The Scope and Growth of Spatial Analysis in the Social Sciences

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Part of the spectrum of CSISS in promoting the use of spatial analytic methods in the social sciences is to assess the penetration of such approaches in these disciplines currently and over the last decade. For this assessment, we conducted "bibliometric analysis" of a representative collection of social science literature on a set of spatially oriented topics and methods. The following summary shows changes in this literature over time and among disciplines.

Methods

The many services producing electronic indexes of social science literature greatly facilitates bibliometric analysis of trends, but poses challenges for selecting particular topics from among millions of articles. We developed and refined a set of 86 topics used for searching for published articles and classifying results.[1] These topics included methods for representing spatial phenomena, such as geographic information systems and mapping techniques. Also covered were tools for analyzing spatial data and for simulating social phenomena in a spatial and temporal context.[2]

We applied these search terms to six online bibliographic indexes of social science disciplines, which were Social Sciences Citation Index, EconLit indexing economic literature, Sociological Abstracts, Social Services Abstracts, Anthropological Literature, and Historical Abstracts. We chose these social science indexes to facilitate our initial distinction of articles from other sciences, and for their inclusion of article abstracts.

A set of Filemaker databases was developed for collecting and classifying articles. Using a combination of computer-aided filtering with manual verification, each article was coded for one or more of the 86 topical subjects, by their appearance in the article's title, abstract, or subject keywords provided by the online indexes. We also coded, when possible, the discipline most closely associated with each article, using a three-tiered approach. A discipline was assigned first if an author's affiliation was known to the investigators, and second if the source journal was clearly associated with a specific discipline. Remaining articles were coded by assessing title and abstract content for its relevant discipline. Roughly 8% of the articles were coded with two disciplines if

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[1] We excluded books, book chapters, papers and theses to maintain a manageable and consistent dataset.

[2] The list of classification terms can be found at Uwww.cssis.org/resources/litsearch-class.htmU.

both applied relatively equally. Issues on the reliability and validity of such coding will be discussed below.

We updated our database roughly every six months from summer 2000 to fall 2003. The results, discussed below, represent 9,653 coded articles. Our data set best represents the contributions of indexed journals from 1990 to 2001. The online services have a lag time of over one year for thoroughly indexing journal contributions, and coverage of these services appears less comprehensive prior to 1990 before they fully adopted electronic indexing.

Results

The full database of coded articles represents a comprehensive sample of articles oriented to spatial and spatio-temporal analysis, representation, and simulation in current use within social science disciplines.
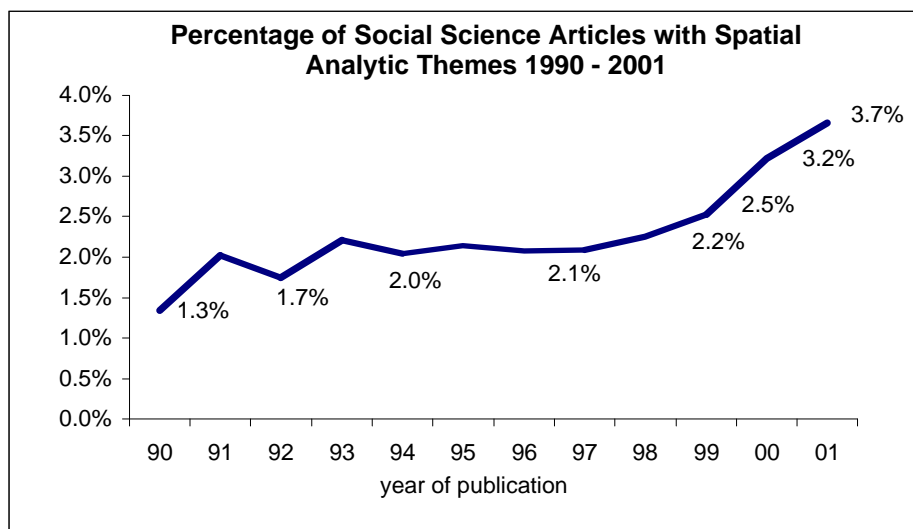
Figure 1

Figure 1 shows the number of spatial analytic articles published annually from 1990 to 2001, presented as a proportion of the annual total of articles for the journals in which each article appeared. In other words, we used our database survey to select those journals indexed by the five bibliographic sources that have during this period published one or more spatial analytic articles, according to our selection criteria. Within that set of journals, the chart shows annual percentage of spatial analytic articles to the total articles indexed for each journal per year. Over the decade, the proportion of articles rose from 1.3% (250 of 18,643 articles published in 1990) to 3.7% (928 of

25,561 articles published in 2001.)[3] These results show a steady increase in the penetration of articles with spatially oriented methods and themes to published social science articles.

Disciplines. As discussed above, articles were coded for discipline based upon author affiliation, journal source, and content. This allows comparison of proportions of spatially-oriented articles and relative growth among the social science disciplines we followed.
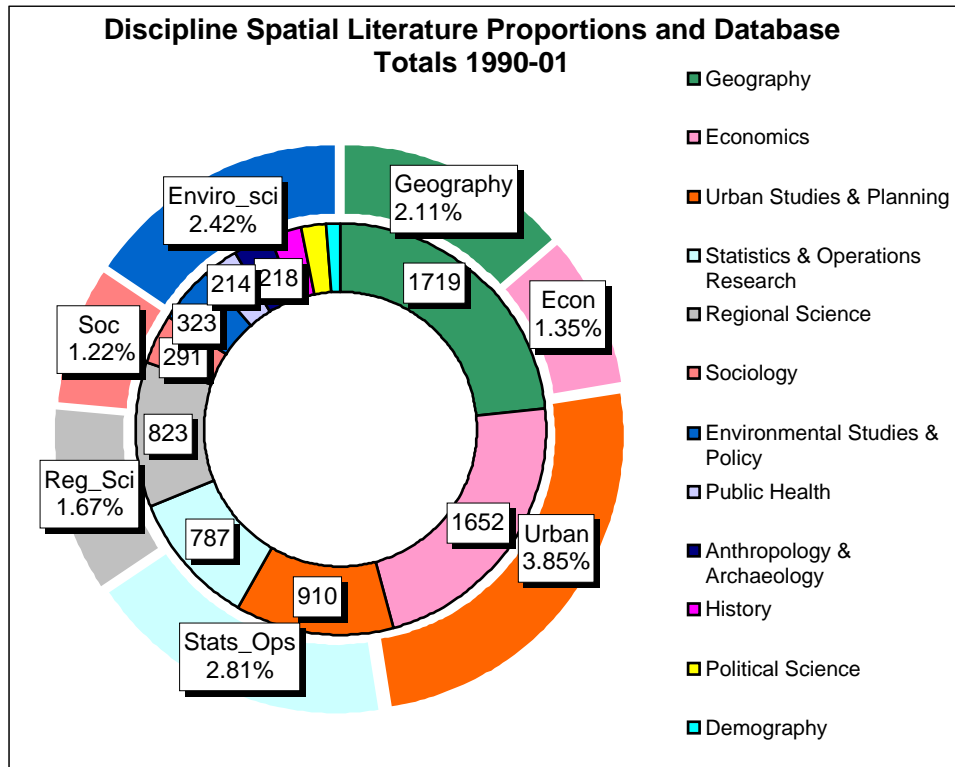
Figure 2

Figure 2 combines a view of the total number of articles for each discipline and, for the top seven disciplines, the proportion of spatially oriented articles in the set of journals for that discipline in which our coded articles appeared. Geography, for example, constituted the largest portion of our dataset, with 1,719 articles, and in the set of source journals with geography articles, those matching our set of spatial themes made up 2.1% of the set's total articles during the decade. Spatially-oriented articles on urban and regional planning and urban studies constituted a larger portion of the journals from which the articles were drawn, at 3.85%. It was not feasible as a base of

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[3] Results for the annual proportion of all indexed journals, not considering their inclusion of SA articles, show an almost identical growth pattern, but of smaller proportions, from 0.15% in 1990 to 0.47% in 2001. This measure is less accurate, however, because it does not control for journals indexed by more than one bibliographic service.

comparison to distinguish the disciplines of all articles or journals in the electronic indexes; however, the proportions in our results are an illustrative estimate of the penetration of spatial themes in approximately 1,400 social science journals that either typically or occasionally contain spatially-oriented articles. Given these limitations, changes over time in the relative proportions of disciplines can also be illustrated.
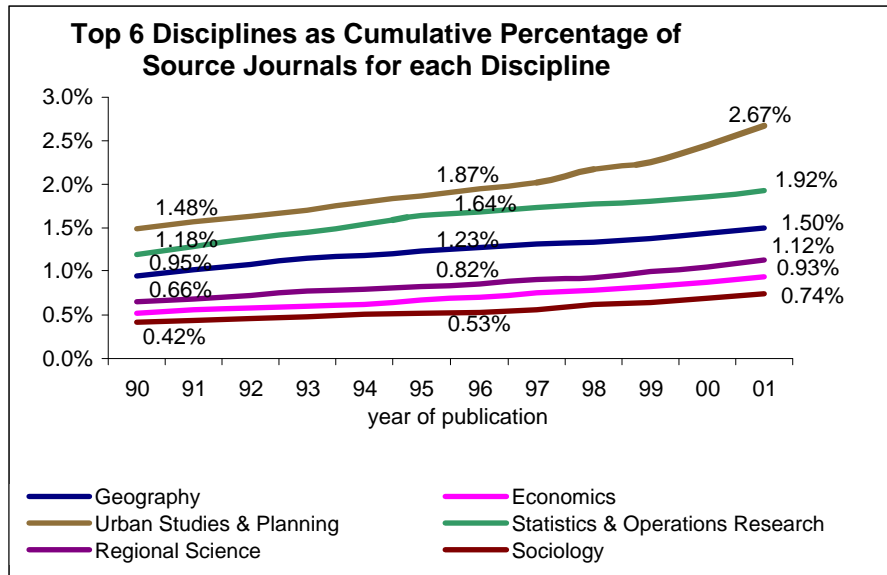
Figure 3

Figure 3 shows the relative growth among a selection of disciplines in the cumulative totals of spatial analytic articles to cumulative totals of each discipline's journal articles. Since annual additions for each discipline are relatively small (usually less than 10 articles), presenting cumulative values helps show the trend of growth during the decade. Articles from urban studies grew over 1%. This growth was primarily in urban planning topics such as facility location and land use models. Other disciplines show a relatively steady growth of approximately 0.5% over the decade of spatial topics within this set of journals.

Spatial topics: Our database allowed the 86 spatial topics to be tracked individually. Since many terms yielded fewer than 200 articles overall, examining annual rates of change is more informative for groupings of terms by similar themes. Figure 4 shows a sample of such groupings as three-year rolling averages of article totals to total articles of the journal sets for each topic group.

Figure 4

Selected spatial topic proportions of journals by 3 yr rolling average 1991-2001
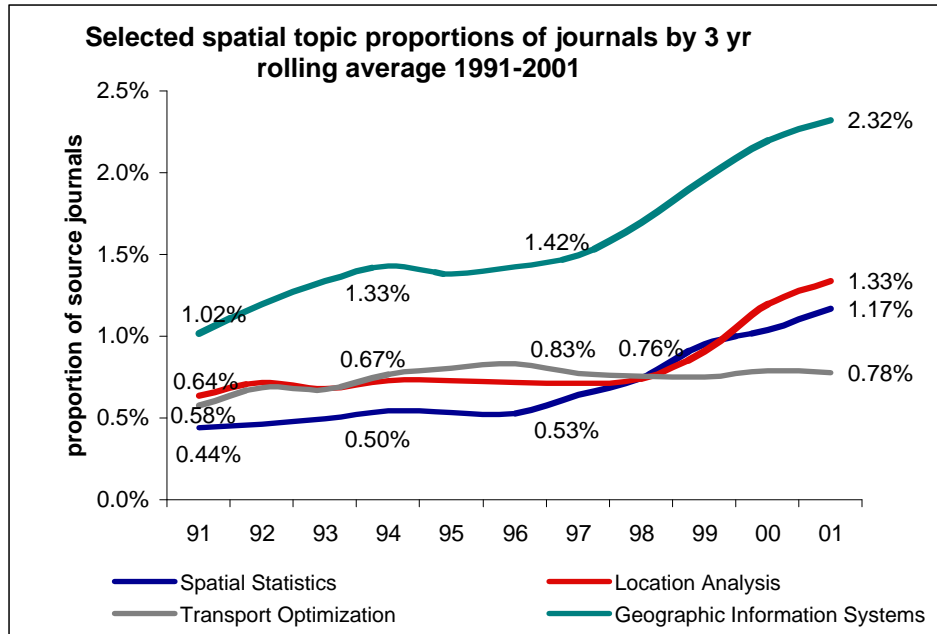
Articles on Geographic Information Systems, as either topic or method, show a steady rise of 1.3 % of source journals. Articles we categorize as "location analysis," that include industrial location, location-allocation and land use modeling as main topics, grew as a proportion of its social science journals primarily after 1998, along with "spatial statistics." That category included spatial autocorrelation, spatial regression, and spatial cluster analysis among its methodologies. These methods were employed primarily in geography, economics, and regional science, but showed increased usage over the decade in urban planning, anthropology, archeology, sociology, and demography. Articles on transport optimization, including transport costs, trip matrices and optimal routes, maintained a relatively consistent proportion of their respective social science journals.

These data suggest overall that use of spatially oriented methods and topics oriented to spatio-temporal issues has grown in the social sciences over the last decade. These approaches, however, are better represented in certain disciplines, namely geography, economics, regional science, and urban planning where "macro" analysis of physical space is common. While spatial topics appear less frequently in other disciplines, these results may reflect a degree of bias in our data toward searching for articles with "named" methods, such as spatial autocorrelation. Some disciplines, such as archeology or sociology, may employ similar methods without using in their title or abstract the terms commonly employed in other disciplines. Our data is also limited to the choices made by indexing services in the journals they carry, and authors' choices in what they

include in abstracts and subject keywords. Our results, however, offer a starting point for closer analysis of spatial approaches in social science disciplines. A sampling of the text of articles, books, presented papers, and dissertations could locate new directions and areas of application especially in disciplines for which spatial approaches are less commonly employed.