks for interdisciplinary scholars (Payton & Zoback, 2007). Interdisciplinary work is often conducted in teams, which require additional time for overcoming disciplinary language barriers (Borrego & Creamer, 2007) and ensuring publications are satisfactory to both coauthors and reviewers (Committee on Facilitating Interdisciplinary Research, 2004; Pfirman et al., 2005a). Similarly, Pfirman et al. (2005b) cite the "high networking costs" of coordinating with colleagues who have different priorities and participate in different professional societies and conferences.

Joint Appointments across Two Organizations

Joint appointments of faculty across two academic units or an academic unit and an interdisciplinary center are the most commonly described mechanisms of interdisciplinary hiring cited in the literature (Committee on Facilitating Interdisciplinary Research, 2004; Pfirman et al., 2005a; Sa, 2008). Organizations can often share costs and pool resources to provide more competitive offers (Mallon, 2006; Sa, 2008). While these faculty help bridge the two organizations (Ogilvie et al., 2004) and reap benefits from both, there is often also a heavy service and governance load (Pfirman et al., 2005b); jointly appointed faculty might be expected to attend twice as many faculty meetings and serve on twice as many committees. Pfirman et al. (2005b) recommend that pre-tenure faculty only have governance responsibilities in one home department, unless particular types of service provide important benefits (e.g., serving on a committee that would provide early exposure to incoming graduate students). A memorandum of understanding should serve as a contract between the two organizations to define expectations for research, teaching and service. Administrators should be committed to making the joint appointment work, to communicating with each other, and to understanding policies and procedures across the university (Pfirman et al., 2005b). Also of concern is "face time" with senior colleagues. Junior faculty may not want to spend time away from the department responsible for their promotion and tenure, even if a more attractive interdisciplinary community resides elsewhere in the university (Mallon, 2006; Pfirman et al., 2005a).

Discipline-Oriented Review Criteria, Reviewers and Mentors

Even in light of innovative joint appointments, tenure and review procedures remain stubbornly oriented along disciplinary lines (Mallon, 2006). Committees are increasingly assembled to represent the various disciplines (Payton & Zoback, 2007), but their expectations reflect those of an established discipline rather than an emergent field. For example, in emergent fields, there are fewer journals, professional societies, and committees through which to distinguish oneself (Pfirman et al., 2005b). Reviewers representing traditional disciplines also tend to devalue work outside the discipline (Committee on Facilitating Interdisciplinary Research, 2004; Pfirman et al., 2005b). Being accustomed to valuing individual achievement, they may also question the contribution to collaborative initiatives, treating them as fractional contributions, which is unfair due to the effort required in cross-disciplinary coordination described above. To counter this, review committees should consult with external reviewers personally familiar with the candidate's work to elicit input on the relative contribution (Payton & Zoback, 2007; Pfirman et al., 2005b). Few senior scholars may be uniquely qualified to evaluate the work as a whole rather than the sum of disciplinary parts, but many advocate mentoring and regular evaluation by qualified interdisciplinary scholars from outside the department or institution (Committee on Facilitating Interdisciplinary Research, 2004; Mallon, 2006; Pfirman et al., 2005a; Sa, 2008). Pfirman et al. (2005b) recommend inviting some of these scholars to campus to mentor junior faculty and meet with review committees.

In sum, the disciplinary structure and expectations of higher education institutions pose unique challenges to interdisciplinary scholars. To ensure the success of interdisciplinary faculty, several authorities advocate recognition of these challenges, clarity in expectations, communication between units, and seeking out truly qualified reviewers. Pfirman et al. (2005a) suggest beginning at the hiring phase, with a search committee composed as closely as possible to the eventual promotion and tenure committee, so that expectations are consistent. By extension, interdisciplinary faculty postings should be as clear as possible about the expectations for working across organizations and engaging in interdisciplinary scholarship or teaching, particularly since candidates will have questions about review procedures and criteria.

Career Risk for Junior Researchers

Because of the promotion and tenure concerns cited above, conventional wisdom advises junior faculty against interdisciplinary pursuits, at least until after they are granted tenure (Mallon, 2006). Frickel and Gross (2005) explain the rationale: "with proven track records in research and the security of tenure behind them, established scholars are in possession of more scientific and social capital to invest in [a new interdisciplinary field] than either younger or less distinguished colleagues" (2005, p. 211). In a survey of graduate students and faculty, Rhoten and Parker (2004) found 16% of graduate students associated negative career impacts with the interdisciplinary design of their program, a higher percentage than among the faculty and staff researchers associated with the same interdisciplinary organizations.

Despite the perceived early-career risks of interdisciplinary work, many graduate students look forward to interdisciplinary research. Sixty-one percent of graduate student respondents to Golde and Dore's (2001) survey were "interested and looking forward" to interdisciplinary research collaboration (p.17). However, only 25 percent of new faculty members in a different survey felt that they were "very prepared" to participate in interdisciplinary collaboration (Berberet, 2008, p. 9).

The benefits of job security, higher salary, prestige, academic freedom, and opportunities to participate in governance of tenure-track positions (Thedwall, 2008) make them a desirable goal for doctoral students, as well as prestigious placements for one's former graduate students. Tenure-track positions are most attractive, but non-tenure track positions are a common alternative (Brakeman, 1983). Thedwall (2008) cites the American Association of University Professors (2006) as stating that 58% of faculty at four-year institutions and 83% at two-year institutions are non-tenure-track faculty. Coupled with parallel changes in research faculty (funded by soft money), part-time appointments, and increases in the availability of distance education, it is clear that tenured and tenure-track faculty analyses do not reflect the entire range of career trajectories in the academic sector (Schuster & Finkelstein, 2006). Nonetheless, in the relatively unstudied arena of interdisciplinary career paths, this initial analysis of tenure-track faculty job postings is an important first step. It is important to note, also, that in many fields, postdoctoral research and/or teaching positions are the norm (Nettles & Millett, 2006; Walker, Golde, Jones, Bueschel, & Hutchings, 2008), and may provide additional

interdisciplinary training opportunities for faculty positions that are not present in doctoral programs.

Defining Interdisciplinary Positions

Identifying interdisciplinary faculty positions is not a trivial task, as "the line between the disciplines and interdisciplinarity has begun to blur in recent years" (Klein, 1990; Repko, 2008, p. 5). Repko, Klein, and others (The National Academies, 2006) cite examples, such as social psychology, psycholinguistics, ethnomusicology, cultural anthropology, and American Studies, but contradict each other in their categorization of biochemistry and environmental engineering as established or emergent fields. In addition to being contradictory, these lists are also not exhaustive. This is further complicated by the trend that in areas such as medicine, agriculture, and oceanography, interdisciplinarity is being practiced, but not necessarily labeled as such (Klein, 1996; Repko, 2008). At the other end of the spectrum, traditional programs can be merely relabeled, at least initially, with terms like "environmental," (Repko, 2008) "studies," (Garber, 2001) and "interdisciplinary" (Rhoten, 2004).

The term interdisciplinary is itself problematic; indeed, one of the aims of this analysis is to better understand how academic employers operationalize interdisciplinary qualifications. Some scholars differentiate between multidisciplinary work, which is often a combination of separate disciplinary components or team members, and interdisciplinary work, which is more integrative (Committee on Facilitating Interdisciplinary Research, 2004). Definitions of transdisciplinarity usually include stakeholders beyond academic disciplines, such as practitioners or the public (Klein, 2005). For this analysis, we make no normative assumptions about what employers mean by these terms used in their postings; rather, we rely on search committees' self-identification of the scholarly area or position as interdisciplinary, multidisciplinary, or transdisciplinary to explore how the labels are being used in faculty hiring. As a kind of shorthand, these openings are described as "interdisciplinary" throughout this manuscript, but as readers will see, many of these postings are lacking detailed description that might otherwise qualify them as truly interdisciplinary (or allow for an interesting comparison of when one term is used versus another).

Method

Data Sources

From June 1, 2007 to November 30, 2007, tenure-track faculty job postings appearing on the *Chronicle of Higher Education's* web site (www.chronicle.com/jobs) were used to populate two overlapping databases:

All faculty job postings (n = 2,687) for one month (November, 2007, the peak of the six-month sampling period).

Interdisciplinary faculty job postings (n = 825) for six months (June 1 to November 30, 2007). Extending the data collection period to an entire year did not yield many more unique openings, as autumn is the peak faculty recruiting season.

For the first 30 days, every position description was read to identify key words that described interdisciplinary positions in a way that could be applied uniformly as a selection rule. It was determined that a keyword search for "discipline" and "disciplinary" would identify all relevant postings (with "interdisciplinary," "multidisciplinary," "cross-disciplinary," "transdisciplinary," or "crossing disciplines" in the title or description). This type of search was used in subsequent months. Though this approach necessarily excludes more established or obviously interdisciplinary scholarly areas, it provides important insight into how the term "interdisciplinary" and its variants are being used in new faculty hiring.

For each position, the title, full description, contact information, rank, and institution were included in the database. Postings describing multiple positions were duplicated and separated as appropriate so that each database record corresponded to one opening. Unspecified multiple openings were interpreted conservatively (e.g., "multiple" = 2 positions).

Variables and Coding

Major quantitative variables for the postings were coded as described in the following paragraphs.

Institutional type categorizations were based upon the Carnegie Foundation classifications in 2000, which are archived on a *Chronicle of Higher Education* web site (http://chronicle.com/stats/carnegie/). Three values were created for this analysis: 1) doctoral institutions (doctoral and extensive), 2) master's institutions (I and II), and 3) other institutions (i.e., baccalaureate). Some smaller or more specialized schools (e.g., art schools and seminaries) were not included in the 2000 Carnegie classification, and were categorized along with baccalaureate institutions for this analysis. This variable was treated as categorical in statistical analysis.

The discipline of the posting followed the Taxonomy of Fields of Research Doctorate Programs used by the National Research Council in their Assessment of Research Doctorate Programs, archived on a National Academies web site (The National Academies, 2006). The major categories in this taxonomy are: a) life sciences, b) physical sciences, mathematics and engineering, c) social and behavioral sciences, and d) arts and humanities. Besides the subfields listed on the taxonomy, business, education and human development were included in social and behavioral sciences; architecture, design and apparel/fashion design were added to arts and humanities. Miscellaneous fields included social work, math education, and hospitality and tourism. For most analyses, categories were combined to simplify analysis and reporting. Specifically, biological and physical sciences and engineering (categories a and b) were combined into a "sciences" category, and social and behavioral sciences and arts and humanities (categories c and d) were combined into a "social sciences and humanities" category. This variable was treated as categorical.

The language used in the postings precluded categorization by tenured and untenured positions. Many positions, for example, specified "tenure-track assistant or associate professor." Categorization of the position as open rank, tenure-track assistant or associate ("junior rank"), tenure-track associate or full ("senior rank"), or unspecified rank was based on statements in the body of the posting. This variable was treated as categorical.

Postings in the one-month sample were also identified as either interdisciplinary or disciplinary, based on whether their descriptions included variations of "interdisciplinary," "multidisciplinary," etc., as

described above. This variable was treated as categorical. For the remainder of this document, the term interdisciplinary and the abbreviation ID are used to collectively refer to all of these variations.

The textual descriptions of the interdisciplinary positions (six-month sample) were first parsed into multiple text fields: title and appointment, scholarly area, description of the organization, duties, qualifications, and miscellaneous application instructions. The context of interdisciplinarity within each of these categories was used to further subdivide each, and variables were created as needed according to an open coding content analysis approach (Leedy & Ormrod, 2004; Patton, 2002). The final list includes 20 variables, listed in Table 4 grouped into the three categories of ID organizations, ID responsibilities, and ID qualifications. These variables were treated as categorical (dichotomous).

Data Analysis

Research question 1 (percentage of all postings that is interdisciplinary and differences by institutional type, discipline, and rank) was addressed using the postings from the one-month sample. Institutional type, discipline, and rank were cross-tabulated with the interdisciplinary or disciplinary nature of the posting. Chi-square tests were used to identify significant differences.

The six-month sample of interdisciplinary (ID) positions was used to answer research question 2 (specific interdisciplinary duties and preparation and differences by institutional type, discipline, and rank). Institutional type, discipline, and rank were cross-tabulated with the 20 different variables describing various ID organizations, responsibilities, and qualifications. Chi-square tests identified significant differences.

Research question 3 was answered by reporting frequencies and percentages of joint, department, and center appointments as specified in the posting text.

To answer research question 4, the interdisciplinary positions from the six month sample were used to generate a new data set in which each row corresponded to a specific institution. For each institution, the numbers of science (life sciences, physical sciences, mathematics and engineering) and social science/humanities positions were tallied and treated as scale variables. For institutions with positions uncategorized

by discipline, the values were coded as missing unless the institution had at least five categorized positions. A Pearson correlation analysis was run between these broad disciplinary groupings.

Limitations

According to the *Chronicle of Higher Education*, 2008 was a bad year for hiring at colleges and universities due to impending economic recession (Wheeler, 2008). While enrollments crept higher, some states resorted to hiring freezes in order to cut spending. Other limitations to the database include the cost of advertising on the site, which might deter some types of institutions or organizational units from advertising in this venue. The results are limited by vague descriptions within the job postings themselves. While the coding procedures were adjusted to minimize the degree of interpretation required of the researchers, some extrapolation was necessary. Institutions were relied upon to label their programs and fields as interdisciplinary (or similar), which may have skewed the sample to over-represent emergent areas and under-represent more established interdisciplinary areas. Finally, search committees may not have carefully considered subtle differences in wording that distinguish responsibilities from qualifications.

Results

What percentage of all faculty openings is described by the posting institution as interdisciplinary?

This section includes descriptive statistics and tests comparing interdisciplinary positions to other positions. Overall, a small percentage of recently posted faculty positions are interdisciplinary. Of 2,687 faculty openings, only 166 or 6% included a variation of the term "interdisciplinary."

How are these distributed across <u>institutional types</u>?

Table 1 lists the number and percentage of interdisciplinary positions at doctoral and other types of institutions. Over the one-month sampling period, there were more interdisciplinary positions at doctoral institutions (doctoral=73, master's=54, other=39), but the percentage of positions which were interdisciplinary was highest for other (baccalaureate) institutions (other=10%, doctoral=7%, master's=4%). Chi-square analysis reveals that this difference is indeed statistically significant

(χ^2=20.970, df=2, p=.000). Therefore, we conclude that interdisciplinary faculty openings are not equally distributed across institution types.

Table 1
Interdisciplinary Faculty Openings by Institutional Type

Institution Type	Interdisciplinary		Disciplinary		Total
	n	%	n	%	n
Doctoral	73	0.07	951	0.93	1024
Master's	54	0.04	1228	0.96	1282
Other	39	0.10	342	0.90	381
Total	166	0.06	2521	0.94	2687

How are these distributed across <u>disciplines</u>?

Table 2 lists the number and percentage of interdisciplinary positions in various disciplinary categories. Arts and humanities (9%) and life sciences (8%) had the highest percentages of ID faculty positions, while social and behavioral sciences had the lowest (4%). Chi-square analysis (treating "other" category as missing data) reveals this difference is statistically significant (χ^2=27.580, df =3, p=.000).

Table 2
Interdisciplinary Faculty Openings by Discipline

Discipline Category	Interdisciplinary		Disciplinary		Total
	n	%	n	%	n
Life Sciences	33	.08	377	.92	410
Physical Sciences, Mathematics and Engineering	28	.06	336	.94	364
Social and Behavioral Sciences	42	.04	1158	.96	1200
Arts and Humanities	56	.09	541	.91	597
Other	15	.13	101	.87	116

How are these distributed across <u>faculty rank</u>?

Table 3 lists the number of interdisciplinary positions for each rank. The percentage of interdisciplinary positions was higher at the senior rank (18%) than at junior rank (6%). However, there were ten times as many openings at the junior rank, and nearly three times as many interdisciplinary openings at the junior rank than at the senior rank (junior=112, senior=34). Chi-square analysis comparing only the specified ranks reveals this difference is not statistically significant (χ^2=.861, N.S.). Therefore, we conclude that there are more interdisciplinary faculty openings at the junior rank than at senior rank.

It is also important to note that the overall distribution across ranks is similar for the interdisciplinary and disciplinary positions. Interdisciplinary positions were 64% junior level, 20% senior level, and 16% open rank or unspecified. Disciplinary positions were 72% junior level, 6% senior level, and 22% open rank or unspecified.

Table 3
Interdisciplinary Faculty Openings by Rank

	Interdisciplinary		Disciplinary		Total
Rank	n	%	n	%	n
Junior (assist/assoc)	112	0.06	1808	0.94	1920
Senior (assoc/full)	34	0.18	152	0.82	186
Open Rank or Unspecified	28	0.05	553	0.95	581

Which specific interdisciplinary duties and preparation are desired by academic employers?

Table 4 summarizes the ways in which interdisciplinarity was described in the descriptions of 825 ID faculty positions. We found through the course of the analysis that in addition to ID job responsibilities and ID qualifications of the applicants, many of the postings described the organization as interdisciplinary. Thus, there are three groupings in Tables 4 through 7: ID organization, ID responsibilities and ID qualifications.

Nearly half (47.6%) of the postings described one of the organizations the candidate would be working in as interdisciplinary; most common

was the department or other organization of appointment. This high percentage of departments—usually aligned with traditional disciplines—describing themselves as interdisciplinary does raise questions as to how seriously search committees are considering their use of the term. Similarly, of the 825 ID positions, 206 or 25% described only the organization as ID (not the responsibilities or qualifications of the candidate).

Over half (56.0%) listed some type of ID responsibilities, but most of these were unclear, coded in a category of enthusiasm or commitment to interdisciplinarity (including "commitment," "maintaining," "strengthening," "adding," "thriving in," "expanding," "continuing" or "participating in" an ID environment or initiatives). Examples from postings include: "Also desirable is an ability to complement and fit into an interdisciplinary program," and, "The candidate will be expected to engage in appropriate collaborative and interdisciplinary activities within and outside the department." Less than one third (29.2%) of the ID positions listed any ID qualifications of applicants, and many of these described interdisciplinarity as "desirable" or "a plus," rather than a requirement.

The following sections explore these categories and codes in greater detail, subdividing by institutional type, discipline and rank to better understand the types of interdisciplinarity desired or advertised in the various faculty position descriptions.

Table 4

Interdisciplinary Organizations, Responsibilities and Qualifications for all Interdisciplinary Positions

ID Category	Interdisciplinary Positions	
	n	Percentage n = 825
Organization (total)	393	.476
ID degree program	62	.075
ID "program", usually academic	47	.057
ID Core or other teaching	53	.064
ID Institute or Center or Research Program	30	.036
ID Organization of appointment (department, school)	156	.189
ID Organizational Unit such as a college or school	16	.019
ID Institution	60	.073
Responsibilities (total)	462	.560
"Contribute" to ID environment or initiatives	226	.274
Lead, develop, foster or facilitate ID initiatives	46	.056
Teach ID courses	116	.141
Conduct ID research	28	.034
Bridge or connect disciplines or departments	6	.007
Collaborate (with other faculty) across disciplines	28	.034
ID Opportunities exist	69	.084
Qualifications (total)	241	.292
ID degree, training, or background	26	.032
ID teaching or curriculum development experience or ability	47	.057
ID research experience or ability	31	.038
ID leadership experience or ability	9	.011
ID collaboration experience or ability	24	.029
Other: ID experience/environment	28	.034

How do these differ by <u>institutional type</u>?

Table 5 compares the types of interdisciplinarity described in postings by doctoral, master's and other (baccalaureate) institutions. A chi-squared test identified statistically significant differences. In cases where the cell

size was less than 5, either the two remaining institutional types were compared to each other (indicated by df=1 in Table 5) or "N/A" indicates that the cell size for at least two of the types was less than 5.

Master's institutions were most likely to describe an ID degree program in their postings (master's=13%, doctoral=6%, other=5%; χ^2=11.012, df=2, p=0.004). Both master's and other (baccalaureate) institutions more frequently described an interdisciplinary core or other program that successful candidates would be teaching in (master's=11%, other=10%, doctoral=3%; χ^2=20.657, df=2, p=0.000). On the other hand, doctoral institutions were more likely to describe the organization of the faculty appointment as interdisciplinary (doctoral=25%, master's=14%, other=12%; χ^2=18.000, df=2, p=0.000). Finally, other (baccalaureate) institutions most often described the entire institution as interdisciplinary (other=18%, master's=4%, doctoral=5%; χ^2=38.859, df=2, p=0.000). The findings might have been expected given the relative size of these types of institutions. Smaller institutions would be expected to share an institution-wide ID identity more often than large institutions that are organizationally separate. The relative emphasis on teaching explains why master's institutions emphasized ID degree programs and both master's and other (baccalaureate) institutions emphasized ID core programs.

This emphasis also plays out in job responsibilities. Master's institutions were most likely to list any ID responsibilities (master's 65%, other=55%, doctoral=53%; χ^2=8.430, df=2, p=0.015), but also most likely to list the vaguest kind of responsibility: contribute to ID initiatives (master's=41%, other=34%, doctoral=24%: χ^2=6.752, df=2, p=0.034). Both master's and other types of institutions indicated that successful candidates would teach ID courses (master's=22%, other=16%, doctoral=9%; χ^2=20.790, df=2, p=0.000); fewer postings specifically mentioned conducting ID research (1% to 5%), and the differences were not significant. Master's institutions were also more likely to expect their hires to collaborate with other faculty across disciplines (master's=7%, doctoral=3%; χ^2=6.665, df=1, p=0.010), while doctoral institutions merely offer ID opportunities (doctoral=14%, master's=3%; χ^2=17.647, df=1, p=0.000) if new hires desire to take advantage of them.

So few ID qualifications were listed in the job postings that few differences could be discerned between institution types. Master's institutions were most likely to list the qualification of prior experience in an ID environment (master's=7%, doctoral=3%; χ^2=6.665, df=1, p=0.010). It is clear from these findings that master's institutions are both more likely to describe any type of ID organizations, responsibilities, and qualifications in their job postings as well as to be most specific.

Table 5
Differences by Institutional Type in Interdisciplinary Organizations, Responsibilities and Qualifications

ID Category	Type of Institution			χ^2	Df	Probability
	Doctoral (n=416)	Masters (n=216)	Other (n=185)			
Organization	**0.45**	**0.39**	**0.35**	**5.704**	**2**	**0.058**
ID Degree Program	0.06	0.13	0.05	11.012	2	0.004*
ID "Program", usually academic	0.06	0.02	0.09	0.898	1	0.343
ID Core or other teaching	0.03	0.11	0.10	20.657	2	0.000**
ID Institute or Center or Research Program	0.05	0.03	0.02	1.485	1	0.223
ID Organization of appointment (department, school)	0.25	0.14	0.12	18.000	2	0.000**
ID Organizational Unit such as a college or school	0.02	0.02	0.01	0.015	1	0.902
ID Institution	0.05	0.04	0.18	38.859	2	0.000**

Table 5 cont.

ID Category	Doctoral (n=416)	Masters (n=216)	Other (n=185)	χ^2	Df	Probability
Responsibilities	**0.53**	**0.65**	**0.55**	**8.430**	**2**	**0.015***
"Contribute" to ID environment or initiatives	0.24	0.41	0.34	6.752	2	0.034*
Lead, develop, foster, or facilitate ID initiatives	0.06	0.07	0.04	1.304	2	0.521
Teach ID courses	0.09	0.22	0.16	20.790	2	0.000**
Conduct ID research	0.04	0.05	0.01	0.103	1	0.749
Collaborate (with other faculty) across disciplines	0.03	0.07	0.01	6.665	1	0.010*
ID Opportunities exist	0.14	0.03	0.02	17.647	1	0.000**
Qualifications	**0.31**	**0.30**	**0.25**	**2.560**	**2**	**0.278**
ID Research area focus, approach, interests, perspective, vision	0.01	0.01	0.00	N/A	N/A	N/A
ID degree, training, or background	0.05	0.07	0.06	1.789	2	0.409
ID teaching or curriculum development expertise or ability	0.05	0.03	0.02	1.792	1	0.181
ID research experience or ability	0.02	0.01	0.00	N/A	N/A	N/A
ID leadership experience or ability	0.03	0.03	0.02	0.007	1	0.934
ID collaboration experience or ability	0.15	0.11	0.15	2.738	2	0.254
Other: ID experience/environment	0.03	0.07	0.01	6.665	1	0.010*

How do these differ by <u>discipline</u>?

Table 6 compares the types of interdisciplinarity described in postings by discipline, specifically sciences (biological sciences, physical sciences, mathematics and engineering) to social sciences and humanities (abbreviated "SS/hum"). A chi-square test identified statistically significant differences, except where "N/A" indicates that the cell size for at least one of the groups was less than 5. There were no differences by discipline in terms of how the organization was described; rather there were several differences in job responsibilities and a few in qualifications. Overall, the sciences were more likely to emphasize research and collaboration, while the social sciences and humanities emphasized teaching, similar to findings by Braxton and Hargens (1996) and Biglan (1973). Postings in the social sciences and humanities more frequently desired unspecified contributions to the ID environment (SS/hum=30%, sciences=19%; χ^2=8.633, df=1, p=0.003) and expected successful candidates to teach ID courses (SS/hum=16%, sciences=9%; χ^2=6.398, df=1, p=0.011). Postings in the sciences were more likely to list the responsibilities of conducting ID research (sciences=8%, SS/hum=2%; χ^2=16.056, df=1, p=0.000) and collaborating across disciplines (sciences=8%, SS/hum=3%; χ^2=6.542, df=1, p=0.011), an indication that "collaborate" often refers to research. Sciences also included more vague statements about the existence of ID opportunities (sciences=14%, SS/hum=6%; χ^2=10.470, df=1, p=0.001).

Social science and humanities more often listed ID qualifications of any kind (SS/hum=20%, sciences=32%; χ^2=10.021, df=1, p=0.002), as well as describing the scholarly area of the position as ID (SS/hum=17%, sciences=6%; χ^2=13.213, df=1, p=0.000). The sciences emphasized ID collaboration ability or experience (sciences=6%, SS/hum=2%; χ^2=5.953, df=1, p=0.015). Biglan also found that faculty in the sciences reported more collaboration on both teaching and research than those in social sciences and humanities (1973).

Table 6
Differences by Discipline in Interdisciplinary Organizations,
Responsibilities, and Qualifications

Disciplinary Category					
ID Category	Sciences (n=194)	SS/Hum (n-519)	χ^2	Df	Probability
Organization	**0.46**	**0.46**	**0.016**	**1**	**0.899**
ID Degree Program	0.09	0.07	1.318	1	0.251
ID "Program", usually academic	0.01	0.06	N/A	N/A	N/A
ID Core or other teaching	0.05	0.07	0.894	1	0.344
ID Institute or Center or Research Program	0.04	0.02	2.261	1	0.133
ID Organization of appointment (department, school)	0.18	0.19	0.172	1	0.678
ID Organizational Unit such as a college or school	0.03	0.02	0.522	1	0.470
ID Institution	0.09	0.07	0.538	1	0.463
Responsibilities	**0.54**	**0.57**	**0.365**	**1**	**0.546**
"Contribute" to ID environment or initiatives	0.19	0.30	8.633	1	0.003*
Lead, develop, foster, or facilitate ID initiatives	0.06	0.05	0.214	1	0.643
Teach ID courses	0.09	0.16	6.398	1	0.011*

Table 6 cont.

ID Category	Sciences (n=194)	SS/Hum (n-519)	χ^2	Df	Probability
Conduct ID research	0.08	0.02	16.056	1	0.000**
Collaborate (with other faculty) across disciplines	0.08	0.03	6.542	1	0.011*
ID Opportunities exist	0.14	0.06	10.470	1	0.001*
Qualifications	**0.20**	**0.32**	**10.021**	**1**	**0.002***
ID Research area focus, approach, interests, perspective, vision	0.06	0.17	13.213	1	0.000**
ID degree, training, or background	0.03	0.03	0.051	1	0.822
ID teaching or curriculum development expertise or ability	0.03	0.06	N/A	N/A	N/A
ID research experience or ability	0.03	0.04	0.135	1	0.714
ID leadership experience or ability	0.02	0.00578	N/A	N/A	N/A
ID collaboration experience or ability	0.06	0.02	5.953	1	0.015*
Other: ID experience/environment	0.02	0.04	N/A	N/A	N/A

How do these differ by <u>faculty rank</u>?

Table 7 compares junior and senior level ID positions. Statistically significant differences were identified by a chi-square test, except where "N/A" indicates that the cell size for at least one of the groups was less than 5. Senior faculty were more often associated with an ID institute, center, or research program (senior=9%, junior=2%; χ^2=11.037, df=1, p=0.001), and more likely to be hired to lead, foster, or develop ID initiatives (senior=29%, junior=2%; χ^2=97.709, df=1, p=0.000). Junior faculty postings more frequently mentioned contributing in unspecified ways to an ID environment (junior=31%, senior=17%%; χ^2=7.775, df=1,

p=0.005) and ID teaching responsibilities (junior=19%, senior=6%; χ^2=9.645, df=1, p=0.002). Postings for senior faculty were also more likely to list ID qualifications (senior=43%, junior=31%; χ^2=4.885, df=1, p=0.027), specifically ID collaboration experience (senior=6%, junior=2%; χ^2=4.656, df=1, p=0.031). In sum, senior hires were most often sought to develop and lead ID activities, often in centers, while junior faculty were sought for ID teaching and other less specific ID responsibilities.

Table 7

Differences by Rank in Interdisciplinary Organizations, Responsibilities, and Qualifications

Disciplinary Category					
ID Category	Junior Levels (n=481)	Senior Level (n-101)	χ^2	Df	Probability
Organization	**0.49**	**0.45**	**0.619**	**1**	**0.431**
ID Degree Program	0.08	0.14	3.646	1	0.056
ID "Program", usually academic	0.07	0.04	N/A	N/A	N/A
ID Core or other teaching	0.08	0.05	N/A	N/A	N/A
ID Institute or Center or Research Program	0.02	0.09	11.037	1	0.001*
ID Organization of appointment (department, school)	0.17	0.15	0.345	1	0.557
ID Organizational Unit such as a college or school	0.02	0.03	N/A	N/A	N/A
ID Institution	0.07	0.01	N/A	N/A	N/A

Table 7 cont.

ID Category	Junior Levels (n=481)	Senior Level (n-101)	χ^2	Df	Probability
Responsibilities	**0.58**	**0.51**	**1.265**	**1**	**0.261**
"Contribute" to ID environment or initiatives	0.31	0.17	7.775	1	0.005*
Lead, develop, foster, or facilitate ID initiatives	0.02	0.29	97.709	1	0.000**
Teach ID courses	0.19	0.06	9.645	1	0.002*
Conduct ID research	0.04	0.02	1.088	1	0.297
Collaborate (with other faculty) across disciplines	0.05	0.03	N/A	N/A	N/A
ID Opportunities exist	0.05	0.02	N/A	N/A	N/A
Qualifications	**0.31**	**0.43**	**4.885**	**1**	**0.027***
ID Research area focus, approach, interests, perspective, vision	0.16	0.21	1.497	1	1.221
ID degree, training, or background	0.04	0.02	N/A	N/A	N/A
ID teaching or curriculum development expertise or ability	0.07	0.04	N/A	N/A	N/A
ID research experience or ability	0.04	0.03	N/A	N/A	N/A
ID leadership experience or ability	0.00	0.05	N/A	N/A	N/A
ID collaboration experience or ability	0.02	0.06	4.656	1	0.031*
Other: ID experience/environment	0.03	0.06	1.911	1	0.167

Many of the senior level ID positions came with titles and administrative duties. Among the 101 senior level ID positions were 13 center or institute directors, 25 endowed chairs, and 57 department heads, deans, or other administrators. While endowed chairs are an effective means of attracting top senior scholars for a variety of teaching and research responsibilities, most of the senior rank positions are for directors, chairs or deans (n = 70, 70%). Of the 13 center director postings, only half (n = 7) described the center, institute or program as ID. The most commonly cited job responsibilities for center directors were leading (n = 7) and contributing (n = 5) to ID initiatives; most commonly listed qualifications were ID leadership experience (n = 3), ID collaboration experience (n = 3) and an ID scholarly area (n = 3). Of the 57 department head and dean positions, 30 described the organization as ID, 20 expected the successful candidate to lead ID initiatives, and 12 expected some sort of unspecified contribution. The most common ID qualification was ID leadership experience (n = 5), followed by ID teaching (n=3), collaboration (n=3), research experience (n=3) and experience in an ID environment (n = 3). These findings align with Mallon's (2006) conclusion that effective administrators often have interdisciplinary experience, making them less likely to emphasize and reward individual contributions. Similarly, Pfirman et al (2005b) emphasize training administrators to understand the challenges of ID scholarship as well as expectations and policies across the institution.

Where are new interdisciplinary faculty appointed, e.g. in centers, traditional departments or jointly?

Of the 825 ID positions, 316 specified appointment in departments, 36 specified joint appointments, and 468 did not specify. Among the 36 joint appointments, 25 were at junior rank and only 7 at senior rank. All joint appointments which were categorized by discipline were in social sciences (n=19) and humanities (n=11). While several were unclear, 12 specified an ID program or center and specific department for the joint appointment, 14 listed two specific departments, five specified an ID program or center and left the department open to the candidate, and two others left both departments open to the candidate. Very few also specified the tenure home; however, the examples found were all at the assistant professor level. An Assistant Professor of Women's Studies opening at the University of Connecticut explained, "the position will be jointly held in the Women's Studies Program and the academic

department corresponding to the successful candidate's doctorate. The candidate's tenure will reside in that department." A University of Tennessee Knoxville Assistant Professor opening was described as "a joint position between Africana Studies (50%) and the Department of Sociology (50% and tenure home)." The Committee on Facilitating Interdisciplinary Research reports that as many as 63% of institutions offer joint appointments with salary shared across units, but 75% responded that 0-10% of faculty actually hold these appointments (2004). Cluster hires are a second strategy for hiring interdisciplinary faculty, in which an interdepartmental search committee specifies and interdisciplinary area of scholarship, and then finds appropriate departments to appoint successful candidates (Sa, 2008). There were only 30 cluster hire positions in the sample of 825 ID positions.

Do institutions with many natural science openings also have many social science and humanities interdisciplinary positions?

A Pearson correlation analysis across disciplinary categories was performed to determine the location of motivation for interdisciplinary hiring as institution level or at the college/department level. A statistically significant correlation was identified between sciences and social sciences/humanities positions (r=.350, p=.000). In an attempt to understand the role of institutional type, this analysis was repeated on doctoral institutions only (r=.066, N. S.), master's institutions only (r=.709, p=.000), and other institutions only (r=.298, p=.002). It appears that Carnegie master's and other institutions are more likely to identify institution-wide as ID than doctoral universities, a logical result given the relative size of the institutions and liberal arts focus of many master's and baccalaureate institutions.

The 825 interdisciplinary faculty openings were posted by 341 different U.S. and Canadian institutions. In some cases, high numbers were achieved through special initiatives focused on one part of the institution. For example, Syracuse University posted 12 openings across various social science and humanities organizations. Other institutions with the highest number of ID openings did exhibit distribution across disciplines. Arizona State University posted 16 openings on its main campus, five at the Polytechnic campus and one at the West campus, covering all disciplinary categorizations. University of Michigan posted 13, and University of California Berkeley posted 12, again distributed across disciplinary categories. Combined with the number of National Science

Foundation IGERT interdisciplinary graduate training grants at these institutions, the number of ID faculty positions seems to be yet another indicator of the interdisciplinarity of a university (Carney, Chawla, Wiley, & Young, 2006). Among other types of institutions, University of Wisconsin Colleges coordinated to post 34 ID faculty openings, College of New Jersey posted 13, and Elon University posted 9. In each case, these Master's I institutions represented a range of disciplines in their ID faculty postings, and postings from the same institution included similar text related to an ID undergraduate core in which faculty would teach, or a commitment to ID undergraduate education.

Discussion

The purpose of this analysis was to understand how and to what degree interdisciplinary trends are represented in new faculty hiring, and to identify implications for faculty hiring and interdisciplinary graduate education. It appears that the rigid departmental structure still governs faculty appointments, including interdisciplinary ones. Few postings described joint appointments; much more common was departments (ranging from traditional Mathematics to nontraditional Human Sexuality) describing themselves as interdisciplinary, reinforcing Rhoten's (2004) finding that traditional organizations are more prone to relabeling than truly reorganizing. Interdisciplinary schools within large institutions were also common organizations for ID faculty appointments, indicating that alternatives to traditional department structures (and the barriers, mentioned previously, that they represent) are available. It is interesting to note, then, that proportionately few faculty appointments were fully within ID centers or institutes, though these organizations were often described as the main sites of interdisciplinary interaction. These findings suggest that while ID centers and institutes abound in academia, these are not frequently utilized as homes for ID faculty or degree programs. One possible reason for this trend, as Mallon (2006) explains, is that at least some center directors believe faculty should be appointed in traditional departments to avoid competition between departments and centers. However, centers are still viewed as an important recruiting tool for high-quality faculty, and as such, they should be mentioned in faculty job postings when applicable.

The ambiguity surrounding interdisciplinarity in faculty job postings suggests that academic employers are still uncertain of which ID skills

and experience they desire. Particularly in the case of ID organizations, "interdisciplinary" may simply be the newest buzzword to join "dynamic," "innovative," and "cutting-edge" in the boilerplate language of faculty job postings. Brakeman (1983) explains the potential appeal of such terms, saying:

> A place that is vital, open to new ideas, full or life, working to balance tradition and change, and responsive to new intellectual currents will be more likely to be attractive to candidates than a place that is dormant, closed, conservative, and run in a heavy-handed fashion. (p. 7)

While terms such as "interdisciplinary" may attract certain types of candidates, potential employers often fail to specify precisely what they mean by the term. Therefore, it becomes a label without meaning—or one which is vague or even misleading to candidates. To avoid confusion, employers ought to be careful in their use of interdisciplinary terminology (such as "interdisciplinary", "multidisciplinary", "transdisciplinary", or "cross-disciplinary"), and clarify specific expectations for the position.

Despite this ambiguity, some important information on preparation for an ID academic career path can be extracted from the postings studied above. For example, the findings indicate that ID research and collaboration are emphasized by physical and biological science disciplines, and that collaboration experience is more desired for senior level positions. Additionally, ID teaching is more prominent in postings by non-doctoral institutions, particularly in undergraduate ID core programs, social science and humanities disciplines, and junior rank positions. It is unclear where junior candidates are expected to gain the interdisciplinary teaching experience required for many of these positions, at least during graduate school, as teaching schedules and associated teaching assistantships are typically controlled by traditional departments (Mallon, 2006). Postdoctoral teaching fellowships and adjunct positions may be a viable alternative. The lack of opportunities to gain this experience ought to be considered by search committees when writing job descriptions for interdisciplinary positions at the junior level.

Also significant is that larger doctoral institutions are more likely to describe the organization of the faculty appointment as ID, while

baccalaureate and master's institutions have a campus-wide interdisciplinary identity. By these descriptors, it is unknown whether interdisciplinary commitment at an institution is embodied by a general curriculum for undergraduates, by cross-listed courses, or by a number of ID research centers. Various descriptors of the intensity and level of interdisciplinary support can attract faculty members with different expectations, so job postings ought to be as clear as possible on this point. Interestingly, senior level positions are more likely than junior level to be affiliated with a research center, to include ID leadership responsibilities, and to require ID qualifications, particularly ID collaboration experience. Few junior level faculty positions require or even mention prior ID experience; rather, they emphasize an ID area of scholarship and enthusiasm for contributing to ID, in addition to aforementioned teaching responsibilities. Fortunately, these trends mirror well-established characteristics of institutional type and disciplines (Biglan, 1973; Braxton & Hargens, 1996; Donald, 2002; Repko, 2008), so conventional advice on applying for faculty positions is likely to apply (Barnes, 2007; Heiberger & Vick, 1992; Reis, 1997). However, with so few ID postings in any given scholarly area, networking prior to graduation may be an even more important strategy in ID fields.

Few outcomes for ID graduate education and postdoctoral training can be extracted from ID faculty job postings. Other than area of scholarship, ID teaching and collaboration appear to be most prominent. While collaboration experience varies by the nature and requirements of the program, it is not clear that many opportunities exist for graduate students or postdoctoral researchers to gain ID teaching experience. The US National Science Foundation's IGERT program, for example, focuses on research and related scholarship (due to the NSF orientation towards technical fields). While ID graduate programs necessarily focus on excellence within the area of scholarship, important contributions can be made across ID fields by articulating the types of integrative skills students are expected to gain, and sharing these with potential employers. For example, "collaboration" is left undefined in many of the postings, but can mean anything from team teaching to forming and leading a team of researchers.

Those that argue against interdisciplinary faculty hiring are to some extent vindicated by these findings; indeed, very few faculty openings are interdisciplinary, and half of these may be using the term as a

buzzword more than a bona fide qualification for candidates. It is the same academic community that is producing ID scholars as is hiring them into faculty positions, but academic leaders are uncertain in either role (hiring or educating doctoral students and postdoctoral scholars) what skills and experience are critical to interdisciplinary success. Among those institutions that show leadership in interdisciplinarity, this is manifested in a high number of ID faculty postings in this study, multiple IGERT grants (particularly at doctoral institutions) and an institution-wide interdisciplinary identity (particularly at baccalaureate institutions). Fortunately, these institutions are easily identified by those that wish to locate exemplary ID practices.

As the previous discussion indicates, much of the confusion regarding interdisciplinary job postings may be remedied by the careful attention of the potential employer. By using clear language to describe specific expectations for interdisciplinary work—whether it be collaborative teaching or research, or is housed in a traditional department or a center—is an important part of attracting the faculty candidates with the desired skill set. This means that buzzwords like "interdisciplinary" or "multidisciplinary" are no longer enough. In fact, the vagueness of these terms could very well lead to confusion among prospective candidates. In addition to a more conscientious use and description of the terms of ID work, future employers would do well to keep in mind that graduate school is the first (and only, in some instances) preparation that some students will have for the ID job market, and adjust their own programs or else their expectations for junior faculty accordingly.

Conclusion

The findings of this study do not contradict the already existing understanding of the nature of ID faculty work: namely, that it occurs in different ways at different types of institutions (consistent with discipline and institutional type), and that its current use in job postings appears to be more as an attractive buzzword than as accurate descriptor of actual expected duties or qualifications. However, this study is significant in that it offers a quantitative analysis of the extent to which innovative practices to accommodate ID work are being institutionalized across a broad range of disciplines. Future studies might build from this preliminary analysis and include data on eventual placement and success in ID jobs, measured against other variables in the ways the job postings

were written (such as clarity) or qualities of the positions themselves (senior versus junior level, perhaps).

Interdisciplinary faculty positions and associated policies are important indicators of the willingness of academia to embrace interdisciplinary scholarship. Our findings echo those of Sa, (2008) namely that:

> In scale, the recruitment models examined still innovate at the margin, responding for a relatively small fraction of faculty hiring. They build upon existing policies and practices in evolutionary ways, rather than represent "radical innovations." They do introduce new terms in the vocabulary of university models, however. (p. 549)

The apparent lack of truly interdisciplinary faculty positions at most universities necessarily has implications for interdisciplinary graduate education and postdoctoral training. Those involved in training interdisciplinary graduate students ought to be aware of the number and types of faculty positions that may be available to them upon graduation, and work more proactively to publicize the unique skills of interdisciplinary graduates. Furthermore, graduate students in interdisciplinary programs should be trained to adapt not only to different disciplinary ways of knowing, but also to different ways of applying knowledge in academic and other settings.

Acknowledgements

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