Venue-Author-Coupling: A Measure for Identifying Disciplines Through Author Communities

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Conceptualizations of disciplinarity often focus on the social aspects of disciplines; that is, disciplines are defined by the set of individuals who participate in their activities and communications. However, operationalizations of disciplinarity often demarcate the boundaries of disciplines by standard classification schemes, which may be inflexible to changes in the participation profile of that discipline. To address this limitation, a metric called venue-author-coupling (VAC) is proposed and illustrated using journals from the Journal Citation Report's (JCR) library science and information science category. As JCRs are some of the most frequently used categories in bibliometric analyses, this allows for an examination of the extent to which the journals in JCR categories can be considered as proxies for disciplines. By extending the idea of bibliographic coupling, VAC identifies similarities among journals based on the similarities of their author profiles. The employment of this method using information science and library science journals provides evidence of four distinct subfields, that is, management information systems, specialized information and library science, library science-focused, and information science-focused research. The proposed VAC method provides a novel way to examine disciplinarity from the perspective of author communities.

Introduction

Conceptualizations of disciplinarity focus in large degree on the social element of a discipline. Valenza (2009) defines a discipline as a "recognized community of researchers" (p. 5); Lattuca (2002) calls it an "organized social grouping" (p. 716). Some abandon the term *discipline* in favor of labels that accentuate the predominance of the human element: Beecher (1989) studied *academic tribes* and Knorr-Cetina (2007) *epistemic cultures*. The social grouping of scholars is fundamental for the concept of *invisible colleges* (Price & Beaver, 1966). Yet in understanding the structure of disciplines, scholars often turn to pre-established organizational schemes: operationalizing disciplinarity through Library of Congress (LC) classification schemes for monographs, Journal Citation Report (JCR) categories for journals, or departmental affiliations for authors. Elements within these categories have been used as proxies for disciplines using a top-down approach: For example, scientometricians routinely state that they are studying a discipline by looking at the journals in a given JCR category. In this way, the set of journals is considered representative of the discipline. However, this work proposes a bottom-up approach, in which the clustering of journals is determined by the author profile of the journals. That is, the similarity between journals is determined by the number of shared authors between these journals. This work is premised on the assumption that authors who frequent the same venues are more likely to share similar conceptual frameworks and belong to the same invisible college or domain than those who never publish in the same venues.

Borgman and Furner (2002) classify the communicative activity of scholars by their various capacities: as writers, linkers, collaborators and submitters, that is, "choosers of journals or other sources to submit papers to" (p. 3). In this way, they highlight the importance of this part of the research process—choosing the venue to which you will submit is a complex decision in which the author balances a number of different issues: matching the topic of the paper with the scope statement of the journal and the topicality of previous articles published is an intellectual decision. However, in submitting scholarship to a certain

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journal, you are becoming an active participant in the author profile of that journal; your scholarly identity, therefore, becomes linked with the past participants in that venue and, iteratively, contributes to the topical shaping of the journal. This presents a social dimension in terms of author communities: These author communities comprise all the authors who have submitted to the journal. These authors, and their conceptual markers, facilitate in creating the intellectual and social identity of this journal. Therefore, grouping journals by their shared author profiles may provide evidence of an underlying social and intellectual community.

This work is informed by the work of Small (1978) and White and Griffith (1981). Small's (1978) canonical work on concept symbols proposed that a citation is not merely a link to a document, but also represents a concept and is indicating that the concept has influenced the current document in some way—the citation is not only functional (in directing the reader to a source) and honorary (in acknowledging the work that influenced the present work) but also conceptual—in that it acts as proxy for the concept at hand (whether that be a theory, method, finding, etc.). In a similar fashion, White and Griffith (1982) presented the idea that authors are "markers of intellectual space." (p. 255). This can be seen as an extension whereby the citation (author-date) is not only a conceptual marker, but the author alone (and cumulative output of the author) can be considered a conceptual marker. That is, the mention of a single author's name evokes all the work that has been produced by that author and represents a concept marker. The present work builds upon this idea: If the work of author can be seen as a conceptual marker, then a venue can be defined by the authors who participate in that space. The central argument of this work is that venues belonging to the same discipline or domain can be demarcated by identifying an underlying group of authors. In this way, venues are grouped not only intellectually, as is the case with citation studies, but also socially. Collaboration networks describe the structure of interaction between authors; however, these studies rely on hyperauthorship behavior and may not be as suitable for examining disciplines with high degrees of single authorship. This study argues that the single author remains part of a discipline, even if they do not interact with their community by means of coauthorship.

This article should also be seen as an extension and variation of the work conducted by Minguillo (2010) on Spanish authors. Minguillo presents a theoretical foundation used in the present study (influenced in large part by the work of Whitley (2000)). In his work, Minguillo outlines the fundamental premise that journals act as "platforms of interaction and membership" for scientific fields, stating: "[i]ntellectually or thematically proximal journals can be grouped to form scientific fields, which serve as social and dynamic platforms with a shared social competence for a collective validation and coordination of knowledge within particular scientific communities" (p. 775), and that "[a]nalysis of the relation between authors and journals makes it possible to see how communication among scientists overall forms the structure of highly specialized and well-controlled scientific (sub)fields influenced by the reputational system and cognitive limitations" (p. 776). The reader is referred to Minguillo for a more thorough analysis of the conceptual framework on which this method is built.

Using this premise, we demonstrate one manifestation of this analysis that allows us to examine the thematically and socially similar journals classified in the JCR category for library science and information science (LS&IS). JCR categories are commonly used to operationalize disciplinarity. This study will evaluate the degree to which the journals in this list are related, based on their shared authorship list. The grouping of authors across journals, therefore, provides a novel way to examine not only the intellectual but also the social coherency of the communicative landscape. Although the primary objective is to introduce and demonstrate the utility of the method, a byproduct of this examination is the elucidation of the structure of information science and library science (IS&LS), one that can be compared to previous bibliometric analyses of the field. This paper should be of interest to scientometricians and historians of science, as it provides a new way of exploring the structure of disciplines. It should also be of specific interest to scholars of IS&LS as a new lens for evaluating the structure of the domain.

Related Work

As Borgman (1990) described, bibliometric studies rely on three main variables: producers, artifacts, and concepts. These variables have each been explored to elucidate the structure of a discipline. Author-based studies map individual scholars, based on their collaboration or citation relationships. Documents are examined to explore the degree to which they are similar based on citations. Topics are explored and described within a corpus, often through the use of word analysis. Varying levels of aggregation are performed for each of these variables: A producer can be a single author or all authors at an institution or in a given country. An artifact can be a single document or the set of documents in a journal. Concepts can similarly be examined for a person, a document, or set of people and documents. Co-occurrence methods have been widely used to demonstrate the structure of scientific domains, focusing on the producers, artifacts, or concepts of scholarly communication. The most dominant of these co-occurrence methods include bibliographic coupling, cocitation, coword, and coauthorship analysis.

Bibliographic coupling is premised on the concept that two documents are related if they share the same sets of citations. This was presented originally on the document level (Kessler, 1963), but was expanded to journal bibliographic coupling (Small & Koenig, 1977) and author bibliographic coupling (Zhao & Strotmann, 2008a). As with most derivative bibliometric methods, these methods each use the same basic approach, but at different levels of granularity: Journal bibliographic coupling and author

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bibliographic coupling are both essentially document-based analyses, but at different levels of grouping. Venue-author-coupling (VAC) is premised on the same type of assumption: Whereas with bibliographic coupling two documents are related if they share similar citations, VAC states that two journals are related if they share similar authors.

The inverse of bibliographic coupling is cocitation analysis (Small, 1973). This method is premised on the assumption that two documents are related if they are cited by the same document. As with bibliometric coupling, this method was extended to varying levels of granularity: author (White & Griffith, 1981), journal (McCain, 1990), and field cocitation analysis (Sugimoto, Pratt, & Hauser, 2008). Another approach to intellectual mapping is through coword analysis. Coword analysis has been used to study the concepts of scholarly communication, utilizing keywords, title words, abstract words, and full text. This method was first proposed by Callon, Courtial, Turner, and Bauin (1983), in which they made the assumption that an article can legitimately be reduced to a set of macro terms, "translation operators," that can designate the problems that scholars are interested in solving. Leydesdorff (1989, 1997) applied this method, demonstrating that words also serve as concept markers for documents, but warned that these cannot be used to show the development of the sciences. As another co-occurrence analysis technique, coword analysis often involves similarity analyses based on those used in bibliographic coupling and cocitation analysis. However, this differs from the VAC approach in that word-based analyses is generated from the intellectual rather than the social structure of the field.

Another social way of studying disciplinarity is from the perspective of a collaboration network analysis, operationalized by examining coauthorships among scholars (e.g., Acedo, Barroso, Casanueva, & Galán, 2006; Liu, Bollen, Nelson, & Van de Sompel, 2005; Palla, Derényi, Farkas, & Vicsek, 2005). However, this method limits analysis to those publications featuring two or more authors. This eliminates the single-authored publications (which this paper demonstrates) that represent a large proportion of knowledge production in some fields (including the present study). The grouping of venues across authors provides a novel way to examine the coherency of the social aspect of the communicative landscape, without marginalizing disciplines with a large percentage of single authors.

The domain of information science has been no stranger to the application of these methods. Information science authors have been mapped using author bibliographic coupling (Zhao & Strotmann, 2008a) and author cocitation analysis (Astrom, 2010; Leydesdorff & Vaughan, 2006; Moya-Anegón, Herrero-Solana, & Jiménez-Contreras, 2006; Persson, 1994; White & McCain, 1998; Zhao & Strotmann, 2008b). Information science journals have been mapped using journal cocitation analysis (Astrom, 2007, 2010; Moya-Anegón et al., 2006) and field cocitation analysis (Sugimoto et al., 2008). Of most relevance to the present study is Minguillo's (2010) analysis of the Spanish library and information science community. This work is premised on the same basic assumption: Journals are defined and can be clustered using their shared authorship communities. However, the present work differs in a number of ways. The first is conceptualizing this as inherently a method of coupling, a theme largely omitted from Minguillo's work, but of central concern to a scientometric community.

Second, this expands the data set beyond a single country, to all authors publishing in the journals, making for a more robust analysis. Third, this study employs a wide variation in the statistical approach to the analysis: it uses hierarchical clustering and multidimensional scaling to cluster journals, while Minguillo's paper used social network analysis approaches aimed at identifying core and periphery journals (our analysis does not attempt to do this as the parameters of the data are set by the selection of JCR journals). Furthermore, the addition of some technical details, e.g., author name disambiguation and similarity measurements, are provided in this article, enhancing the VAC approach for readers who want to replicate the approach.

Data and Methods

A new method, VAC, is introduced and illustrated with the journals in the IS&LS category of JCR. According to Kessler (1963), the phenomenon that two documents share the same reference is called *bibliographic coupling* and the number of references that the two documents share is viewed as an indicator of their *coupling strength*. In this research, we extend the idea of coupling to explain the relationships between journals. That is, the phenomenon that two venues (conference proceedings, journals, etc.) share the same author is called venue-author-coupling and the number of authors that two venues share is calculated as an indicator of their coupling strength. The proximity between journals is obtained from the coupling strength and the structure of IS&LS was examined as an illustration of utilizing the VAC method. The detailed method will be introduced in the following sections.

Journals studied in this project were those categorized in the IS&LS category of the 2008 JCR in Web of Knowledge (WoK). Programs were developed by our team to extract authors from WoK data and obtain a binary author-journal matrix[1]. In WoK, there are 73,629 publication units, including 65,672 articles, 2,550 reviews, and 5,417 proceeding papers, that were published by 58 journals[2] indexed in the IS&LS category according to the 2008 JCR. From 1955 to 2009, there were 50,673 unique authors who published

[1]All the authors in the data set are used as the row names, and all the journals studied are the column names. This binary data matrix indicates the appearance of an author in each journal: 1 means yes and 0 means no.

[2]There are in total 61 journals in the information and library science category in 2008 JCR. Three journals in languages other than English were excluded, that is, Profesional de la Informacion (Spanish), Library and Information Science (Japanese), and Zeitschrift Fur Bibliothekswesen und Bibliographie (German).

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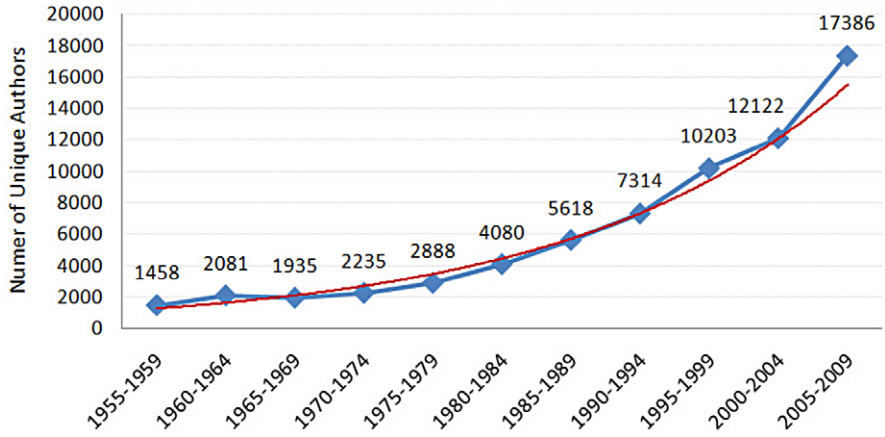

FIG. 1. Number of unique authors in each 5-year period. (Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.)

papers in these 58 journals. Publications with unknown authors are excluded, that is, 1,079 publications, leading to a total number of 72,533 valid publication units.

One limitation with our proposed VAC method is the name ambiguity issue due to non-standardized author names as indexed in WoK. A very basic approach was adopted to perform name disambiguation:

1. For authors with both abbreviated names and full names available in our data set, a program was written to match the abbreviation and full name.
2. At the same time, all possible abbreviations for an author's full name were generated. For instance, for the author "Sugimoto, Cassidy Rose," "Sugimoto, C," and "Sugimoto, CR" were treated as alternate names. If these alternate names had the same affiliation, they were treated as a single individual.
3. For the remaining authors that were not matched, a manual check based on our knowledge of the domain and searching results from Google was performed.

The name ambiguity problem was reduced but not eliminated by the above steps. This remains a limitation of the present work. Future work could incorporate other elements, in addition to author names and affiliations.

One key issue that should be discussed here is the similarity measure of journals based on their author profiles. In the scientometric community, the discussion on the diagonal value of the co-occurrence matrix, normalization of co-occurrence matrix, and similarity measure of the research entity have been extensively discussed (e.g., Ahlgren, Jarneving, & Rousseau, 2003; Eck & Waltman, 2009; Leydesdorff, 2008; Leydesdorff & Vaughan, 2006; White, 2003), but no consensus has been reached. In this article, an asymmetric author-journal matrix was extracted from the WoK data set, and the Tanimoto similarity measure (see formula below) was utilized as a normalization of the raw coupling strength. The reason for using the asymmetric matrix is that it avoids the problem of choosing the diagonal value for a symmetric matrix. Furthermore, the Tanimoto similarity is an extension of the Jaccard coefficient and commonly used as a set-theoretic similarity measurement for binary data. The influence caused by the publishing duration is not fully eliminated, but is reduced with the Tanimoto similarity measure as a normalization of the raw coupling strength.

$$T_s(X,Y) = \frac{\sum_i (X_i \cap Y_i)}{\sum_i (X_i \cap Y_i)}$$

Some multivariate statistical analysis methods, e.g., multidimensional scaling (MDS), hierarchical clustering, and factor analysis, have been widely used in bibliometric studies (e.g., McCain, 1990). In this article, MDS and hierarchical clustering were also employed to explore the proximity of IS&LS journals via their author profiles, which was also visualized in Pajek[3] as a journal network.

Results

IS&LS Authorship Overview

Of the total 73,629 valid publication units in our data set, 68% are single-authored. A close examination of the change in single-authored papers in our data set by each 5-year reveals that the percentage of single-authored publication has been decreasing by time, falling from 89% down to 46%, while the percentage of multiauthored publications grew from 11% to 54%. However, the large percentage of single-authored publications over time and in recent years calls for a metric that takes the sole author into account.

The number of unique authors in IS&LS was calculated within each 5-year period from 1955 to 2009, as displayed in Figure 1. As indicated by the figure, the rate of increase for each 5-year period is about 30%, with the most abrupt increase in the 2005–2009 period (43%). A slight decrease can be found between the 1960–1964 and the 1965–1970 time period (7%). Figure 1 also shows that the number of

[3]Pajek software is free for use and can be found at http://pajek.imfm.si/doku.php.

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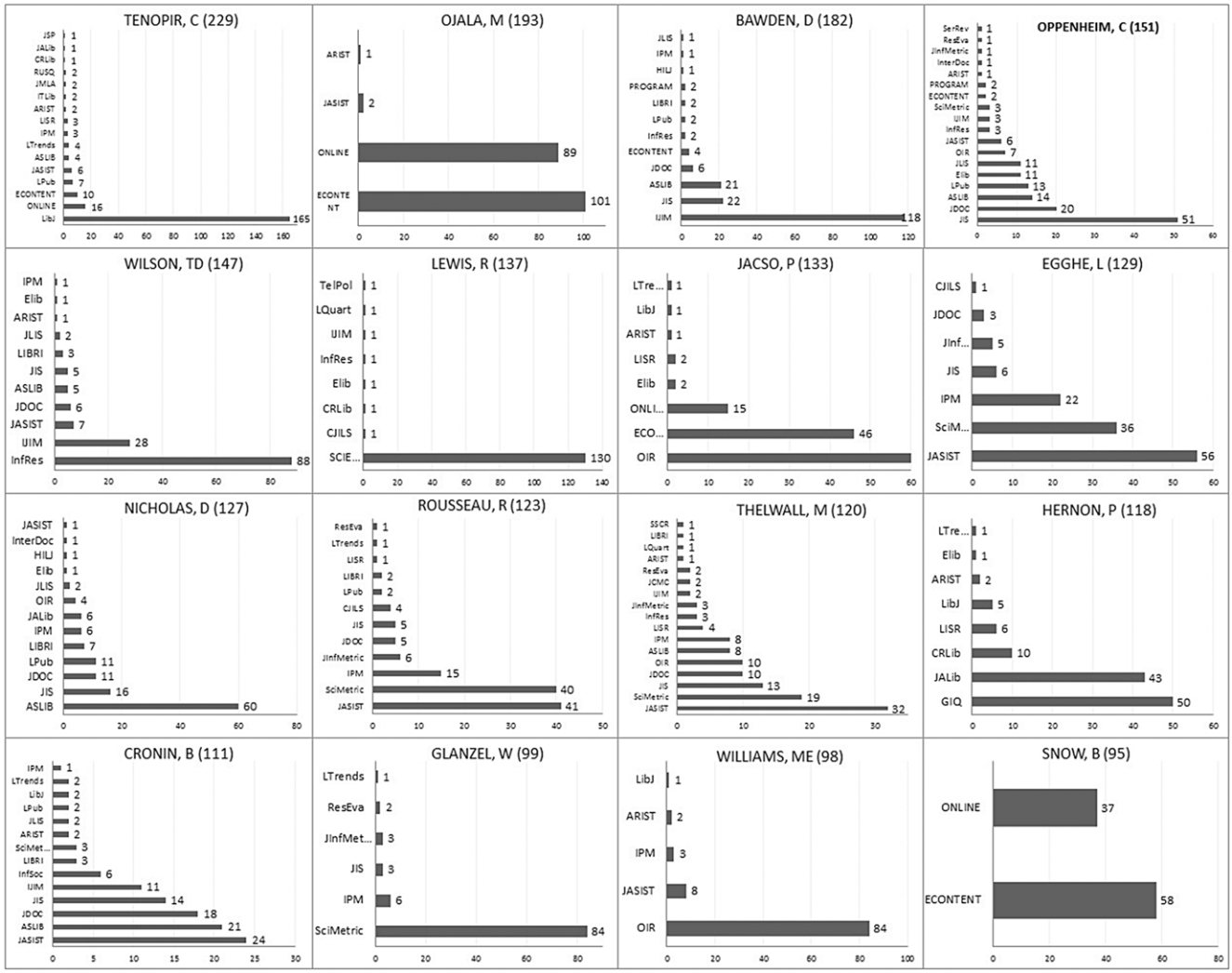

FIG. 2. Top 20 authors' publication distribution among journals.

unique authors in IS&LS field experienced an almost exponential growth (refer to the red trend line in Figure 1). This growth in total number of authors provides the potential for tighter coupling between the journals.

Core Venues for Individual Scholars

One assumption of the method is that scholars will favor certain groups of journals, forming communities through these associations. To test the assumption that an author's work is primarily published in a small number of core journals, we examined all journals of publication for our top 21[4] authors (by publication quantity in our corpus[5]). Of the top authors, five authors only published in one IS&LS journal: ODER, N., CONSTANS, A., MERVIS, J., ROGERS, M., and RAITT, D. The distribution of publications across venues is shown for the remaining 16 authors (Figure 2). As shown, publications are concentrated in a few journals. For example, Tenopir, C. published 72% of her articles in one journal (*Library Journal*). Ojala, M. published 98% of his articles in two journals (*Online* and *ECONTENT*). Cronin, B. and Thelwall, M. are the most distributed of the authors in our data set (publishing in the largest number of journals); however, 69% of Cronin, B.'s output remains concentrated in four journals and 70% of Thelwall, M.'s publications can be found in five journals. In theory, there are dozens, if not hundreds, of potential venues for publication for each of these authors (as can be seen by the dozens of LS&IS journals listed in JCR and the hundreds of library and information science journals listed in Ulrichs, not to mention the proliferation of specialist journals to which their topics may be relevant). However, scholars appear to stick to familiar grounds and engage in repeated publications with a few

[4]There was a tie in the top twenty, resulting in 21 total authors.

[5]It should be noted here that this analysis relies on the categorization of articles by ISI. In a closer examination of the results, it was discovered that some of these might be inaccurately classified. For example, many of the publications listed here for Tenopir are actually editorials. However, ISI lists them as an article. Excluding inaccurately categorized publication units was outside the purview of this study, but should be considered in future analyses.

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TABLE 1. Distribution of coupling counts for IS&LS journals.

#Authors coupled		#Journal pairs	%Journal pairs
0		118	7.1385%
1–100	1–5	589	35.6322%
	6–20	529	32.0024%
	21–50	246	14.8820%
	51–100	105	6.3521%
101–150		29	1.7544%
151–200		16	0.9679%
200–300		12	0.7260%
300–400		4	0.2420%
400–500		3	0.1815%
500–600		1	0.0605%
600–700		1	0.0605%
Total		**1653**	**100.%**

Note. IS&LS = information science and library science.

TABLE 2. Top 10 of 50 journals that are not coupled with **all** other IS&LS journals.

Journal	#Un-coupled journals	Journal	#Un-coupled journals
Restaurator	29	Korg	9
JGIM	24	SerRev	9
JInfMetric	14	MIS	8
JAIS	12	ISR	7
ResEva	11	JLIS	7

Note. IS&LS = information science and library science.

TABLE 3. Top 10 journal pairs by number of shared authors.

Journal pair	#Shared authors
IPM (25.78%) & JASIST (16.80%)	631
CRLib (16.07%) & LibJ (9.09%)	516
LibJ (8.65%) & LTrends (21.36%)	491
CRLib (14.38%) & JALib (20.08%)	462
CRLib (12.86%) & LTrends (17.96%)	413
JDOC (22.11%) & JASIST (8.87%)	333
CRLib (10.03%) & LRTS (22.04%)	322
IM (14.07%) & MIS (29.96%)	305
JASIST (8.07%) & SciMetrics (12.34%)	303
JALib (11.82%) & LibJ (4.79%)	272

favorite venues. As they do this, communities begin to form, which will be discussed in more detail below.

Venue-Author-Coupling Strength

As mentioned above, the number of shared authors between two journals can be viewed as a raw indicator of coupling strength between them. Therefore, the number of authors that each journal pair shared was obtained from our data set. The 58 IS&LS journals analyzed in this study can be grouped into 1,653 journal pairs, and the number of authors that each journal pair shared was calculated as the raw coupling strength. Table 1 shows the distribution of journal pairs by the number of authors they shared. As shown in Table 1, 118 (7%) journal pairs do not share authors with each other. About 36% of journals pairs share one to five authors, and 90% of journals pairs share less than 50 authors. *Information Processing & Management* (*IPM*) and *Journal of the American Society for Information Science and Technology (JASIST)* share the largest number of authors ($n = 631$). As this is the first study of this kind, it is unclear what one should expect from such an analysis. However, as a baseline for future comparisons, most of the journal pairs shared between 1 and 50 authors. In a field with a higher degree of hyperauthorship or collaboration, a larger number might be expected.

The 118 journal pairs with no shared authors include 50 IS&LS journals. In other words, if the network for journal author coupling was constructed, only eight journals in our data set are fully connected in the network. The remaining 50 journals are ranked from least to greatest connectivity (i.e., ranked by the number of journals with which the journal does not share authors) in Table 2. *Restaurator* is the least connected journal in the network (it shares no authors with 29 journals in the data set), followed by *Journal of Global Information Management (JGIM*; which shares no authors with 24 journals in the data set). Twelve journals, though not fully connected, are disconnected only from one journal within the data set. For instance, *Information & Management (IM)* is disconnected only from *Restaurator*. Those journals that are the most disconnected appear to represent specialized knowledge areas in the field (e.g., preservation) or are more recent journals. The factors of specialty and time, therefore, should be acknowledged when using this method. More mature journals are likely to be more connected than younger journals. However, if the author profile is coming largely from another well-connected journal, the new journal will cluster into the existing community. If a new community is being formed from disparate journals or from outside the field, the journal will appear disconnected from other journals in the community.

There are eight journals that share authors with every other journal in our data set, that is, *Electronic Library (ELib)*, *IPM*, *Journal of Academic Librarianship (JALib), Journal of the American Medical Informatics Association (JAMIA), Journal of Information Science (JIS), Library Collections Acquisitions & Technical Services (LCATS), Library Journal (LibJ)*, and *Online Information Review(OIR)*. Table 3 displays the top 10 journal pairs by the number of shared authors, with the percentage in parentheses indicating the percentage of authors that the journal shares with the other journal in the pair. *IPM* & *JASIST* share the largest number of authors, that is, 631, which is about 26% of *IPM's* total authors, and 17% of *JASIST* authors. *College & Research Libraries (CRLib)* shares 516 authors with *LibJ*, which is about 16% and 9% of their total authors, respectively. As can be seen, this represents in part an intellectual similarity, with journals aligning with those

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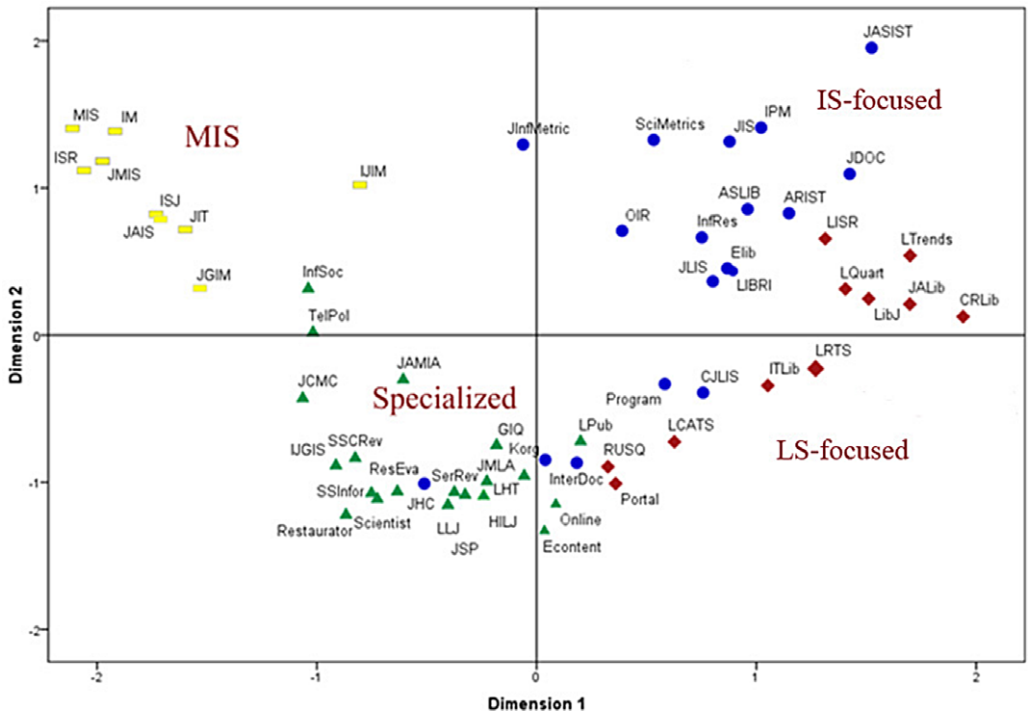

FIG. 3. MDS result of IS&LS journals via VAC approach. (Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.)

of similar topical areas (e.g., librarianship, information science, or information systems).

Examining these journal titles by the total number of unique authors (see Appendix 1), it can be seen that those with the highest number of total authors are most likely to be in the set of journals with a high number of shared authors (Table 3). *MIS Quarterly* is the only journal that has a large number of total authors (ranked 24th), but most of the authors are isolated and publish only within this journal. This provides evidence, as might be expected, that journals with larger author populations tend to share more authors with other journals. Therefore, a subsequent analysis is necessary that takes into account the actual author population of each journal and the proportion of shared authors. For example, *JInfMetrics* shares only 76 authors with *Scientometrics*, but the number is about 44% of *JInfMetrics's* total authors, as it has a short publication history. Meanwhile, *JInfMetrics* shares 40% of its authors (69) with *JASIST*, which is only 7% of *JASIST* authors. Therefore, *JInfMetrics* shares a high percentage of its authors but relatively small number of authors compared with other journals. *Annual Review of Information Science and Technology (ARIST)* shares 249 authors with *JASIST*, which is a large proportion (41%) of *ARIST*'s total authors. In this way, it is possible to locate core or central journals, defined as those with large populations of authors, many of whom are shared with other journals in the field. *JASIST* certainly represents a core journal in this respect.

General cluster features. In this article, MDS and hierarchical clustering were also employed to explore the proximity of IS&LS journals via their author profiles. Figure 3 shows the journal proximity map using MDS[6], with the corresponding hierarchical clustering[7] result shown in the Appendix 2. Journals in Figure 3 were colored according to the clustering result, and labeled after reading through the scope statements of these journals from their websites. According to the results, the 58 journals are grouped into four clusters, that is, management information systems (MIS; yellow rectangle), specialized IS&LS (specialized; (green triangle), library science focused (LS-focused) research (red diamond), and information science focused (IS-focused) research (blue circle). As can be seen in Figure 2, the MIS cluster is the most disconnected from the other clusters; the IS-focused and LS-focused clusters appear visually parallel, and the specialized cluster has the most overlap with the IS-focused.

The relationships between clusters are reinforced in Table 4, which lists the number of shared authors between clusters. The specialized cluster has the highest number of shared authors with the IS-focused; however, this is also the case with the MIS and LS-focused clusters. This provides evidence that the IS-focused cluster may represent a core community of researchers for this set of journals.

From these findings, one may suspect that the research cluster is the largest in terms of journals or authors. However, as shown in Table 5, this is not the case. The

[6]MDS analysis in this article used squared Euclidean distance to show the proximity of journals. The final stress of MDS result is 0.134.

[7]Hierarchical clustering (agglomerative) analysis used squared Euclidean distance and Ward's method.

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TABLE 4. Number of authors shared between clusters.

	MIS	Specialized	Practice	Research
MIS	5553			
Specialized	523	19481		
Practice	245	1457	15328	
Research	696	1533	1694	15647

Note. MIS = management information systems.

TABLE 5. The general information of the four clusters.

	C1:MIS	***C2:specialized***	***C3:LS***	***C4:IS***
#Journals	9	20	11	18
#Coupled journal pairs (#Possible total journal pairs)	36 (36)	173 (190)	55 (55)	152 (153)
#Authors	5,553	19,481	15,328	15,647
#Authors shared per pair	80.69	8.54	122.07	83.81
Citation per journal 2008	1,814.2	504.7	289.1	706.3
Impact factor per journal 2008	2.31	1	0.63	1.14
# Publications per author	1.99	1.82	2.05	2.30
# Journals per author	1.33	1.06	1.28	1.29

Note. MIS = management information systems; LS = library science; IS = information science.

specialized cluster has 20 journals and the largest number of authors, demonstrating that size does not overwhelm this method. The MIS cluster contains journals with some of the largest number of citations and highest impact factors. Journals in the LS-focused cluster received the lowest average citations and impact factors in 2008, but had the highest number of authors shared by each pair of journals. This could be interpreted that the MIS cluster is a small but moderately well-connected cluster. The specialized cluster is large and has a low level of within-cluster connectivity. The IS-focused cluster is large and moderately well connected. The LS-focused cluster is fairly small, but highly connected.

VAC network of IS&LS. These 58 journals and their author coupling relationship can also be reflected in a network: each node in the network is a journal, and the edge between a pair of journals indicates the coupling relationship between the journal pair. A network view of these journals can supplement information about the cluster that the MDS result may not show: the interconnection and intraconnection of journals. The network in this article has a large network density, 0.93, reflecting the fact that only 7% of the journal pairs do not share any authors.

Figure 4[8] shows the VAC network view of these 58 journals with a threshold of Tanimoto similarity at 0.2. (The reason for setting a threshold is that a network with density as high as 0.93 is not very readable.) Journals in the network are colored consistently with the MDS and hierarchical clustering result. The size of each node (journal) is proportional to its degree centrality and the width and grey scale of an edge is proportional to the similarity of the journal pair linked by the edge (the wider and darker, the more similar). In Figure 3, *ARIST* is in a central position, indicating its proximity to many other journals, which can be explained by its feature as an annual review of the field. The MIS cluster is not very close (by author profile) to other clusters, as demonstrated by its isolated status in the figure. Similar status was founded for MIS journals by Ni and Ding (2010) in their analysis of the editorial board members and Sugimoto et al. (2008) in their analysis of MIS and IS&LS journals. The LS-focused cluster is tightly connected with the IS-focused cluster and *ARIST* is the important bridging journal between these two clusters. The author profile similarity between journals in the specialized cluster is on average not very strong, as most journals remain unconnected within the cluster after trimming edges with values below 0.2. However, *The Information Society* has stronger connections with *ARIST* compared to other journals in the specialized cluster.

Two possible interpretations could be noted here. In the first interpretation, the fact that the network density is .93 could provide evidence that the JCR category has identified a fairly cohesive group of journals in terms of the author profiles. However, a closer examination demonstrates at least two macro-level communities—an MIS community that is largely disconnected from the other journals and IS-focused and LS-focused communities that are largely intertwined. The specialized journals are disparate and do not give evidence of a community or underlying invisible college.

From this global view, an additional investigation was made to describe the detailed characteristics of each cluster, as identified in the MDS analysis.

Cluster 1—MIS cluster. The MIS cluster comprises nine journals that publish articles related to "information systems," "information management," or "management information systems" as indicated by the scope statements of these journals. There are 5,553 authors who have published in the nine journals in this cluster, regardless of authorship type. Of all these authors, about 80% (4,447) published only within this cluster, 13% published in one other cluster, 4% in two other clusters, and 1% published in all of the other three clusters. Table 6 displays detailed information about this cluster, as well as the top 10 authors by number of (all authorship) publications within the cluster. Bawden, D. has the largest number of within-cluster publications (118) among authors in this cluster and the largest number of first-authored publications (113). All of his publications are in a single journal, *International Journal of Information Management* (*IJIM*), within this cluster. However, as indicated by the cluster information, he also published in journals outside of MIS cluster (in the

[8]Figure 4 was visualized using Pajek with the Kamada-Kawai (free) layout algorithm.

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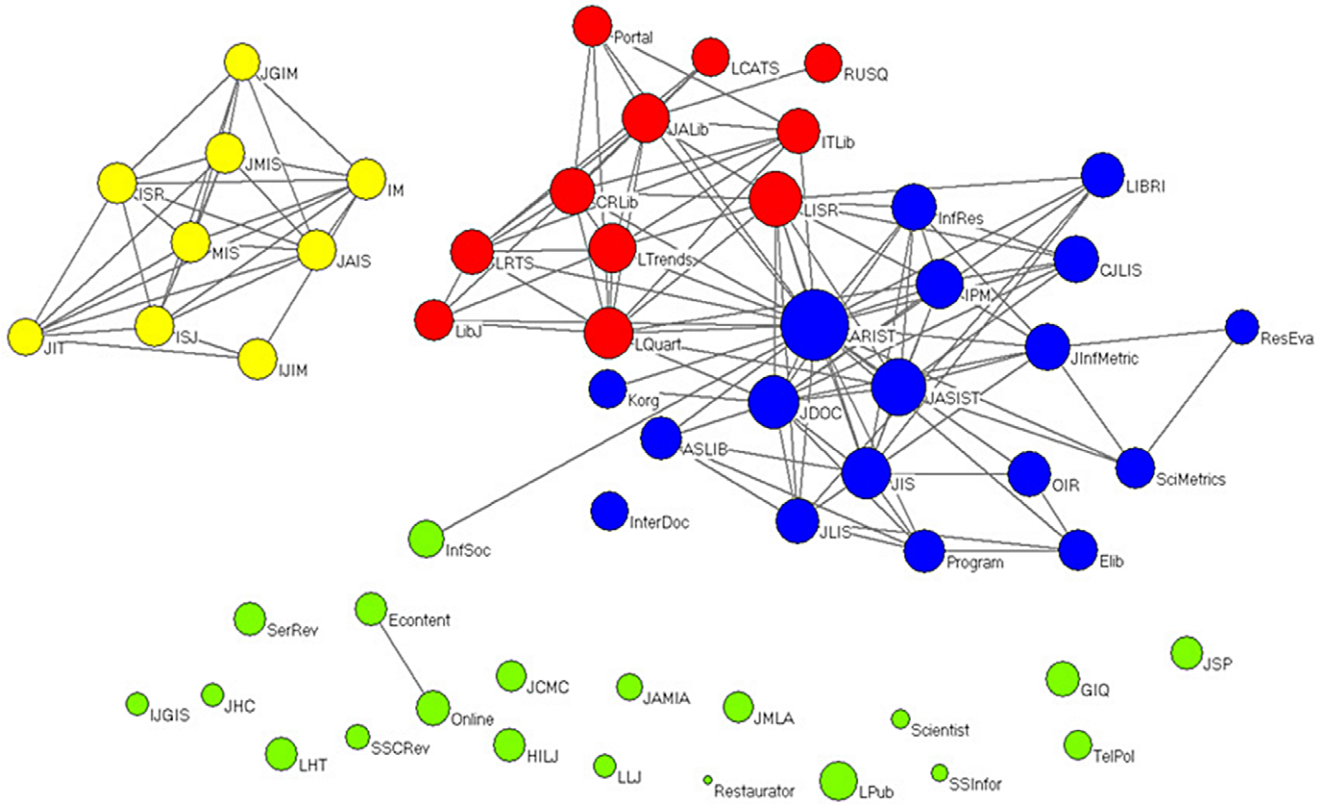

FIG. 4. Journal coupling network (similarity >0.2). (Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.)

TABLE 6. Top 10 authors by number of publications within MIS cluster.

Cluster 1—MIS cluster

- Number of journals: 9
- Number of coupled journal pairs: 36
- Number of unique authors: 5,553
- Number of authors shared by each journal pair: 80.69
- Number of mean citations for each journal: 1,814.2
- Mean impact factor for each journal: 2.31

Author	#Pub	#First_pub	# journal	#First_journal	Other cluster_all	Other cluster_first
Bawden, D	118	113	1	1	Yes (2,4)	Yes (2,4)
Benbasat, I	47	6	6	3	No	No
Grover, V	42	21	8	8	No	No
Wilson, TD	28	20	1	1	Yes(4)	Yes(4)
Klein, G	27	2	6	1	Yes(4)	Yes(4)
Robinson, L	27	23	1	1	Yes(2,3,4)	Yes(2,3,4)
Jiang, JJ	26	14	6	6	Yes(4)	Yes(4)
Whinston, AB	26	1	5	1	Yes(4)	Yes(4)
Dennis, AR	25	17	4	4	No	No
Igbaria, M	25	17	4	4	Yes(2)	Yes(2)
Lyytinen, K	25	13	1	1	Yes(2,4)	Yes(2,4)
Cluster Mean	1.99	1.76	1.33	1.24		

Note. MIS = management information systems.

specialized and research clusters). Interestingly, Benbasat, I. ranks second by the number of publications (47) and published in six journals within this cluster, but did not publish in any journals outside of the MIS cluster. Among the most productive authors, Benbasat, I., Grover, V., and Dennis, A.R. published only within the cluster. Of the eight authors with outside MIS cluster publications, seven have published in journals in the research cluster. This may

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TABLE 7. Top 10 authors by number of publications within specialized cluster.

Cluster 2—Specialized cluster
- Number of journals: 20
- Number of coupled journal pairs: 173
- Number of authors: 19,481
- Average number of authors shared by each journal pair: 8.54
- Number of mean citation for each journal: 504.7
- Mean impact factor: 1.00

Author	#Pub	#First_pub	# Journal	#First_journal	Other cluster_all	Other cluster_first
Ojala, M	190	188	2	2	Yes(4)	Yes(4)
Lewis, R	131	122	2	2	Yes(1,3,4)	Yes(1,3,4)
Constans, A	126	121	1	1	Yes(1)	No
Mervis, J	120	119	1	1	No	No
Snow, B	95	95	2	2	No	No
Hoke, F	94	94	1	1	No	No
Perkel, JM	88	83	1	1	No	No
Russo, E	86	81	1	1	No	No
Pennisi, E	80	79	1	1	No	No
Kreeger, KY	78	78	1	1	No	No
Cluster Mean	1.82	1.96	1.06	1.05		

provide evidence that the authors in this category do not publish frequently in other journals in the IS&LS category, but when they do, they would be most likely to publish in the research cluster. As detailed earlier, this is a small cluster, but moderately well connected within-cluster.

Cluster 2—Specialized IS&LS research (specialized) cluster The specialized cluster comprises journals related to specialized topics, for example, medical research (e.g., *JAMIA, JMLA, JHA*), law (e.g., *Law Library Journal*), communication (e.g., *JCMC, Telecommunication Policy*), publishing (e.g., *Learned Publishing*, *Journal of Scholarly Publishing*), geography (e.g., *International Journal of Geographic Information Science*), and political science (e.g., *Government Information Quarterly*). It has the largest number of journals and authors in the IS&LS category.

About 86% (16,651) of the authors published only in journals within this cluster, 11% published in one additional cluster, 3% published in two more clusters, and less than 1% published in three additional clusters. Table 7 displays the top 10 authors by the number of publications within this cluster. Ojala, M. is the most productive author within this cluster and has published in two journals. He also published in journals in the research cluster. Lewis, R. is the second most productive author within cluster, but he published in more clusters than Ojala, M.: She published in the MIS, specialized, and IS-focused clusters. It is interesting that seven of the top 10 authors only published in journals within the cluster. This cluster is much larger than the previous cluster, in terms of number of journals and authors, but does not display a high level of within-cluster connectivity. This is evidenced by the most productive authors, who predominately publish only in this cluster and only in a single journal within the cluster. It is probable that these authors are productive in other JCR categories and do not represent core authors within IS&LS.

Cluster 3—LS-focused research (LS-focused) cluster. All journals in the practice cluster publish papers on library practice and service-oriented research as indicated by their scope statements. This cluster received the lowest number of citations and lowest impact factor per journal in 2008, but journals in this cluster are tightly connected. Most authors, that is, 12,544 (82%), published only within this cluster, 15% published in one additional cluster, 3% published in two more cluster, and less than 1% published in all the other three clusters. Table 8 displays the top 10 authors by number of publications in this cluster. Oder, N. is the most productive author in this cluster. Interestingly, he published only in one journal (i.e., *Library Journal*) in this cluster, and never published in any other clusters. The second most productive author in this cluster, Tenopir, C., has published in seven journals in this cluster. She also published in journals in the IS-focused and LS-focused clusters. Six of the top 10 authors published only in journals within this cluster, and four of them published only in one journal within this cluster. This is a smaller cluster, but densely connected (with the highest average number of authors shared by each journal pair). However, the most productive authors tend to be limited to this cluster. The exceptions spanned boundaries between both the specialized and the research clusters.

Cluster 4—IS-focused research (IS-focused) cluster The IS-focused cluster comprises journals reporting on a wide range of topics in IS&LS, metric-related topics (e.g., *Sciencetometrics, JInfMetrics*, and *research Evaluation*),

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TABLE 8. Top 10 Authors by number of publications within LS-focused cluster.

Cluster 3—LS-focused cluster
- Number of journals: 11
- Number of coupled journal pair: 55
- Number of authors: 15,328
- Average number of authors shared by each journal pair: 122.07
- Number of mean citation for each journal: 289.1
- Mean impact factor: 0.63

Author	#Pub	#First_pub	# Journal	#First_journal	Other cluster_all	Other cluster_first
Oder, N	186	168	1	1	No	No
Tenopir, C	178	175	7	6	Yes (2,4)	Yes (2,4)
Rogers, M	116	92	1	1	No	No
Hoffert, B	93	73	1	1	No	No
Berry, J	75	73	2	2	No	No
Berry, JN	69	67	1	1	No	No
White, HS	68	65	6	6	Yes (4)	Yes (4)
Hernon, P	65	59	5	5	Yes (2,4)	Yes (2,4)
Albanese, A	60	60	1	1	No	No
Kaser, D	60	59	5	5	Yes (2,4)	Yes (2,4)
Cluster Mean	2.05	2.08	1.28	1.27		

Note. LS = library science.

TABLE 9. Top 10 authors by number of publications within IS-focused cluster.

Cluster 4—IS-focused cluster
- Number of journals: 18
- Number of coupled journal pair: 152
- Number of authors: 15,647
- Average number of authors shared by each journal pair: 83.81
- Number of mean citations for each journal: 706.3
- Mean Impact Factor: 1.14

Author	#Pub	#First_pub	# Journal	#First_journal	Other cluster_all	Other cluster_first
Oppenheim, C	132	54	14	8	Yes (1,2)	Yes (1,2)
Egghe, L	129	127	7	7	No	No
Rousseau, R	119	40	9	8	Yes (2,3)	Yes (2,3)
Wilson, TD	**119**	**99**	**10**	**9**	**Yes (1)**	**Yes (1)**
Thelwall, M	110	70	12	11	Yes (1,2,3)	Yes (1,2,3)
Nicholas, D	109	54	10	9	Yes (2,3)	Yes (2,3)
Glanzel, W	98	45	5	4	Yes (3)	Yes (3)
Raitt, D	98	98	1	1	No	No
Williams, ME	97	94	4	4	Yes (3)	Yes (3)
Cronin, B	88	80	9	9	Yes (1,2,3)	Yes (1,2,3)
Cluster Mean	2.30	2.24	1.29	1.28		

Note. IS = information science.

information science (e.g., *JASIST, ARIST, IPM, JDOC and JIS*), and library-related research (e.g., *Libri, OIR, Program, Interdoc, and CRLIS*). There are 15,647 authors in this cluster, and 80% published only within this cluster, 16% in one other cluster, 4% in two additional clusters, and less than 1% in three additional clusters. Table 9 displays the top 10 authors by number of publications within the cluster. Oppenheim, C. is the most productive author in this cluster, with 132 publications and 54 first-authored publications. He published in 14 journals within the cluster, eight as first author. He also published in journals in the MIS and specialized clusters. Egghe, L. is the second most productive, particularly in terms of single-authored publications: He has 129 publications, and 98% of them (127) are first-authored publications. His publications are spread among seven journals in this cluster, but he does not have any publications outside of this cluster. Furthermore, it is noted that Wilson, T.D. (highlighted in Table 9) ranks fourth in this cluster and also fourth in the MIS cluster and has no publications outside of these two clusters, which means he is active and very productive only in the two clusters. However, Wilson has 119 publications in 10 journals in the IS-focused cluster, and 28 publications in one journal (*IJIM*) in MIS cluster, indicating that he has been more active in the former

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cluster. There are some authors who published very broadly both within the cluster and across clusters. For instance, Thelwall, M. published in 12 journals within this cluster, and published across all four clusters; Cronin, B. published in nine journals in this cluster and published across all four clusters as well. It is perhaps these boundary spanners that make this the connecting cluster—it has the lowest percentage of authors who publish only within the cluster (compared with the other three clusters). Of the most productive authors, only two maintain publication records solely within the cluster. This could therefore be seen as the bridging cluster, connecting the other journals within IS&LS. It could also be interpreted as the core social group of the discipline.

Discussion

This work presents a novel method, VAC, that seeks to group journals by shared authorship profiles. The intention of this article is to introduce and demonstrate the value of this proposed method. In doing so, IS&LS was used to illustrate the method. The objective of the discussion is two-fold: One desire is to discuss and interpret the results of the analysis on IS&LS; however, the larger focus is to reflect upon the application and examine the potential use of this new method.

Using the journals in the IS&LS category of JCR, VAC identified four major clusters: MIS, IS-focused, LS-focused, and the specialized cluster. The highest degree of connectivity among the groups was between the LS and IS clusters. The MIS cluster had a high degree of within-group connectivity, but did not appear to share a large number of authors with other journals classified in the JCR category. One interpretation of this result is that the authors in the MIS cluster represent a distinct invisible college, separate from the social community in LS-focused and IS-focused research and should potentially be reclassified by JCR (this suggestion has been made in previous research, e.g., Ni & Ding, 2010). The specialized cluster was isolated both among the other subgroups and within its cluster: Authors tended to publish only in one journal in this cluster and in no other clusters. The relative isolation of the specialized cluster may provide evidence that those journals are not part of the discipline, as they do not share a social connectivity either within their cluster or between their cluster and other clusters in the JCR category. Alternatively, it is possible that this represents the dichotonomy between basic and applied venues. As noted by Abbott (1999), "problem-oriented empirical work does not create enduring, self-reproducing communities like disciplines" (p. 134). Although specialized sources provide a valuable output for the discipline, the participation base appears to be largely disparate. However, it is possible that the authors in these journals are well-connected to other bodies of literature outside the confines of the journal set classified as IS&LS in JCR.

The VAC method itself presents a novel way to expose the similarity between and among journals. In this illustration, it was able to cluster journals in such a way that provides high face validity, in terms of grouping similar journals. However, beyond the initial clustering, the VAC method provides data on how cohesive the groups are, in terms of shared authors, and how much the authors in the cluster participate in other clusters within the discipline. In this way, the results were able to identify the core journals within the field and those that are socially peripheral. In addition, the results provided evidence of a cluster that was internally cohesive but not well connected in terms of the larger corpus of journals. Initial sensitivities of the method to temporal factors (i.e., duration of publication) were also exposed. Those journals that utilized authors already within the core (e.g., *Journal of Informetrics* drawing authors largely from *JASIST* and *Scientometrics*) obtain a relatively central position. However, a new journal that brought in authors from other disciplines would not appear as well connected. Overall, this method proved useful for depicting the social groupings of a domain, particularly one that retains a large proportion of single-authored publications.

Conclusion and Future Work

A frequent criterion for disciplinarity is a coherent social body—an established group of individuals working and publishing in a given area of research. However, classification schemes (JCR, LoC, etc.) and communicative units (e.g., publications, citations, and journals) are often used to operationalize disciplinarity. This work explored a novel method for examining similarity among journals, by overlapping author profiles. The results of this work not only inform the study of IS&LS research but also provide a malleable measure that can be utilized by other fields and expanded to answer additional research questions.

This work served as a proof of concept by examining a single JCR classification. Future research should examine the entire set of WoK journals, clustering first by VAC and then examining the results in comparison to the JCR categories. It is possible that although distinct clusters were identified in this micro-level study, a macro-level study would indicate that these journals are more alike than they are different.

It is recommended that this method be tested on other venues, such as conference proceedings or scholarly social networks. Comparison studies could also examine the degree to which authors participate in various social groupings dependent and independent of genre. In addition, this work should be applied to venues diachronically, to map the shifting development of disciplines as authors move from one venue to another or leave the discipline entirely. Particularly if used in comparison with other bibliometric indicators, this could provide a rich lens on disciplinary development.

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Appendix 1

Overview of Information Science & Library Science Category Journals

Journal	#aut	#Autship	#Paper	.#author/paper	#Cit	IF	duration	freq
LIBR J	5675	10509	9273	1.1333	365	0.388	135	20
J AM MED INFORM ASSN	5172	8937	2225	4.0166	2574	3.428	17	6
J AM SOC INF SCI TEC	3755	8864	4788	1.8513	3967	1.954	73	12
COLL RES LIBR	3212	5485	4588	1.1955	556	0.781	72	6
SCIENTOMETRICS	2455	4734	2350	2.0145	2492	2.328	33	4
INFORM PROCESS MANAG	2448	3949	1906	2.0719	2003	1.852	48	6
J ACAD LIBR	2301	3946	3238	1.2187	503	0.667	36	6
LIBR TRENDS	2299	2819	2313	1.2188	386	0.239	59	4
INFORM MANAGE-AMSTER	2168	3401	1698	2.0029	2919	2.358	43	8
ASLIB PROC	1825	2801	2193	1.2772	196	0.493	62	6
J DOC	1506	3007	2087	1.4408	1014	1.712	66	6
J INF SCI	1477	2347	1291	1.818	729	1.648	32	6
LIBR RESOUR TECH SER	1461	2116	1716	1.2331	158	0.698	54	4
TELECOMMUN POLICY	1445	2001	1267	1.5793	629	1.244	35	11
J HEALTH COMMUN	1395	1818	570	3.1895	955	2.057	15	8
ELECTRON LIBR	1334	2457	1795	1.3688	161	0.393	29	2
INT J GEOGR INF SCI	1296	1774	679	2.6127	1724	1.596	24	12
SOC SCI INFORM	1234	1602	1266	1.2654	295	0.341	57	4
LAW LIBR J	1233	2013	1538	1.3088	217	0.296	103	4
INT J INFORM MANAGE	1163	1901	1149	1.6545	519	1.043	31	6
INFORM TECHNOL LIBR	1152	1551	1144	1.3558	98	0.703	43	4
LIBR COLLECT ACQUIS	1099	2370	1852	1.2797	85	0.364	34	4
GOV INFORM Q	1081	1789	1377	1.2992	396	1.91	29	4
MIS QUART	1018	1689	742	2.2763	5684	5.183	34	4
ONLINE	971	2093	1729	1.2105	89	0.352	34	2
SCIENTIST	884	4053	3884	1.0435	311	0.353	25	12
LIBRI	883	1119	852	1.3134	113	0.156	60	4
LIBR QUART	875	1198	1001	1.1968	287	0.364	80	4
J MED LIBR ASSOC	872	1125	407	2.7641	538	1.669	100	4
ONLINE INFORM REV	803	1588	937	1.6948	268	1.103	34	2
ECONTENT	761	2867	2536	1.1305	58	0.271	33	10
LIBR HI TECH	743	817	382	2.1387	109	0.344	28	4
J MANAGE INFORM SYST	738	1071	413	2.5932	2527	2.358	27	4
J INF TECHNOL	695	904	448	2.0179	838	1.966	25	4
SOC SCI COMPUT REV	648	735	358	2.0531	360	0.714	28	4
LIBR INFORM SCI RES	618	883	536	1.6474	419	1.226	32	4
INFORM RES	608	1007	642	1.5685	429	1	35	4
INFORM SYST RES	603	944	386	2.4456	2778	2.261	21	4
ANNU REV INFORM SCI	598	695	470	1.4787	477	2.5	45	1
INFORM SOC	556	693	474	1.462	487	1.042	30	5
J COMPUT-MEDIAT COMM	551	619	283	2.1873	803	1.901	16	4
REF USER SERV Q	541	716	371	1.9299	105	0.339	51	4
INTERLEND DOC SUPPLY	539	797	605	1.3174	102	0.559	40	4
LEARN PUBL	539	830	557	1.4901	92	0.484	34	4
INFORM SYST J	482	632	287	2.2021	528	2.375	20	6
PROGRAM-ELECTRON LIB	435	662	373	1.7748	193	0.286	45	4
RES EVALUAT	434	565	226	2.5	212	1	20	5
HEALTH INFO LIBR J	423	538	229	2.3493	187	0.939	27	4
RESTAURATOR	417	666	266	2.5038	110	0.172	42	4
J LIBR INF SCI	409	573	334	1.7156	95	0.562	42	4
PORTAL-LIBR ACAD	363	434	252	1.7222	218	1.146	10	4
KNOWL ORGAN	300	385	266	1.4474	128	0.429	37	4
J ASSOC INF SYST	299	390	138	2.8261	335	1.836	11	12
J SCHOLARLY PUBL	262	376	316	1.1899	38	0.455	42	4
CAN J INFORM LIB SCI	257	425	326	1.3037	55	0	35	4
J GLOB INF MANAG	200	235	88	2.6705	200	1.387	18	4
SERIALS REV	189	215	113	1.9027	112	0.383	36	4
J INFORMETR	171	221	99	2.2323	89	2.531	4	4

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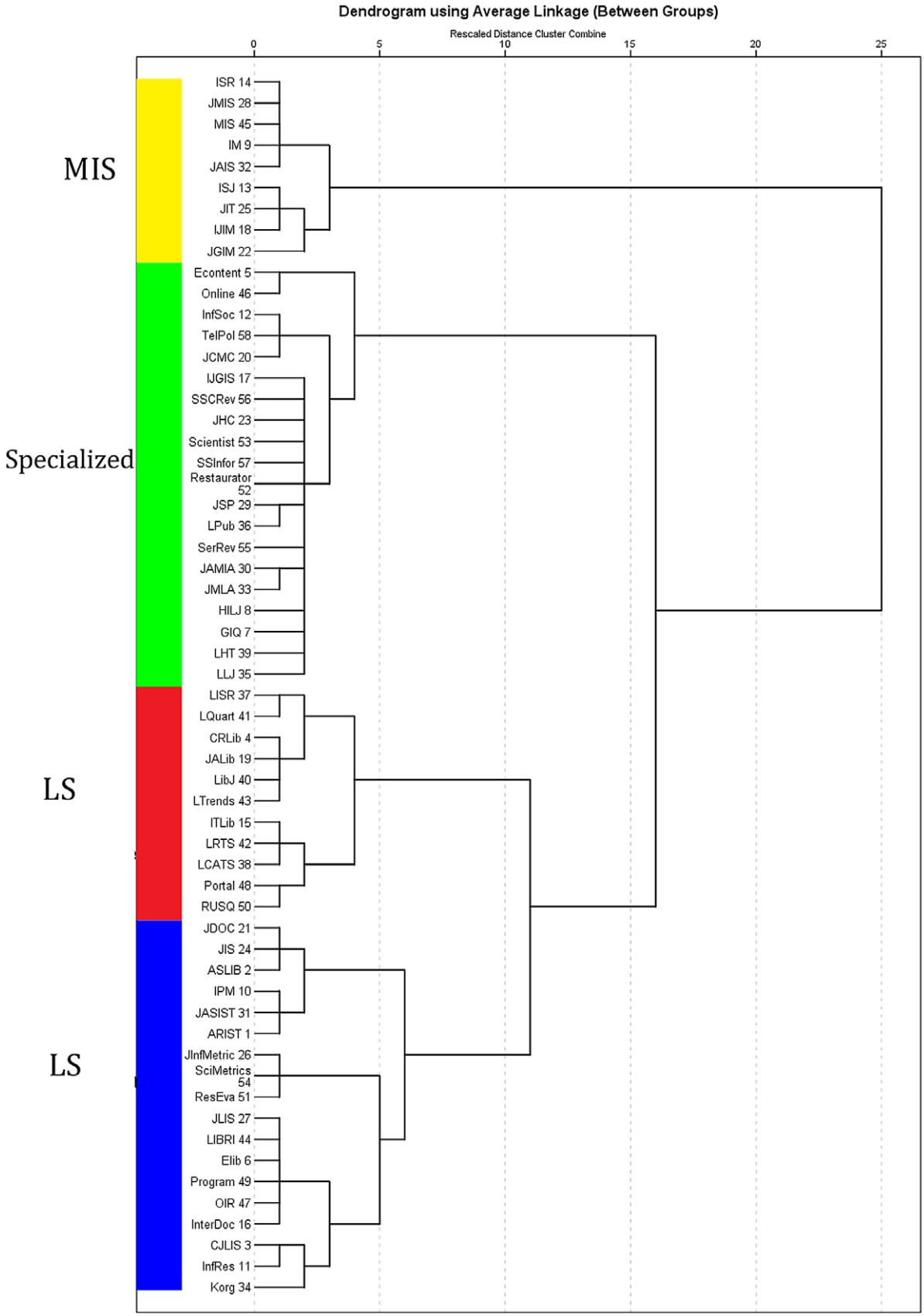
Appendix 2



(Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.)

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