Information Resources Used by Academic Professors of the Unites States in the Electronic Age

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ABSTRACT
To identify what information resources the professors use to support their research activities and how they use them in the electronic age, this paper surveyed 637 faculty members from five research universities across the nation. Three questions were asked including the five most important specific resources, how many articles they retrieved from 13 channels of sources, and which search engine (Google vs. Library's homepage) they preferred to use. Descriptive statistics, exploratory factor analysis, regression analysis and binomial test were used to analyze the data. Factors including age, gender, and disciple are related to choice of particular information sources. We find that most of the faculty members still rely on electronic journals. Preferences were evenly divided regarding using library's search page versus a Google search page.

Categories and Subject Descriptors
H.1.2 [Information Systems]: USER/ MACHINE SYSTEMS—*Human information processing*

General Terms
Human Factors, Measurement

Keywords
scholarly communication, information seeking , information resources, electronic journals, electronic format, Google, library

1. INTRODUCTION
With the rapid development of online resources and databases and the emergence of Web 2.0 technology, there has been a dramatic change in the scholarly communication. In an effort to understand how the faculty members of universities respond to the electronic transformation and highlight how they use information resources, 637 professors in the field of science and engineering from five research universities—University of North Carolina at Chapel Hill (UNC), University of Florida (FL), University of Oklahoma (OU), Colorado State University (CSU) and University of South Florida (USF) were surveyed about their information seeking behavior in this study.

2. METHODOLOGY
2.1 Survey Questionnaire
The survey (http://ils.unc.edu/bmh/isb/National-ISB-Survey.pdf) used in this study is part of the National Survey of Information Seeking Behavior of Scientists (http://bioivlab.ils.unc.edu/sandbox/ISB_national_survey/index.php/Information_Seeking_Behavior_National_Survey) conducted by the NeoRef research group led by Dr. Hemminger at University of North Carolina at Chapel Hill. The original survey attempted to quantify academic scientists' transition to electronic communications, and how this affected different aspects of information seeking. The data of this paper was cleaned and imported into SAS 9 for analysis. Descriptive statistics, exploratory factor analysis, and logistic regression analysis were done on these data, resulting in both descriptive and exploratory results.

2.2 Study Populations and Demographics
The 637 subjects of this study are faculty members of UNC, UFL, OU, CSU, and USF, five research universities across America. This is a subset of the complete national study which included graduate students and other researchers. Included in the faculty are professors with tenure (full professor and associate professor) and without tenure (assistant professor) from 46 disciplines including science, engineering, and medical science. Social science and humanities are not included in this study because our focus is academic scientists. The average age of the participants is 48 with standard deviation of 11. Gender is not balanced since the majority(69%) are males. The distribution of the academic position by professor, associate professor, assistant professor is 42.33%, 25.43%, and 32.34% respectively.

3. RESULTS
The first question asked the professors to list five most important individual sources (journals, websites, listservs, etc) for them to stay current in their field. Table 1 lists the top 10 sources mentioned by faculty. Seven of the 10 sources are journal titles. Of the 7 journals in the top-10 list, Nature, Science, and Proceedings of the National Academy of Sciences are the generally-focused and highly impact journals. The other four are from areas of biology and chemistry.

There is some agreement on a few common sources of information as the most commonly utilized sources (for instance Science and Nature are the top two journals). Most researchers, though, use many different and varied sources. As shown in Figure 1, over 1100 resources are listed by the participants and over 900 resources are listed only once. Therefore, there is a "long tail" of the curve and the distribution of the data appears to be the Power Law distribution. This means the vast majority of faculty members have their own individual selection of resources for keeping current depending on their fields and interest.

Table 1. Top 10 most important individual sources

Most Important Individual Sources	Count
Science	117
Nature	96
PubMed	93
ISI Web of Science	42
Proceedings of the National Academy of Sciences (PNAS)	34
Journal of Biological Chemistry (JBC)	26
Journal of the American Chemical Society (JACS)	23
Cell	21
Google	21
Ecology	17

Sources in italics are general source types and not specific sources.

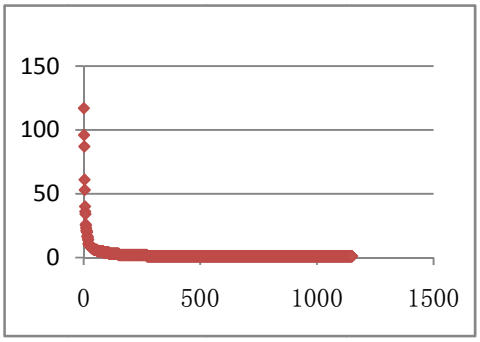

Figure 1. Distribution of numbers of individual source mentioned by faculty members

Table 2 shows the average number of articles retrieved each month by faculty members. The results show that faculty members retrieve much more articles from library subscribed electronic journals than from any other source. The large standard deviation from the mean for all the items indicates the large variance of individual behavior.

Exploratory factor analysis was conducted on the 13 information sources to cluster the 13 sources into groups according to researcher preference. The results are described in Table 3. Five factors yielded by the factor analysis.

In evaluating the factors, it appears that two of the factors (Factor 2, and Factor 4) neatly identify the information from lab and colleague respectively. Factor 5 may be explained as identifying the most popular sources, but also interestingly involves externally requested resources (interlibrary loan, and document delivery services).Even more difficult to explain is factor 1, which is confounded by both library subscribed and personally subscribed journals. As all the five factors are considered, we could infer that the factors are more directly tied to the information channels (e.g., lab subscriptions and colleague copy sharing than the information format (electronic, print) in clustering different information sources.

Table 2. Number of articles retrieved from the following sources in a typical month

	mean	Std Dev
[Electronic]Library subscribed journal	26	71
[Electronic]Open Access journal or Institutional Repository or Digital Library	9	18
[Print]Personally subscribed journal	6	19
[Electronic]Personally subscribed journal	5	17
[Electronic]Personal digital library	4	10
[Print]Library subscribed journal	4	18
[Electronic](Author's) Web site	3	6
[Print]Copy of colleague's	3	48
[Electronic]Colleague's e-copy	2	4
Interlibrary loan	2	6
[Electronic]Lab subscribed journal	1	5
[Print]Lab subscribed journal	1	5
Document delivery service	1	2

To identify which type of interface is preferred in academic field, the survey asked participants to indicate their preference between the Google search interface and their library catalog search interfaces. Responses from participants in the five universities split nearly half and half with a small difference (Figure 2). Binomial test shows the difference is not significant (p-value: 0.8340).

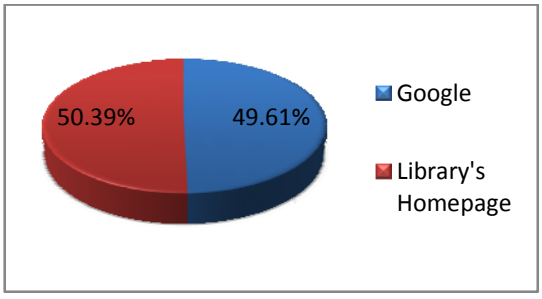

Figure 2. Google vs. Library's Homepage

Table 3. Factor analysis for information sources

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
[Electronic]Personally subscribed journal	**0.94342**	-0.07216	0.02257	0.04660	0.01670
[Electronic]Lab subscribed journal	0.07413	**0.92707**	0.13763	0.10741	0.01274
[Electronic]Library subscribed journal	0.21312	0.01488	0.08637	-0.01295	**0.46233**
[Electronic]Open Access journal or Institutional Repository or Digital Library	0.00389	0.07231	0.07041	-0.02131	**0.30304**
[Electronic](Author's) Web site	-0.00369	0.08224	0.27881	0.12964	0.03976
[Electronic]Personal digital library	0.01204	0.00869	**0.65260**	0.04619	0.05018
[Electronic]Colleague's e-copy	0.04688	0.12204	0.18667	**0.59860**	0.02770
[Print]Personally subscribed journal	**0.88676**	0.14725	-0.04744	0.02619	0.05884
[Print]Lab subscribed journal	0.08165	**0.93389**	-0.03701	0.10488	0.06050
[Print]Library subscribed journal	**0.94609**	0.10764	0.01745	-0.02052	0.06776
[Print]Copy of colleague's	-0.00740	0.02769	0.03360	**0.55882**	0.00246
Interlibrary loan	-0.02750	-0.02794	0.02631	0.03518	0.24245
Document delivery service	-0.01050	-0.04621	**0.42758**	0.02653	0.24521

Table 4. Regression analysis for faculty's preference between Google and Library's Homepage

parameter		estimate
age		**-0.0177***
gender	male	**0.5726****
	female (reference)	0
position	professor	0.0407
	associate professor	-0.3093
	assistant professor (reference)	0
department_	medical science	-0.1074
type	engineering	-0.5761
	science (reference)	0

*denotes significant at 0.1 level

**denotes significant at 0.05 level

To further examine the potential factors that impact the faculty's choices, logistic regression model is constructed for the binary preference for Google and Library's homepage search. Table 4 summarizes the regression results. According to Table 4, the only factors have a significant effect were age and gender, with younger professors and male professors preferring Google more to start their search process. Although significant, the impact of age on professors' preference is rather weak.

4. CONCLUSIONS

Five conclusions are found:

1) More articles are retrieved from electronic journals subscribed by library than from any other source

2) The overlap of journals used by the professors is rather small due to their different background (disciplines, academic positions, and demographics);

3) Faculty members prefer electronic format materials than the print counterparts;

4) Preferences were evenly divided regarding using library's search page versus a Google search page to start;

5) A few people are starting to use innovative information resources, e.g. blogs, wiki pages. However, most of the professors have yet to adopt these newer collaborative tools, and continue their traditional ways of finding information.

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