Statistics Education for Undergraduate Sociology Majors: Survey Findings across Institutions

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Abstract

The need to close the quantitative literacy gap for sociology majors is a perennial topic in discussions of undergraduate sociological training. More and better statistical education with a greater focus on active research and engaged analysis is recommended by the major disciplinary association, as well as virtually all pedagogical agencies. This project explores these differences in the implementation of these recommendations, employing a survey (n=90) to report on the structure of quantitative training for undergraduates majoring in sociology. It finds that the type and extent of this education available to, and required for, sociology majors varies widely across not only institutions but by type of institutional context. The pedagogical resources and tools employed also vary widely. It explores the curricular elements that departments view as the strengths and weaknesses of their quantitative programs in terms of perceived student outcomes and competencies.

Keywords

Statistics Education, Sociology, Quantitative Social Sciences

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Cover Page Footnote

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Introduction

Teaching statistics to undergraduate majors is crucial to closing the quantitative literacy gap – an identified problem in sociology education (Howery and Rodriguez 2006; Wilder 2009). Scholars have conducted extensive research on the best way to accomplish the task, investigating the ways in which social science students learn statistics and the obstacles that make their learning more challenging (Finkelstein 1994; Forte 1995; Bridges et al. 1998; Paxton 2006; Yamarik 2007; Hulsizer and Woolf 2009; Millis 2012). In addition to this research, the American Sociological Association has developed guidelines on goals and best practices for its teaching (Howery and Rodriguez 2006) and has issued a series of recommendations regarding where statistics training should fall in the departmental curriculum (McKinney et al. 2004). Despite this disciplinary interest in statistics education at the undergraduate level, there is little information regarding what is actually being implemented by instructors, departments, and institutions. This paper uses survey data to explore how statistics curricula in sociology departments are structured, what courses are offered, what pedagogical practices are incorporated, and how successful sociologists believe themselves to be in fulfilling this important mandate.

Background

Teaching Statistics to Sociology Majors

Existing pedagogical research (Finkelstein 1994; Bridges et al. 1998; Howery and Rodriguez 2006) and guidelines from the American Sociological Association (Sociology Task Force 1991; McKinney et al. 2004) tell us that adequate statistics training in the sociology major is integral to preparing our graduates for their futures as citizens, scholars, and employees. *Social Statistics for a Diverse Society*, a textbook for statistics in sociology departments, reads "Statistics can help us gain insight into real-life problems that affect our lives" (Frankfort-Nachmias and Leon-Geurrero 2015, xv). Simply, as academic sociologists, we teach statistics because it matters to our students.

Yet instructors teaching statistics in sociology departments face a number of challenges, and an ASA review of sociology major curricula found insufficient statistics training early on, a lacuna they referred to as a "quantitative literacy gap" (Howery and Rodriguez 2006). The infamous "statistics anxiety" that robs students of confidence in their ability to succeed continues to plague statistics classrooms (Bridges et al. 1998; Onwuegbuzie and Wilson 2003; Van Gundy et al. 2006; Delucchi 2014). Additionally, undergraduates choosing sociology as a

major may have less prior mathematical preparation and, to some degree, may self-select into the major because they perceive it requires fewer quantitative skills (Wilder 2009). At its most dire, this anxiety can develop into a larger antipathy towards quantitative methods: "[A] majority of students fear and loathe the required statistics course. Students often postpone taking the course as long as possible and experience anger and anxiety during the class" (Paxton 2006, 65).

Pedagogical Tools Employed at Undergraduate Level

In order to overcome these challenges, sociology instructors and departments have incorporated a variety of strategies and resources to improve student learning. Scholars have developed a significant literature detailing methods of reducing statistics anxiety, engaging students, and improving the teaching of statistics. Here, this literature is distilled.

The incorporation of undergraduate research activities into quantitative coursework is crucial to making statistics training relevant to the development of undergraduate students generally (Hardin et al. 2015) and sociology majors specifically (Howery and Rodriguez 2006). Insofar as students can learn statistics by engaging with relevant research questions that build on other sociological coursework, they will be more likely to experience statistics as an indispensable tool of sociological learning (Howery and Rodriguez 2006; Strangfeld 2013). Student collaboration in group settings may also offer the validation and mutual support many undergraduates need to succeed in what can be an intimidating course – especially in the context of large classroom settings (Longmore, Dunn and Jarboe 1996). The act of teaching can serve to reinforce learning (Winquist and Carlson 2014), so these types of informal peer cooperation arrangements appear to buttress lecture-based instruction (Garfield 1993; Yamarik 2007).

Researchers have also worked to ascertain the potential of both technological and traditional pedagogical resources to enhance student outcomes. Van Gundy et al. (2006) investigate the utility of web-based technological resources in reducing student anxiety and improving student learning. They find mixed results – with students becoming more confident but not necessarily more capable, with the addition of these resources (Van Gundy, et al. 2006). The importance of statistics software packages in facilitating student learning cannot be overstated in the extant literature (Smith 2003; Hulsizer and Woolf 2009; Šebjan and Tominc 2015). Similarly, employing an appropriate and well-integrated textbook, whether print or electronic, is integral to improving student outcomes (Forte 1995; Symanzik 2006).

Variety between Classes, Departments, and Institutions

Building on the 2004 ASA report delineating a series of recommendations for the form and structure of undergraduate sociology majors across institutions

(McKinney et al. 2004), the research reported here assumes that departments seek to meaningfully and effectively integrate statistics training into the undergraduate curriculum. Although best practices are adopted unevenly across institutions, departments have goals for the major that largely conform to disciplinary standards (Sweet et al. 2014). This project seeks to illuminate differences in departmental curricula in both the incorporation of statistics methods and adoption of selected best pedagogical practices – while gauging departmental satisfaction with learning outcomes of their existing programs.

This Study

Using the existing literature on departmental curricular models for the undergraduate major, this paper first seeks to describe the statistics requirements for graduating with a BA in sociology across U.S. institutions. It then explores what courses are offered to majors, and in what setting those courses are offered. Anchoring investigation in existing research on best practices for teaching statistics, the paper details the resources employed in introductory-level statistics coursework. The paper then engages with the two central research questions:

1. What are the programmatic and curricular elements of departments that are most confident in the success of their programs?

2. Beyond elements mentioned in the existing literature, are there recurring concerns and successes in undergraduate statistics training in sociology departments?

Data Methodology

In order to explore these research questions, a survey invitation was distributed via email link to Sociology Department Chairs of the *U.S. News and World Report* highest-ranking 200 National Universities, 50 Liberal Arts Colleges, and 25 Regional Universities in each of the four regions of the United States. A web link was also posted on two Facebook websites devoted to sociological pedagogical methods and practice. Facebook invitations yielded 14 valid survey responses, while email links yielded 76 responses (n=90). Determining the response rates for the open Facebook invitations is not possible, but 26% of email invitations yielded a response – introducing the likelihood that survey responses are biased towards departments most concerned with statistics education.

Department chairs receiving invitation emails had the option to complete surveys themselves or forward them to other members of the department who were familiar with the social statistics curriculum. Chairs completed 48 surveys, or just over 53%, while 25 of the respondents were statistics instructors, and 17 were other department members. There was no significant relationship between respondent title and subjective responses to survey questions (r = –0.028, p =

0.671) – although this does not preclude the possibility that different positions of respondents affected survey results in other ways. Data collection occurred during June and July of 2016. All surveys considered required an institutional email address, and respondents were informed that addresses would be used to classify institutional and departmental context. Institutions were categorized using *U.S. News and World Report* categories: National University, Liberal Arts College, and Regional University (U.S. News Education 2015). *U.S. News and World Report* ranking measures were also added to the dataset in order to proxy the preparedness of undergraduates entering institutional sociology programs (Winston 2000). Data regarding whether sociology is taught in a dedicated or merged department were also appended.

Surveys were approved by the Institutional Review Board at Emory University prior to distribution. Respondents were required to give their informed consent to participate in the study. Survey respondents were given reports detailing aggregated survey results in consideration of their participation.

The Survey Instrument

The survey collected information about the respondent, including institutional email address and department position. It then requested the number of undergraduate majors in the department, a proxy of department size that is not publicly available. The survey is then divided into three major parts – curriculum, perceptions of outcomes, and open-ended responses.

The first part, on the curriculum, started with questions about a) the number of statistics courses required for the major, b) whether the introductory statistics class was taught in the department, c) whether statistics were taught in a research methods class, and d) the advanced statistics course offerings available to department sociology majors. It then explored pedagogical practices in the departmental Introduction to Statistics classes. Respondents were asked to choose which of the following undergraduate research activities were incorporated in introductory statistics coursework: a) survey design, b) original data collection, c) secondary data source identification, d) secondary data analysis, e) research proposal writing, f) research presentation, and g) original research paper. Next, respondents identified which activities and tools were incorporated in addition to traditional lecture: a) group work, b) discussion sections, and c) lab work. They were asked about the materials incorporated in statistics classes, i.e., the type of textbook adopted – whether open-source or traditionally published, whether specific to sociology classrooms or cross-disciplinarily applicable – and what auxiliary materials are required. A variety of software options are available to facilitate the teaching of statistics, and respondents detail which of these programs, if any, are taught to department students: a) R, b) Stata, c) SPSS, d) SAS, e) Minitab, or f) Excel.

In the second part of the survey, about perceptions of student outcomes, the respondents are asked to choose the proportion of graduating students with various levels of statistical literacy on an ordinal scale with either a small minority (fewer than 1%), a minority (approximately 25%), about half, a majority (approximately 75%) and an overwhelming majority (greater than 99%) of department graduates able to understand statistics at a low, medium, or high level – as "routinely presented in a newspaper like the *New York Times* or *Washington Post*," "up to and including bivariate correlations and OLS regression," and "more complex than OLS regression," respectively. The survey subsequently asks the same question in reference to the production (rather than the consumption) of statistics at each level. Respondents are then asked to estimate, using the same ordinal scale of minority/majority, the proportion of graduates who continue to suffer from "statistics anxiety." Respondents answered two additional questions using this scale: a) the proportion of graduates who could be effective as entry-level data analysts in the private sector, and b) the proportion of graduates who were prepared to enter graduate sociology programs.

Finally, in the third part of the survey, respondents were asked to use their own words to "describe the strengths of the statistics education in [their] department[s]." The subsequent question asked for weaknesses. These were open-ended responses with no word or character limit, and respondents were able to share sources of pride as well as areas of concern.

Methods of Analysis

Data analysis was first completed on quantitative data. All continuous and ordinal data were first described, and cross-tabulations were created by institutional type to better describe how data varied across contexts. Bivariate correlations were then completed to better isolate departmental characteristics associated with significantly improved student outcomes as measured in the survey instrument. In order to gain a more nuanced understanding of the findings, qualitative analysis of open-ended responses was conducted. By coding these responses for major themes, this paper presents relevant quotations from respondents that are representative of the study's response set.

Descriptive Research Findings

Surveys found what the extant literature posits: some statistics training is a common element of undergraduate sociological education in U.S. universities (Howery and Rodriguez 2006; Strangfeld 2013; Delucchi 2014). Responses detailed a great variety of course offerings, activities, methods and tools across institutions and institutional types. Table 1 presents the distribution of survey responses, broken down by institution type.

Table 1.
Statistics Training across Institutional Contexts

	Liberal Arts Colleges		National Universities		Regional Universities		Total	
Number of Required Statistics Courses								
0	6	*38%*	9	*19%*	9	*35%*	24	*27%*
1	9	*56%*	37	*77%*	14	*54%*	60	*67%*
More than 1	1	*6%*	2	*4%*	3	*12%*	6	*7%*
Courses Available								
Survey Methods	11	*69%*	32	*67%*	16	*62%*	59	*66%*
Advanced Linear Regression	2	*13%*	21	*44%*	6	*23%*	29	*32%*
Probit and Logit Models	2	*13%*	14	*29%*	1	*4%*	17	*19%*
Big Data	4	*25%*	8	*17%*	2	*8%*	14	*16%*
Other Advanced Statistical Methods	3	*19%*	6	*13%*	3	*12%*	12	*13%*
Structural Equation Models	-	*0%*	8	*17%*	-	*0%*	8	*9%*
N	16		48		26		90	

In just over one in four institutions surveyed, there is no statistics course requirement in the BA course major. The presence of the requirement varies considerably based on institutional type. While only 19% of respondents from schools categorized as "National Universities" by *U.S. News and World Report* have no statistics requirement, six of the 16 respondents from Liberal Arts Colleges − or 38% − reported having no such requirement. Meanwhile, 12% of responding representatives from Regional Universities were from departments in which more than one class was required.

Where introductory-level statistics courses are offered to undergraduates in the sociology major, they are generally offered within the sociology department and integrated into the sociological curriculum in accordance with ASA recommendations (McKinney et al. 2004). In 66% of responding institutions, departments taught this course themselves, while 5% of institutions had an intra-departmental center or institute devoted to teaching statistics to undergraduates across majors and the remaining 29% of departments depended on courses offered in other disciplines. There was no clear variation in these distributions by institutional type.

A variety of more advanced statistics coursework is available in departments − a consideration that is not explored in the current literature regarding teaching statistics. Table 1 also details the percentage of departments offering each particular type of statistics methodological training − not necessarily an entire course solely devoted to the method − in order of descending popularity. Besides some variation of "Survey Methods," no instruction in a single type of method is offered at the majority of institutions surveyed. Indeed, there is considerable variety in course offerings between institutions and institutional type − with much of this variety seemingly driven by faculty specializations.

Existing literature suggests that the pedagogical practices employed in statistics training are critical to the learning outcomes of students. Elements of statistics courses such as incorporation of undergraduate research activities, statistics software, textbooks, labs, and class activities differed greatly among survey respondents. These practices are detailed in Table 2. Liberal arts colleges consistently and significantly lead in the incorporation of undergraduate research activities, while research and national universities do so to a lesser extent.

Table 2.
Statistics Pedagogical Practices across Institutional Contexts

	Liberal Arts Colleges		National Universities		Regional Universities		Total	
Research Activities								
Survey Design	6	*38%*	7	*15%*	5	*19%*	18	*20%*
Original Data Collection	4	*25%*	6	*13%*	4	*15%*	76	*84%*
Secondary Data Identification	7	*44%*	13	*27%*	11	*42%*	31	*34%*
Data Analysis	8	*50%*	25	*52%*	13	*50%*	46	*51%*
Research Proposal	5	*31%*	5	*10%*	1	*4%*	11	*12%*
Research Presentation	3	*19%*	8	*17%*	5	*19%*	16	*18%*
Original Research Paper	5	*31%*	6	*13%*	6	*23%*	7	*19%*
Pedagogical Tools								
Group Work	3	*19%*	13	*27%*	10	*38%*	26	*29%*
Peer Teaching	2	*13%*	4	*8%*	3	*12%*	9	*10%*
Discussion Sections	1	*6%*	8	*17%*	4	*15%*	13	*14%*
Lab Work	9	*56%*	20	*42%*	12	*46%*	41	*46%*
Textbooks								
Publisher Statistics Text	2	*13%*	8	*17%*	-	*0%*	10	*11%*
Publisher Statistics Text for Social Science	7	*44%*	23	*48%*	13	*50%*	43	*48%*
Open Source Text	-	*0%*	3	*6%*	3	*12%*	6	*7%*
eBook	-	*0%*	4	*8%*	1	*4%*	5	*6%*
Guidebook for Statistics Software	3	*19%*	12	*25%*	4	*15%*	19	*21%*
Online Exercises	3	*19%*	6	*13%*	1	*4%*	10	*11%*
Videos	1	*6%*	3	*6%*	4	*15%*	8	*9%*
Software								
R	1	*6%*	3	*6%*	2	*8%*	6	*7%*
STATA	4	*25%*	11	*23%*	1	*4%*	16	*18%*
SPSS	4	*25%*	22	*46%*	13	*50%*	39	*43%*
SAS	-	*0%*	1	*2%*	-	*0%*	1	*1%*
MiniTab	-	*0%*	-	*0%*	-	*0%*	-	*0%*
Excel	3	*19%*	6	*13%*	3	*12%*	12	*13%*
N	16		48		26		90	

Different pedagogical methods and activities were incorporated in different institutions. Lab work was the most common across contexts, with nearly one half of respondents reporting that students spent time in labs working with statistics software packages. Group work and discussion sections were employed in a significant minority of cases. Discussion sections were in place only in one liberal arts college surveyed – a notable comparative absence in this institutional type

that may be the result of a lack of graduate teaching assistants to lead these sections. Peer teaching, the utility of which is demonstrated in existing pedagogical research (Garfield 1993; Millis 2012), is in place in only 10% of institutions surveyed. Instructors and institutions also vary in their inclusion of textbooks, software, and other resources. Most sociology departments use textbooks to anchor statistics learning, and nearly half of all departments use a textbook developed specifically for the social science students. Of departments teaching statistics, 82% require their students to analyze data using a statistics software program. SPSS is the most popular, with STATA and Excel being used in approximately 18% and 13% of departments, respectively. Minitab, a program widely used the natural sciences (Stephens 2014) and engineering (Maat 2015), was not used in any surveyed sociology departments. Of the 18 positive responses to the use of technological resources, two departments employed both videos posted online – helpful in flipping a classroom – and online exercises completed outside of the classroom, while 14 used either one or the other.

Respondents were asked to estimate the statistics competencies of their graduating majors – those students who had completed the full curriculum required by the department. Overall, there was great variation in estimates of program efficacy in improving student capabilities. Open-ended responses reflected these dissimilarities, with statements that range from "[course(s)] not taught in a way that convey(s) how to apply statistics," "too basic to be useful," and "only the strongest students can translate the material from the math course into the context of social research" to "students learn by doing," "[students] have the skills to land a decent job," and "useful to those who will go into data analysis positions and grad school but also general enough to be of use to any graduating student."

In order to quantify this variation, the survey requests that respondents estimate the proportion of graduating sociology majors who can understand and create statistics at low, medium and high levels of competence. Respondents were then asked to estimate the proportion of graduates who had the particular level of competence – choosing from a small minority (fewer than 1%), a minority (approximately 25%), about half, a majority (approximately 75%) and an overwhelming majority (greater than 99%). Responses to these questions were highly inter-reliable, with a Cronbach's Alpha of 0.919. Given this, a simple aggregate scale of statistical competence was created, with each institution's responses distilled into a single measure that ranges from a low of 6 (reports that fewer than 1% of graduating students can understand or compile statistics at any level) to a high of 30 (reports that over 99% of graduating students can understand and compile statistics at all levels). Table 3 outlines the categorical distribution of this continuous scale.

Table 3.
Competency Scale Distribution

		Liberal Arts Colleges		National Universities		Regional Universities		Total	
0-12	Small minority of students have competence at any level	0	0%	6	13%	8	31%	14	16%
13-17	Approximately 25%-50% of students competent across levels	9	56%	19	40%	6	23%	34	38%
18-30	Greater than 50% of students competent across levels	5	31%	17	35%	7	27%	29	32%
	Respondent doesn't know	2	13%	6	13%	5	19%	13	14%
Total		16	100%	48	100%	26	100%	90	100%

Some respondents cited undergraduate aptitude as contributing significantly to the strength or weakness of their programs in open-ended responses – "some students are really underprepared for the level of stats in our course," for example, or "our majors score[d] [highly in] the national ETS." The possibility that competence at graduation could be inextricably related to preparation at commencement as proxied by institutional selectivity has precedence in the extant literature (Winston 2000). Survey responses do not bear this assertion out, however, as the quantitative measures of student competence were not significantly associated with institutional rank.[1] That is, respondents from institutions with more competitive admissions processes did not rank their graduates as more statistically capable than did those from less-highly ranked universities.

Central Research Findings

The paper seeks to address the two central research questions:

1. What are the programmatic and curricular elements of departments that are most confident in the success of their programs?

2. Beyond elements mentioned in the existing literature, are there recurring concerns and successes in undergraduate statistics training in sociology departments?

The section below explores the ways in which survey findings work to close these two gaps. The relationships suggested by survey results are described and evaluated using measures of Spearman's "Rho" Rank Coefficients (denoted r) to establish the significance of positive and negative correlations,[2] appropriate

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[1] Spearman's "Rho" Rank Coefficient = –0.066, $p<0.536$
[2] Spearman's "Rho" Rank Coefficients of between 0 and 0.29 are classified as weak correlations, between 0.30 and 0.69 as moderate, and between 0.70 and 1.0 as strong. All correlations denoted significant meet the $p<0.50$ cut-off.

because the measure of student competence is a variable measured ordinally. These correlations are not presented as having causal relationships, but rather to illustrate components of statistics training programs shared by departments confident in their outcomes. Additionally, to minimize the risk of reifying associations in a small-*n* study, the strength and significance of coefficients are discussed in narrative, rather than tabular, form. These survey findings are suggestive, not definitive, of departmental realities.

Program Elements Associated with Student Competency

Using the scale measure of student competence as a proxy for institutional confidence in undergraduate statistics training, survey findings suggest a number of program elements may be positively associated with respondent perception of undergraduate competence. Teaching introductory-level statistics in the department is weakly positively correlated with reported statistics competence of graduating majors ($r=0.216$, $p<0.042$). This finding also conforms to what respondents without an internal statistics course believe would benefit their students: "students would prefer to have statistics as a sociology course," or "[s]tudents would benefit from greater depth – a stand-alone statistics/data analysis class." Similarly, and surprisingly given the dearth of information regarding this question in the extant literature, the greater the number of courses required, the greater the perception of student capability ($r=0.359$, $p<0.001$). Offering dedicated classes in survey methods is moderately correlated with perceived better outcomes ($r=0.346$, $p=0.001$). Though other classes have positive relationships with competence, these relationships do not meet the significance threshold.

As the literature posits, incorporating elements of undergraduate research into introductory-level statistics coursework improves respondent perceptions of undergraduate outcomes. Indeed, the use of secondary data identification ($r=0.322$, $p=0.002$) and analysis ($r=0.362$, $p<0.001$), and research paper authoring ($r=0.308$, $p=0.001$) are all moderately strongly associated with a greater proportion of undergraduate majors ascending in estimation of statistics competence. The inclusion of original data collection ($r=0.244$, $p=0.021$), research proposal creation ($r=0.213$, $p=0.045$), and a requirement to present original research pursued in the class ($r=0.261$, $p=0.013$) are also weakly associated with respondent perception of undergraduate statistics competence. Of the undergraduate research activities surveyed, only survey creation ($r=0.205$, $p=0.053$) has no significant positive effect at the $p<0.05$ level. Open-ended responses reflected a belief in undergraduate research activities as crucial strengths in overall departmental programs and individual classes. Speaking to curricular strengths, respondents noted "semester-long project(s) with real data

sets," "hands-on survey project(s)," and "work with real data sets, [allowing students to] learn by doing."

Using a textbook may be correlated with an increase in the reported proportion of graduating majors estimated to be competent in statistics, with the use of textbooks anchored in general mathematics ($r=0.343$, $p=0.001$) associated more strongly with improved outcomes than the use of those made specifically for social science classrooms ($r=0.213$, $p=0.045$). Open-source textbook use is not significantly correlated to the outcome measure ($r=0.101$, $p=0.348$). Despite these significant quantitative relationships, no respondent mentioned textbooks in open-ended responses.

While auxiliary technological resources, operationalized in this survey as use of online exercises and videos, have no significant correlation with competency outcomes, the type of software chosen for data analysis and lab work may. Using SPSS in the classroom is significantly weakly associated with more positive outcomes ($r=0.216$, $p=0.042$), while other programs have insignificant positive correlations and SAS has an insignificantly negative relationship ($r = -0.058$, $p=0.587$) with improved competency results. Importantly, SPSS is also the only statistics program mentioned specifically by open-ended responses – two of which cite the use of SPSS as a program strength.

To some extent, the incorporation of pedagogical activities associated with active learning appears to improve student competence as operationalized in this paper. Incorporating group work is moderately associated with improved outcomes ($r=0.391$, $p<0.001$), as is the incorporation of lab work ($r=0.340$, $p=0.001$) – but neither peer teaching nor discussion sections are significantly correlated with outcomes. Similar to textbook adoption, which had a relatively large quantitative relationship with outcomes but was given little thought or credit, the incorporation of these pedagogical techniques was not noted in open-ended responses.

Program Elements Associated with Student Confidence

Respondents were also asked to estimate the proportion of department graduates who, after completing the statistics training requirements, still experience statistics anxiety. Table 4 details the distribution of responses. Although institutional type is not significantly correlated with statistics anxiety, 82% of respondents from liberal arts colleges said that half or more graduates continued to experience it, while only 61% and 58% of respondents from national and regional universities, respectively, estimate proportions this high. The number of majors in a department was not correlated with enduring statistics anxiety.

The issue of statistics anxiety appeared explicitly in only two open-ended responses regarding departments' perceived strengths and weaknesses, but issues of student fear, frustration, and resultant lack of motivation appear in multiple

accounts of program weakness. One programmatic weakness often referred to is "[C]onvincing students of the excitement, utility, and marketability of statistics skills," as is "overcoming the stats anxiety is something we are working on." Some respondents expressed frustration with the results of anxiety: "Students mostly don't care. Many are convinced they can't do math. Many simply don't want to invest the minimal effort needed to get something out of the course."

Table 4.
Percentage of Graduates and Statistics Anxiety

Percentage	Liberal Arts Colleges		National Universities		Regional Universities		Total	
<1%	0	0%	0	0%	0	0%	0	0%
25%	2	13%	12	25%	6	23%	20	22%
50%	7	44%	21	44%	6	23%	34	38%
75%	6	38%	7	15%	8	31%	21	23%
>99%	0	0%	1	2%	1	4%	2	2%
Doesn't Know	1	6%	7	15%	5	19%	13	14%
Total	16	100%	48	100%	26	100%	90	100%

Despite the existing literature positing the importance of varying program and curricular components, this survey yielded few significant correlations between program or curricular elements and proportions of students graduating with statistics anxiety. Notable is that teaching Introduction to Statistics in the Sociology Department is moderately associated with lessened reported statistics anxiety among graduates ($r=-0.392$, $p<0.001$). Higher degrees of competence were not significantly correlated with higher proportions of students with enduring statistics anxiety ($r=0.171$, $p=0.110$). This lack of significant correlation fails to confirm theories that anxiety leads to diminished outcomes for students.

Other Recurring Concerns and Successes

In sections of the survey devoted to open-ended responses, the most common theme expressed was one largely unexplored in the existing literature regarding teaching statistics in sociology programs: the diversity of statistics coursework available to undergraduates. Twenty-two respondents mentioned the question of course offerings, whether as a source of departmental strength or weakness, in their completed surveys. Respondents indicated insufficient resources were responsible for weak departmental offerings, saying "We are extremely short-handed, which limits the number of courses we can offer" or "Staffing issues mean we cannot make statistics required," – issues which they saw as weakening the departmental major overall. Alternatively, they cited lack of student demand as recursively driving insufficient course diversity: "Most of our soc[iology] majors actively avoid quant[itative] classes... Those students that are drawn to quant[itative] methods often are frustrated at classes getting canceled due to low enrollments." On the other hand, departments whose students had access to a

comparative breadth of course offerings had respondents mentioning this breadth as a source of strength in the undergraduate major.

Moving beyond statistics, respondents describe success in "[t]raining in Data Analytics, Urban Informatics, GIS, etc[.] that students benefit from," "training in several quantitative methods besides statistics… so that students can receive customized training" and "constant evol[ution] to account for new ways of gathering and interpreting data." Departments in which statistics training is considered an integral part of a robust and versatile quantitative methods program viewed this broader orientation as a strength. Conversely, respondents who felt their department programs were not well integrated across methods expressed this as a weakness – though fewer mentions were made of this than were made of the reverse as a strength.

Discussion

These findings are useful in several ways, recalling that all findings presented and discussed here should be understood as suggestive rather than definitive. Although this discussion should be considered only a part of a more robust, empirically anchored conversation about the variety and efficacy of statistics education in sociology departments, associations are provocative. These associations are discussed in the following section.

Smaller departments are less likely to have dedicated statistics courses, and the existence of these courses is helpful to maximizing student outcomes – meaning that departments with fewer resources may be more likely to struggle to provide their students with the infrastructure that helps them to succeed in statistics. Open-ended responses imply that disparities in requirements and offerings may be driven by differences in institutional size. Although respondents suggest limitations in course offerings are driven by a lack of staffing resources, those from liberal arts colleges cite these limitations as influencing the availability of the introductory-level course specifically. This observation is confirmed by analysis of the mean number of undergraduate majors in departments of varying requirements. Respondents from departments requiring more than one statistics class had a mean of 430 majors, while those requiring one class had 141 majors and those requiring no statistics classes for the undergraduate degree had a mean of 82 majors – suggesting smaller departments do have lower expectations in terms of undergraduate statistics instruction.

The ability to access common resources through course-sharing or the creation of consortia has the potential to meet a significant need in these departments. Though only a small minority of survey respondents (5%) had access to these types of organizational structures for the teaching of statistics, an increase in their popularity could prove transformative for smaller departments. This impact is especially likely given the extent to which respondents cited the

availability of advanced statistics and quantitative methodological courses as crucial strengths in undergraduate learning programs.

Another important survey finding is that undergraduate research activities are significantly associated with better student outcomes; this finding confirms the arguments in the existing literature that posit these activities to be an integral part of successful statistics pedagogy. Yet only a minority of introductory-level statistics programs incorporate these activities. Given the confirmatory finding from this survey, further research should investigate the obstacles to adopting research activities as part of the pedagogy. Although this survey did not explore the question, there are a number of possibilities that could explain the disjunction: a lack of institutional support for undergraduate research; the employment of part-time faculty to teach statistics when these faculty members are not adequately integrated into to the research life of the department; or perhaps a general lack of cohesion between statistics training and sociological empirics. Insofar as the adoption of research-anchored pedagogical tools is time-consuming for faculty, future research may work to identify those institutional policies that make faculty most willing to make this investment.

Information about the relationship between statistics anxiety and student competency is always provocative. The lack of significant correlation between the two may suggest that "[a]lthough reducing student anxiety has its place in statistics courses, it should not be an end in itself. Instead, a primary goal of sociological statistics should be to develop the research skills necessary to be an effective practitioner of sociology" (Strangfeld 2013:200). This possibility calls into question the characterization of statistics anxiety as inherently bad - perhaps the phenomenon may be better understood as a normal accompaniment to intellectual growth.

Conclusion

Statistics represents one of the fundamental skills of the undergraduate sociology major, and one of the most crucial pedagogical challenges of the sociology department (McKinney et al. 2004; Howery and Rodriguez 2006). This paper has presented the results of a survey (*n*=90) of respondents in sociology departments in U.S. national universities, liberal arts colleges, and regional universities. Both descriptive and inferential statistics present opportunities for sociology departments and instructors to refine statistics education for undergraduates.

Findings suggest that there is abundant room for growth in terms of greater incorporation of established best practices for teaching statistics, as well as serious structural obstacles to their successful implementation in terms of funding and resources. When possible, undergraduate sociology majors should be introduced to statistics in the sociology department. When resources make this

impossible, collaborative efforts in interdepartmental centers should be pursued as a superior option to turning over statistics education to other departments. The incorporation of undergraduate research activities into the statistics curriculum is also important. By requiring students to find and analyze their own data, to learn statistics through their application in sociological inquiry, instructors and departments maximize student competence. Providing the institutional resources to make research activities possible should be prioritized to better quantitative literacy and outcomes in sociology undergraduates.

Measurements of student competence and anxiety in this study are limited to the perceptions of department chairs and statistics instructors. Although other research methods beyond the scope of this paper would yield more definitive findings regarding efficacy – methods including pre- and post-testing or use of academic performance measures (Delucchi 2014), for example – these results do speak to the confidence respondents have in their programs and the abilities of their graduating majors. This paper thus contributes to the difficult and extensive work of closing the knowledge gap of the state of statistics education for undergraduates in sociology, though it is by no means the definitive answer to enduring questions.

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