A Reflection on the Ph.D. Program in Spatially Integrated Social Science at the University of Toledo

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ABSTRACT

The use of spatial analysis tools is on the rise in many academic fields and practical applications. These tools enhance the ability to examine data from spatial perspectives. Though the study of place and space has traditionally been the domain of the field of geography, growing numbers of researchers are turning to these tools in the social sciences and beyond. The University of Toledo has established a unique Ph.D. granting program to encompass the theories, tools, and applications of spatially integrated social science. In the first couple of years of its inception the program has attracted students from different places and diverse backgrounds. It is expected that the program will continue to thrive in attracting diverse students, securing external grants, and positively impacting on the economy of Northwest Ohio. This paper is a personal reflection of the views of the authors on the Ph.D. program in Spatially Integrated Social Science at the University of Toledo two years after its inception in fall 2009. The views, by no means, are of the University of Toledo, its SISS program, or any of the participating departments and faculty members.

Keywords: Geographic Information Systems, Northwest Ohio, Ph.D. Program, Spatially Integrated Social Science, The University of Toledo

INTRODUCTION

The use of a variety of spatial analysis tools is increasing in social science research. While social problems and study areas span multiple disciplines, the question of location has historically been the domain of geographers. The prevalence of cutting-edge technologies like Geographic Information Systems (GIS) and Global Positioning Systems (GPS) in the social sciences is facilitating the study of the role of place in the society. Thus, geography can be a unifying field for the social sciences, wherein traditional data analysis can be conducted within the context of place.

While each discipline has historically possessed its own set of analytic tools, the increasing ability to measure processes in a spatiotemporal context facilitates sharing of these new tools, a general development that can then be applied to local and unique conditions (Goodchild et al., 2000). Human demographic data, for example, has historically been presented in a series of tables. However, Weeks (2004) argues that such data is spatial in nature because it deals with characteristics of human populations in specific regions. It varies based on time, space, and scale. The recent shift towards locational information in data sets and displaying data in interactive maps in addition to traditional tables and charts has brought to light the importance and usefulness of spatial ways of looking at data in the social sciences.

As GIS tools have become more powerful and more widely available, they have been increasingly used in the application side of the social sciences. More and more it is being realized that these tools are equally powerful for theoretical queries and social research. As Sui (2004) asks, GIS is the answer, but what is the question? Sui (2004) goes on to argue that advances in geocomputation will continue to bring social science disciplines into the trend of spatializing previously non-spatial data.

Spatial analysis is both an inductive and deductive tool, as it can reveal unforeseen patterns and test existing theories about expected patterns (Goodchild & Janelle, 2004). Anselin (2006) categorizes spatial analysis techniques into three general groups: exploratory spatial data analysis (searching for patterns), visualization (methods of showing the patterns), and spatial modeling (methods of explaining and predicting patterns). Recently, the development of the GeoDa software has created a program capable of both advanced spatial statistics and mapping (Anselin et al., 2006).

WHY SPATIALLY INTEGRATED SOCIAL SCIENCE?

As much as GIS has revolutionized many disciplines and practices, including the social

sciences, GIS itself does not fully account for or measure the complexities and relationships inherent in spatial data (Páez & Scott, 2004). Páez and Scott (2004) argue that current GIS software, even with the recent inclusion of spatial modeling, do not adequately account for heterogeneity, interdependence or spatial association, and thus are not as accurate or useful as it could be if more advanced spatial statistics were used. Logan et al. (2010) argue that GIS gives way to more complex spatial analysis tools when patterns on a map lead to additional questions that simple visualization cannot answer. For example, a traditional chloropleth map made in GIS does not take into account the outliers or an uneven population. The longstanding method of collecting data in tables and translating it to maps only scratches the surface of displaying and analyzing spatial data.

The last decade has seen the development of a cohesive shift towards spatial ways of thinking about social data and a demand for tools that facilitate this approach (Voss, 2007). This area of study is increasingly referred to as Spatially Integrated Social Science (SISS). A few key programs have progressed SISS techniques, including the University of California at Santa Barbara (UCSB), which is home to many centers and programs related to the field, perhaps most notably the Center for Spatially Integrated Social Sciences (CSISS, 2011). CSISS focuses on integrating the social sciences via the context of place, and also holds workshops for students, researchers, and instructors (CSISS, 2011). Also at UCSB is the National Center for Geographic Information and Analysis and the UCSB Spatial Studies Center, making the University a vital hub of spatial information research. CSISS reports that the majority of participants in their offered workshops, for which they receive far more applicants than they can accept, are from the field of geography, though the ratio is decreasing, indicating greater interest from other disciplines (CSISS, 2003). CSISS also produces sample syllabi to be used to teach spatial analysis in a variety of disciplines.

The Pennsylvania State University (PSU) has a strong GIS component as well, hosting

the multidisciplinary Geospatial Information Systems Council. PSU's Population Research Institute (PRI) focuses on demography in the context of a variety of disciplines, and conducts statistical and GIS analyses of population data. The PRI also offers an interdisciplinary dual Ph.D. degree in demography (http://www. pop.psu.edu/). PSU's partnership with CSISS has encouraged participation in workshops on spatial analysis by demography students and faculty, helping to further the integration of the social sciences, GIS, and spatial statistics.

The University of Illinois at Urbana-Champaign has established the University Consortium of Geographic Information Science, another prominent GIS program to promote the interdisciplinary use of geospatial techniques. The GeoDa Center for Spatial Analysis and Computation at Arizona State University is the current home of the GeoDa software (http:// geodacenter.asu.edu/). Another spatial analysis software tool is CrimeStat, developed at the Inter-University Consortium for Political and Social Research at the University of Michigan. CrimeStat is in use for practical application by police departments as well as by criminal justice and social science researchers (Inter-University Consortium for Political and Social Research at the University of Michigan, 2011). This is a short sampling of some of the centers that have created spatial analysis tools and are focusing on an interdisciplinary approach to furthering spatial research. Many universities across the United States offer classes, certificates, and degrees in GIS. The SISS program at the University of Toledo establishes a Ph.D. degree that focuses on the theories, tools, and approaches of advanced spatial analysis.

THE SISS PROGRAM AT THE UNIVERSITY OF TOLEDO

The SISS program is the only Ph.D. granting program of this nature in the Midwest. The Master's Certificate Program in GIS at the University of Toledo is housed within the Department of Geography and Planning, however students from several disciplines, ranging from public health to civil engineering, continuously enroll in GIS classes, demonstrating the wide application of this technology. Contrarily, the SISS program is an interdisciplinary program incorporating the departments of Geography and Planning, Economics, Political Science and Public Administration, and Sociology and Anthropology (Lindquist, 2009). The SISS program at the University of Toledo incorporates many of the approaches outlined by CSISS. It is centered on spatial analysis tools, theories, and problems as well as spatial information processing technologies, including GIS, remote sensing, and digital image analysis (SISS Ph.D. Graduate Program Handbook, 2009).

The Department of Geography and Planning at the University of Toledo was already home to the Center for Geographic Information Sciences and Applied Geographics (GISAG), a well-equipped research center which conducts much of the University of Toledo's GIS work (Czajkowski et al., 2003). Through the GISAG, there have been many joint projects between the departments of Geography and Planning, Economics, Political Science, Environmental Sciences, Business Administration, and Civil Engineering. Thus, the Ph.D. program in SISS is a natural extension of this collaboration and the increasing applicability of spatial analysis (SISS, 2011). It is expected that this degree program will solidify such research focus, attracting faculty and students of diverse background, and strengthen the university's role as a research institution.

The original proposal for the SISS program was submitted to the Ohio Board of Regents in 2007, and the program was approved by the Board of Regents and the University of Toledo's Board of Trustees in September 2008 (Lindquist, 2009). The first and second classes of four and five students entered into the program in fall 2009 and fall 2010. Although the application process for admission is on the move, it is anticipated that the number of students who would enroll into the program in fall 2011 will be stable compared to last two years. As such one can be optimistic about the sustainability

of the program. The admitted students come from a diverse background: geography, planning, health education, engineering, sociology, economics, and such. The applicants have to meet three pre-requisites for entering into the program. The first of those is that they have to have a master's or equivalent in a Social Science discipline. The second and third pre-requites include prior successful completion of two courses in GIS and one course in graduate-level multivariate statistics. A typical student would successfully complete six core courses (18 credit hours), three advanced seminar courses (nine credit hours) and three elective courses (nine credit hours) to fulfill the requirement of 36 credit hours of coursework. The core courses consist of Spatial Statistics, Geographical Information Science in SISS, Foundations of SISS, SISS Theory, Advanced Spatial Data Analysis, and Research Design. The advanced seminar courses, on the other hand, include Geo-Computation, Advanced Qualitative Analysis in SISS, Policy Evaluation and SISS, Space and Society: Critical Theory in SISS, Discrete Choice Spatial Process Modeling, Advanced Modeling Methods and Techniques in SISS, Spatial Perspectives on the Environment, Spatial Transport Modeling and Planning, Directed Readings in SISS, Seminar in Special Topics, and Doctoral Dissertation. The elective courses can be taken from any of the participating departments. In addition, she/he has to complete 24 credit hours of dissertation research and successfully defend the research as the requirements to receive the Ph.D. degree (Lindquist, 2009; SISS, 2011).

Currently the core instructors are comprised of nine faculty members representing the participating departments. Because the core faculty members have diverse background and expertise, and that the admitted students come with similar diverse backgrounds, the students have wide open options to expertise in different subfields of SISS: transportation, housing, environment, economics, public health, demography, and such. The list of core faculty members and their expertise are available from the SISS program website (SISS, 2011).

EXPECTED CONTRIBUTION TO NORTHWEST OHIO'S ECONOMY

Northwest Ohio is, like many older industrial areas, in a period of self-reinvention. The City of Toledo has a strong legacy in manufacturing and supplying glass and parts to Detroit auto industry. The region continues to shift away from traditional manufacturing due to decline in that industry, but is hopeful to make use of the skilled labor pool to focus on high tech manufacturing and alternative energies. The University of Toledo is very involved in this transition, and plays a vital role in the regional economy. As such, the creation of the Ph.D. program in SISS at the University of Toledo is expected to contribute to this by attracting a unique group of students, faculty, and collaborators. The SISS program is also expected to contribute to the local economy by working as a research center assisting local organizations, governments, and businesses.

One specific area where the SISS program expects to have a significant impact is in the area of transportation research. The Greater Toledo region is located on Lake Erie and contains the intersection of the Ohio Turnpike and I-75, making it an ideal transportation hub. The region has embraced this possibility, and the SISS program has enough room to collaborate with local government agencies, businesses, and the Intermodal Transportation Institute at the University of Toledo.

CONCLUSION

As spatial analysis approaches gain popularity and the processing abilities of spatial software grow, we can expect to see continued increases in interest in the philosophy and methodology of spatial analysis theory and applications. This unique program at the University of Toledo should prove to contribute not only to the economy of Northwest Ohio, but to the literature and discipline of advanced spatial analysis. The program is designed to train and educate

students on the cutting edge technology and new ways of thinking about data, giving them the skills to contribute in both theoretical and practical applications of spatial analysis in the social sciences. It envisions attracting students from outside the Northwest Ohio region due to its distinctive curriculum. It is expected that the students will both help the region grow and participate in research that will further promote economic development and policymaking.

One may expect, then, that the program will help establish the University of Toledo as a significant center of SISS applications and research. The use of spatial analysis tools is on the rise, and as we study more facets of spatial data, from demography to public health to land use to transportation, it will be important to be able to identify patterns when taking several unique variables into account, as well as to be able to measure and understand the relationships and connections of different places and scales. There are several reasons, therefore, to be optimistic that the Ph.D. program in SISS at the University of Toledo will help further the abilities of several disciplines to do just that.

REFERENCES

Anselin, L. (2006). How (not) to lie with spatial statistics. *American Journal of Preventive Medicine*, *30*(2), 3–6. doi:10.1016/j.amepre.2005.09.015

Anselin, L., Syabri, I., & Kho, Y. (2006). GeoDa: An introduction to spatial data analysis. *Geographical Analysis*, *38*(1), 5–22. doi:10.1111/j.0016-7363.2005.00671.x

Center for Spatially Integrated Social Science. (2003). *Survey of CSISS program applicants and participants 2000-2002*. Santa Barbara, CA: UCSB Social Science Research Center.

Center for Spatially Integrated Social Science. (2011). *Spatial resources for the social sciences*. Retrieved April 27, 2011, from http://www.csiss.org

Czajkowski, K., Lawrence, P., Attoh, S., Reid, N., & Lindquist, P. (2003). *Acquisition of instrumentation in support of the Center for Geographic Information Science and Applied Geographics (GISAG)*. Arlington, VA: National Science Foundation.

Goodchild, M., Anselin, L., Appelbaum, R., & Harthorn, B. H. (2000). Towards spatially integrated social science. *International Regional Science Review*, *23*(2), 139–159.

Goodchild, M., & Janelle, D. (2004). Thinking spatially in the social sciences. In Goodchild, M., & Janelle, D. (Eds.), *Spatially integrated social science* (pp. 3–17). New York, NY: Oxford University Press.

Inter-University Consortium for Political and Social Research at the University of Michigan. (2011). *CrimeStat III: A spatial statistics program for the analysis of crime incident locations*. Retrieved April 27, 2011, from http://www.icpsr.umich.edu/CrimeStat/

Lindquist, P. (2009). *Incorporating intermodal transportation into the spatially integrated social sciences*. Toledo, OH: University of Toledo – University Transportation Center. Retrieved April 27, 2011, from http://www.utoledo.edu/research/ututc/docs/UTUTC_SISS__FinalReport.pdf

Logan, J., Zhang, W., & Xu, H. (2010). Applying spatial thinking in social science research. *GeoJournal*, *75*(1), 15–27. doi:10.1007/s10708-010-9343-0

Páez, A., & Scott, D. (2004). Spatial statistics for urban analysis: A review of techniques with examples. *GeoJournal*, *61*(1), 53–67. doi:10.1007/s10708-004-0877-x

Sui, D. (2004). GIS, cartography, and the ''Third Culture'': Geographic imaginations in the computer age. *The Professional Geographer*, *56*(1), 62–72.

The University of Toledo. (2009). *Spatially Integrated Social Science Ph.D. Graduate Program Handbook 2009-2010*. Toledo, OH: Author.

The University of Toledo. (2011). *Ph.D. Program in Spatially Integrated Social Science*. Toledo, OH: Author. Retrieved April 27, 2011, from http://www.utoledo.edu/llas/siss/Index.html

Voss, P. (2007). Demography as a spatial social science. *Population Research and Policy Review*, *26*(5), 457–476. doi:10.1007/s11113-007-9047-4

Weeks, J. (2004). The role of spatial analysis in demographic research. In Goodchild, M., & Janelle, D. (Eds.), *Spatially integrated social science* (pp. 381–399). New York, NY: Oxford University Press.

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