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Promises and Challenges of Teaching Statistical Reasoning to Journalism Undergraduates: Twin Surveys of Department Heads, 1997 and 2008

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PROMISES AND CHALLENGES OF TEACHING STATISTICAL REASONING TO JOURNALISM UNDERGRADUATES

TWIN SURVEYS OF DEPARTMENT HEADS, 1997 AND 2008

Robert J. Griffin & Sharon Dunwoody

This research is dedicated to the memory of Victor Cohn, former science reporter for the *Washington Post* and often considered the dean of science writers, who collaborated on the first wave of the survey. The 1997 survey was supported by a grant from the American Statistical Association and the 2008 survey by a grant from the Communication graduate program at Marquette University. Special thanks to research assistants Kathryn Zabriskie and Gongke Li for their valuable help in the survey. The analyses and conclusions are solely those of the authors.

WHAT IS STATISTICAL REASONING?

Statistical reasoning is not the same as doing statistical calculations. While definitions of *statistical reasoning* abound in the mathematics and education literature, fundamentally, Garfield and Gal observe (1999) it is "the way people reason with statistical ideas and make sense of statistical information" (207). Garfield (2002) explains that statistical reasoning:

> ...involves making interpretations based on sets of data, graphical representations, and statistical summaries. Much of statistical reasoning combines ideas about data and chance, which leads to making inferences and interpreting statistical results. Underlying this reasoning is a conceptual understanding of important ideas, such as distribution, center, spread, association, uncertainty, randomness, and sampling. (Under "What is statistical reasoning?")

Gigerenzer et al. (2008) argue that all citizens should attain reasonable levels of what they term "statistical literacy," and they take journalists to task for communicating risk probabilities in ways easily misperceived by audiences. Garfield (2002) agrees on the value of these cognitive skills for "journalists and science writers, who are interested in how to best explain and critique statistical information in the media" (Under "What is statistical reasoning?").

STATISTICAL REASONING AND JOURNALISTS

The task of working and thinking with statistics, however, often seems to vex many journalists, as various commentaries and studies have indicated over the years.[1] In 1973, Philip Meyer (1973, 2002) helped to put a spotlight on this problem in his classic book *Precision Journalism* in which he sought to introduce and legitimize, to journalists and those who educate them, the correct use of social science research methods in the gathering and analysis of news. In the process, journalists were urged to add depth and accuracy to their news reports by analyzing statistical data properly and interpreting the results in a meaningful context for their audiences.

Some, but certainly not all, of the key public issues have changed since 1973. Nonetheless, much of the essential information that underlies even today's news is numerical. The economy, energy, environment, elections, health risks and health care, for example, all require reporters to handle statistics adeptly. "Nutritional advice, technology, crime rates, other risk warnings, and weather forecasts all rely on numbers," Cohn and Cope (2001) observed. "Even when we journalists say we are dealing in facts and ideas, much of what we report is based on numbers" (3). For example, a three-month case study of a daily newspaper found that nearly half of the local news stories included mathematical calculations requiring at least some basic numerical skill on the part of the reporter. What is more, this kind of story usually

had greater prominence, tending to appear toward the front of each section (Meier 2002).

Even the top news organizations, unfortunately, can occasionally have trouble working with numbers. For example, the *New York Times* (January 16, 2007) stumbled in a page one story, based on census data, claiming that the majority of American women were living without spouses, probably for the first time in history. The problem, as investigated by *Times* Public Editor Byron Calame (February 11, 2007), was that the reporter included 15- to 17-year-old women, most of whom live with parents, in the analysis. Without them, the "majority" aspect of the story disappeared along with its page-one worthiness, according to Calame (February 11, 2007), who did some simple statistical sleuthing of his own. The reporter's mathematical calculations were not in question, but his assumptions and reasoning were. Afterward, the *Times* created a vetting network of staffers with expertise in demographics and statistics to help edit articles that involve those subjects.

After the 2012 presidential election, in which statistician and *New York Times* blogger Nate Silver accurately predicted the outcome well in advance, *Newsweek* senior political writer Andrew Romano (November 19, 2012) criticized journalism for relying too much on pundit quips, pageantry, and gut feelings in pre-election coverage, and not enough on what social science research and valid, independent political polling data were revealing about the election and the campaign process. Stated Romano:

> In recent years, social-science experiments and data-mining operations have quietly transformed the 21st-century campaign. But campaign reporting hasn't kept up. ...None of which is to say our blow-dried anchors and bigfoot correspondents will disembark the plane, at least anytime soon. And there will always be room for rich narratives and character studies. But maybe, in 2016, the smartest reporters and pundits will realize that Nate Silver & Co. have disrupted the Who Will Win? industry.... Maybe they'll become more quantlike – more data-driven and policy-oriented – in the process. And maybe they'll attract more readers and viewers because of it. I'd say the odds are pretty good" (24).

In many cases, however, journalists have successfully applied sophisticated statistical reasoning to investigations of social issues. They let advanced statistical software handle the drudgery of computation so

that they can uncover patterns and trends amidst an otherwise hopeless flurry of intertwined variables.

For example, reporters Keegan Kyle, Grant Smith, and Ben Poston of the *Milwaukee Journal Sentinel* (August 31, 2008) investigated whether the city took longer to repair potholes in minority areas, as some citizens had complained. Rather than rely only on anecdotes and he-said-she-said assertions, they retrieved relevant data on street repairs from the city database, which they analyzed in part with mapping software, and gathered other essential demographic data, including minority population, population density, and median income in the various census tracts. They then used multiple linear regressions to investigate which factors, if any, corresponded with the amount of time it took to do repairs in more than 11,000 pothole locations. They found that minority population accounted for a significant lag in street repair times, much more so than median income and population density.[2] This kind of analysis, as Meyer (1991) explained in *The New Precision Journalism*, involves "searches for implied causation, for patterns that suggest that different phenomena vary together for interesting reasons" (8).

"We can be better reporters and better citizens," Cohn and Cope (2001) observed, "if we understand how the best statisticians – and best figurers – think ... And a welcome surprise: You can do it without any heavy-lifting math!" (4).

J-EDUCATION AND STATISTICAL REASONING

Arguably, journalists might learn statistical reasoning more readily in college than trying to learn it on the job. However, there may be impediments to their doing so.

In his best-selling book *Innumeracy: Mathematical Illiteracy and Its Consequences*, John Allen Paulos (1988) reflected on some of the reasons many Americans misuse numbers and avoid math: "Poor education, psychological blocks, and romantic misconceptions about the nature of mathematics" (98). Among the key psychological impediments he listed was math anxiety, which has been studied extensively in the educational literature and which probably affects journalism students at least as much as it does others. Math anxiety is related to poor math performance, negative attitudes toward the subject, and avoidance of it (Humbree 2000).

Another, and perhaps more basic, factor that could affect how journalism students might encounter statistical reasoning instruction is their mathematical ability. But that causal chain is hard to validate. "Here is a myth: Journalism is a career for those with math deficiencies," said Becker and Graf (1994) in *Myths and Trends: What the Real Numbers Say about Journalism Education* (11). They examined five-years of Scholastic Aptitude Test data (1989-1993) and found that high school seniors intending to major in journalism indeed scored, on average, considerably above the national mean for all college-bound seniors on the verbal part of the test. Surprisingly, however, the students were not math dummies. They also scored at the national average in their quantitative SAT scores. More recent data (2001-2005), gathered from the College Board, revealed essentially the same results, as shown in Table 1.[3]

Presumably, students attracted to journalism in college should be able to handle at least basic instruction in statistics and statistical reasoning as well as do other college undergraduates. The students, however, might need help working through math anxiety.

PEDAGOGICAL CHANGE OVER TIME

Although we have no evidence on behalf of an increase in critiques of journalistic handling of statistical information over time, there is no question that journalism has experienced a sustained period of critique in the past decade or so, primarily from the scientific and health establishments. Calls for an educational focus on statistics and reasoning have reverberated across universities during this period (Steen 2002), leading a number of universities to institute courses and other training regimens (Steen 2007). Journalism education accreditation standards are somewhat measured on the topic, with only a single phrase "apply basic numerical and statistical concepts" listed among the professional competencies expected of journalism majors (ACEJMC 2008).[4]

We think it fair to wonder about the extent to which journalism educators have been sensitized to the need for such training. Therefore we conducted two surveys of journalism chairs and directors, separated by a decade, to explore that question.

RESEARCH QUESTIONS

This research project examines the various perceptions of teaching of statistical reasoning held by journalism department heads[5] as well as any differences between 1997 and 2008. We expected that these administrators would provide a valuable overview of the role of this instruction in their programs. Therefore, the first research question is:

> **RQ1**: How did the journalism department heads describe the state of statistical reasoning education in their programs in 1997 and in 2008, specifically in terms of (a) statistical reasoning and the journalism profession, (b) the students' willingness and ability to learn, and (c) the curriculum and faculty?

Some department heads may be more or less willing to promote the teaching of statistical reasoning by their faculty. Thus, the second research question is:

> **RQ2**: Among the journalism department heads, what variables in the survey correlate with the extent to which departments might reward faculty who incorporate statistical reasoning into their courses?

METHOD

Sampling. In 1997 and again in 2008, surveys were conducted of the administrators of a probability sample of journalism programs at colleges and universities in the United States. The programs and their administrators (e.g., department chairs) were identified from the relevant year's edition of the *Journalism and Mass Communication Directory* and the Dow Jones *Journalism Career and Scholarship Guide.* The Marquette University Institutional Review Board approved the surveys.

The 1997 survey of 219 programs (out of a population of 430) was conducted by surface mail. The response rate was 75% (n=164). The 2008 survey used the same sample of programs as the 1997 study in an attempt to make the results of the two surveys as comparable as possible despite the likely change in administrative leadership. The 2008 survey, however, used both surface mail and online procedures. Four of the programs had gone out of existence in the eleven years between the two surveys, leaving a sample of 215 in 2008. The 2008 response rate was 63% (n=135). Since only 20 respondents were the

same individuals, and since 11 years had passed in between waves, our analysis will treat respondents from the two waves as independent groups.

1997 Survey. In the 1997 survey, personalized first-contact letters containing information about the survey were sent to the sampled journalism program administrators in advance of the first questionnaire mailing in the spring. A total of three questionnaire mailings, each with personalized cover letters addressed to the administrator and with postpaid return envelopes, ensued over three months. To preserve the anonymity of the administrator, any identifying information was removed from the returned questionnaire upon receipt.

2008 Survey. In the 2008 survey, again in the spring, administrators were sent first-contact letters in advance by surface mail and by e-mail.[6] The surface mailing alerted the participants to the looming online survey and asked them to fill out an enclosed form after completing the online questionnaire, as well as to indicate whether they would like a report of the survey results. They could also ask to be sent a hard-copy questionnaire instead or state that they were not interested in participating at all. Stamped, return address envelopes were provided.

About a week after the first-contact letters were sent, the administrators were sent an e-mail with a web address link to the online questionnaire. These questionnaires were filled out anonymously but could not be completed more than once by the same individual or completed by anyone outside the sampled group of administrators. Respondents were tracked by the online survey system as well as by the returned forms. These procedures avoided linking any respondent with his or her questionnaire. In the following months, reminders were sent via surface mail (these letters again included the return forms and stamped envelopes) and e-mail (with links to the online questionnaire again provided).

After several months, the response rate was lagging behind that of the 1997 survey. Although the reasons were unknown, among possible explanations were that some of the e-mails with links to the online questionnaire had been intercepted by spam filters, that respondents had found it quite easy to set aside electronic exhortations, and that some respondents may have been cautious about the amount of time it might take to fill out the questionnaire sight unseen, even though they were told it normally took no more than 10 minutes. Therefore, in the

fall, two surface mailings were sent to administrators who had not as yet completed the questionnaire. These packets included a hard-copy questionnaire (two sides of a single sheet of paper), a stamped, return envelope for the questionnaire, and a stamped postcard to be mailed back separately. The postcard served the same purposes (e.g., tracking without associating an administrator with his or her questionnaire) as the form sent in earlier mailings.

Ultimately, of the 135 completed questionnaires, 96 (71%) were completed online and 39 (29%) on hard copy. Had we used only online questionnaires, instead of mailing the hard copy questionnaires to non-respondents later in the survey period, the overall response rate for the 2008 survey would have been 45% instead of 63%.

Questionnaire. The hard copy and online versions of the questionnaire both began with the following definition of statistical reasoning (emphases in original): In this survey we are interested in your ideas about the extent to which your undergraduate journalism students should be introduced to statistics and especially to **statistical reasoning**. By "statistical reasoning" we don't mean their ability to compute statistical tests. Instead, we mean their **ability to think systematically and reason using numerical data**, for example:

- to assess critically the quality of data;
- to apply data appropriately to problem solving;
- to understand the limits to generalizability;
- to understand probability and risk;
- to recognize when better data and information are needed for decision-making (*e.g.*, when the data provided are incomplete or not comparable), and to diagnose what information is missing.

Administrators then were asked to respond, using 5-point Likert scales, to a series of 15 statements about statistical reasoning as related to journalism education and the journalism profession (see Appendix). Other items (not shown) asked them how, if at all, they would prefer statistical reasoning to be taught to journalism students; whether any courses that teach statistical reasoning are offered, optional, or required for most or all of their journalism students; and to describe any special efforts that are being made to teach statistical reasoning to students in their programs. The questionnaire also gathered information

about the highest degree offered and the size of the program (number of faculty and number of students).[7]

ANALYSIS

The Statistical Package for the Social Sciences (SPSS) was used for the analysis. To clarify the narrative of results from the 15 Likert-scaled items (see Appendix), we combine the "strongly agree" and "agree" responses, as well as the "disagree" and "strongly disagree" responses in the text that follows. Statistical tests of relationships among variables, however, are based on the full, 5-point scales shown in the Appendix, and controlled by the size of the program, the level of degree offered and, for 2008 data, whether the questionnaire was completed on paper or online. Means in the Appendix are adjusted by these control variables.

Key partial correlations among variables will be reported if they replicate in both waves or if a significant trend is apparent (e.g., a definite weakening or strengthening of a relationship across time). To explore the second research question, multiple regression analyses were conducted within each wave, regressing Q13 (the chair's rewarding faculty who bring statistical reasoning into their classes) on the control variables and on the other 14 Likert-scaled opinion items. Other analyses are as described in text.

The margin of error for percentages (95% confidence interval) based on the 1997 survey is ±6.0% for percentages around 50%, and ±4.8% for percentages around 20% or 80%. For percentages based on the 2008 survey, the 95% CI is ±7.0% for percentages around 50% and ±5.5% for percentages around 20% or 80%. Percentages reported in text and in the Appendix are not adjusted by the control variables.

For purposes of timeliness, all quotations from respondents are taken from the 2008 survey.

RESULTS

RQ1: State of Statistical Reasoning. The first research question concerned the ways the journalism department heads described the state of statistical reasoning education in their programs in 1997 and in 2008.

The Appendix shows that, despite there being comparatively few cases in which the same individual filled out the questionnaire in both

waves, the patterns of responses are remarkably similar in 2008 as compared to 1997. There are no statistically significant differences in means across time for any of the 15 items, and even the percentage of respondents who replied using each of the five Likert scale points is typically quite similar for any given item across time. Most notably, the vast majority of administrators in each year agreed with Q1, that it is important for their journalism students to be able to reason statistically.[8]

Statistical Reasoning and the Journalism Profession. At least two-thirds of the respondents believed that statistical reasoning skills give students a competitive edge in the journalism job market (Q3). In 1997, about 67% of the administrators agreed with Q3 and, in 2008, 72% agreed. In addition, most (about 57% in each wave) disagreed with the statement (Q15) that the news media generally do a good job of interpreting statistically based information, such as polls and health risks, for their audiences. Respondents were more evenly divided when it came to agreeing, disagreeing, or feeling neutral toward Q9: The journalism profession does not reward statistical reasoning by journalists.[9]

Agreement with Q1, about the importance of statistical reasoning skills for journalism students, is much stronger among those who perceived that statistical reasoning skills give students a competitive employment edge (partial $r = .53$ in 1997, .43 in 2008, both $p \leq .001$) and somewhat stronger among those who disagreed that the news media generally do a good job of interpreting statistically based information (partial $r = -.19$ in 1997, $-.20$ in 2008, both $p < .05$).

Given the importance most administrators seem to give to their students being able to reason with statistics, and their perceptions of the benefits that this ability might have for journalism students in the job market, what challenges and opportunities might journalism programs have in delivering this instruction to their students?

Students' Willingness and Ability to Learn. This study, of course, does not directly examine the motivation that journalism students might have to engage statistical reasoning or their actual abilities to deal with probability and statistics. However, when deciding curriculum and course content, administrators and faculty alike typically take into account their own understanding, from whatever sources, of student affective and cognitive readiness to learn. Thus, these perceptions of

students by those in charge of orchestrating their learning are important focal points.

When it comes to learning statistical reasoning, more than three quarters of the administrators (78%, 79%)[10] believed that most of their journalism students would rather not do so (Q6).[11] "We worked with local professionals in print journalism and advertising to develop an Information Gathering course required of all majors," said one chair. "It included applied statistics. After one year of listening to student complaints, the faculty voted to eliminate it."

In terms of students' ability to handle statistical instruction, the plurality of administrators (48%, 42%) believed that most of their journalism students do not have the mathematical aptitude it takes to do well in the basic statistics course at their respective universities (Q4).[12] However, nearly 30% disagreed with that statement in each wave of the survey.[13]

Curriculum and Faculty. Administrators were posed a variety of items designed to tap their views of some of the key aspects of instruction in statistics and statistical reasoning for their students. Nearly two-thirds of the administrators (66%, 64%) believed that it is indeed important for their journalism students to take a basic statistics course (Q2). However, less than half (39%, 42%) thought that the statistics courses at their university met the needs of their journalism students (Q7) and, at most, only one out of four (23%, 25%) believed that their students got adequate instruction in the application of statistics to everyday problems (Q11).

How might administrators prefer to have their journalism students instructed in statistical reasoning, if at all? All were asked to indicate their one most favored option for teaching statistical reasoning to their journalism students, if given the opportunity to do so.

The results:

- The most common response (41%, 47%) was to embed statistical reasoning skills in the various courses in their departments. Indeed, when responding to Q5, about three-fourths of all respondents (74%, 77%) believed that some of this instruction should be integrated into their journalism courses. In response to Q8, however, more than half of all chairs (53%, 53%) indicated that most of their faculty would have difficulty teaching statistical reasoning as part of their journalism classes; about one in four disagreed (29%, 28%). A substantial portion of the respondents (56%, 41%) said that inclusion of statistical

reasoning in a reporting course should be left up to the instructor (Q10).[14]

Some chairs provided examples of the integration of statistical reasoning into more than one course. One chair stated that his/her program "includes survey research and statistical reasoning in upper division advanced reporting, also in an undergraduate research class and in an honors class." Another said that courses "explain stats while working on reporting methods for stat stories. We also cover basic research stats in a capstone course so students are prepared to understand stats they read [in the literature]." The administrator of one program reported that ten faculty members are making special efforts to include statistical reasoning in their courses . "All incorporate percentages as a comparative reasoning tool," the chair reported. "One teaches property tax rates. Others discuss examples of poor statistical reasoning in current news stories."

- Next to planting statistical reasoning instruction in various courses in the curriculum, the next most popular approach among the chairs (30%, 25%) would be to require students to take at least one statistical reasoning course offered elsewhere in the university. Indeed, trying to find room within a tight journalism curriculum for in-house statistical instruction (Q12) posed a problem for a good portion of all administrators (49%, 40%).
- One in five (20%,20%) would opt to have their journalism program offer a statistical reasoning course specifically designed for journalism majors.
- A handful (2%, 4%) indicated that statistical reasoning was not important enough to be a part of the curriculum, while the remainder offered a variety of other options.

Among the chairs who opted for one the first three strategies above[15], various attitudes they held toward statistical reasoning instruction were associated with their choices (Table 2):

- Those who would prefer students to get their instruction elsewhere in the university were more likely than the other chairs, who would prefer some form of in-house instruction, to say that the journalism curriculum is too tight for this internal instruction and that the university statistics courses meet their students' needs. They were a little less likely to endorse the teaching of statistical reasoning in journalism courses. They also tended to feel more strongly that their faculty would have difficulty teaching statistical reasoning in journalism

courses, at least as compared to chairs who would rather have statistical reasoning taught as part of various journalism courses.[16]

● Among the chairs who preferred to offer instruction in statistical reasoning within their own programs, those who opted to provide a dedicated course were more likely to believe that these cognitive skills give students an edge in the journalism job market but were also more likely to perceive that their students would rather not learn statistical reasoning. Chairs who preferred to embed the instruction in various journalism courses put less importance than either of the other two groups on students taking a course in basic statistics.

In the entire sample, about half the administrators (51%, 47%) reported that most or all of their journalism students were currently required take courses that include the teaching of statistical reasoning, whether offered by their program, by another unit in communication, or elsewhere in the university. A little over a third of the programs (35%, 36%) required most or all of their students to take courses such as this offered within journalism (*e.g.*, in a course such as research methods or computer assisted reporting). "We have integrated statistical reasoning into a new journalism research methods course," one chair reported. "One unit deals specifically with understanding statistics, including poll and survey data and introduction to SPSS." About one out of five (21%, 22%) offered such courses in journalism, but as electives.

"Our math and science departments created a class called Quantitative Literacy, a class that fulfills students' math requirements, targeted to the special issues of journalism, film, TV, radio, and PR students," one administrator explained. Others described similar efforts. In one case, a couple of faculty members were participating with the math and statistics department in a team-taught pilot course called "News & Numbers." In another, a chair reported "three faculty, including a journalism professor, have put forth a proposed university-wide required course in quantitative literacy, which would have a component dealing with statistical reasoning."

Some of the universities – roughly a quarter to a third – have been promoting the integration of statistical reasoning into the curriculum, based on the chairs' responses to Q14; more than 40% apparently have not. "There is a current movement afoot to require 'quantitative literacy' across the university," said one chair. "Journalism is well represented in this initiative." Another reported that they are in the first year of

a college-wide quantitative literacy program. "Our department," said the chair, "will be required to offer QL-certified courses where 20% of the graded work (or equivalent) will deal with QL." In other cases, the integration is less formal. "There is a creative thinking program here on campus," said another journalism administrator, "that links the use of statistics to virtually every discipline offered to majors. The program puts on entertaining seminars many departments incorporate into their orientation programs." More than one in four administrators (32%, 27%), when asked to agree or disagree that their university's goal is to integrate statistical reasoning into the curriculum (Q14), felt neutral toward that statement.

RQ2: Rewarding statistical reasoning instruction. A little over a quarter of the administrators (26%, 29%) said that, to the extent they can, they reward faculty who bring statistical reasoning into their classes (Q13). The second research question explored the variables from this study that might be associated with deciding to provide this encouragement.

Results from multiple regression analyses (not shown), conducted for each of the two waves separately, found that administrators' perception that their university promotes this form of instruction (Q14) was associated positively with the administrators' inclination to reward faculty for doing so (beta = .27, $p < .01$; beta = .20, $p<.05$).[17] In 2008 only, administrators who provided this encouragement were less likely to subscribe to the view (Q10) that inclusion of statistical reasoning in a reporting course should be left up to the teacher (beta = -.06, ns; beta = -.31, $p<.001$).[18]

DISCUSSION

We first explored various ways that the heads of journalism departments described their undergraduate programs' instruction in statistical reasoning in the two waves of the study, which were separated by little more than a decade. Patterns of responses were remarkably similar from one wave to the next, despite the passage of time and the fact that, for the vast majority of sampled programs, the chairs in 2008 were different individuals from those in 1997.[19] Perhaps not that much had changed over time in the teaching of statistical reasoning to journalism students.[20] Future research might investigate the ways that journalism faculty perceive the roles of statistical reasoning instruction in their programs.

Much of our analysis was descriptive, although we did also investigate relationships among key variables in the study while controlling for the potential influence of program size, level of degree offered, and whether the questionnaire was completed online or on paper.

Benefits, opportunities, and constraints. Generally speaking, the chairs' responses revealed widespread support for their undergraduates being able to reason statistically, presumably because of the benefits that these cognitive skills could bring to the students. Of course, our study could not tap into all the reasons the chairs might have for supporting such instruction. However, many chairs believed that journalism students who can reason using statistical information would have an advantage in the job market, even in 2008, an increasingly tough year economically for print journalism. (Further research, of course, might examine the extent that journalism employers see an applicant's statistical reasoning ability as value-added.) In addition, although evidence is indirect, some chairs might also believe that sending a cohort of such students into professional journalism could eventually improve media coverage of the many key public issues steeped in data and statistics.

Many of the chairs perceived several opportunities, problems, and constraints in teaching statistical reasoning. While roughly half the programs required most or all of their students to take a course that taught this material, only about one out of four believed that their students got adequate instruction in it. Among all the chairs, the most common preference for delivering this instruction, if at all, was a strategy that could be described as "statistical reasoning across the curriculum," embedding this content in various journalism courses. Otherwise, the most favored strategies were to have journalism students take a course in statistical reasoning elsewhere in the university or to have their department offer a course for journalism students dedicated to those cognitive skills.[21]

In choosing among these strategies[22], the chairs seemed to weigh their views of the benefits of this instruction against factors such as their students' willingness to learn statistical reasoning, their faculty's preparedness to teach it, and opportunities for instruction in the department and the university. From a pedagogical standpoint, many of these beliefs about statistical reasoning instruction for journalism students are worth further research.

For example, would the most popular option, embedding, be the most effective, and if so, why? Would it be the best for all students?

Among those favoring some form of in-house instruction, chairs who preferred offering a dedicated course believed more strongly that their students would rather not learn statistical reasoning. Might a dedicated course indeed be more effective for the highly reluctant, highly anxious student? Among other benefits, a dedicated course could readily offer such students special assistance. Using principles from Bandura's (2007) theory of self-efficacy, Maier and Curtin (2005) found promising evidence in a non-randomized case study that journalism graduate students who enrolled in optional sessions designed to enhance their math skills and confidence showed marked improvement in their math performance in a required quantitative research methods course.[23] The same might be true of journalism undergraduates who encounter courses requiring them to think with statistics.

Perhaps the most compelling finding was that more than 40% of the administrators in both survey waves believed that most of their journalism students lack the mathematical aptitude to do well in even a basic university statistics course. Unless their programs are attracting primarily those journalism students who fall considerably below average on their quantitative SAT tests, this may be a misperception, one that is potentially counterproductive. For example, new college freshmen entering journalism seem to have, on average, quantitative skills sufficient for a general university education that includes some basic math and statistics. Is there something in the journalism curriculum and culture that apparently allows these skills, and students' confidence in their skills, to diminish? By the time many journalists begin to work professionally, they appear to have difficulty working and reasoning with the kinds of statistical information they encounter quite commonly in covering the news, especially about key public issues.

Promoting instruction. We also wondered which factors in our study might have prompted chairs to reward faculty for bringing statistical reasoning instruction into their classes. At least a fourth of the administrators said they try to do so to the extent they can. The only variable consistently associated (i.e., in both waves of the study) with a chair encouraging instruction in this way was his or her perception that the university promotes the blending of statistical reasoning education into the curriculum. Curiously, more than a quarter of the respondents "felt neutral" (rather than agreeing or disagreeing) with the statement that their university's goal is to incorporate this instruction. These respondents might have felt that the university had taken no

stance on the matter, or had been unsure about the university's goal. Universities interested in promoting statistical reasoning instruction might make special efforts to promulgate this objective.

Stability of attitudes and beliefs. Much to our surprise, journalism chairs and directors in 2008 expressed attitudes and beliefs about statistical training that paralleled those of our administrative respondents a decade earlier. Could so little have changed in 10 years? In a world that is exquisitely responsive to reward systems, this level of stability suggests that little has indeed changed in the various landscapes that attend to and reward the behaviors of university departments and training programs. For example, although journalism accreditation standards mention numerical and statistical skills as appropriate educational focuses, it is clear that other accrediting priorities are far more important. Put another way, ignoring the challenge of making journalism majors statistically literate seems do little to affect your accreditation as a journalism unit.

Similarly, there appears to be little impetus in many universities to encourage departments and programs to develop a statistical literacy capacity. A list of quantitative literacy programs compiled by Steen (2007) characterizes the efforts of just 32 colleges and universities. Once again, a journalism chair or director is unlikely to be rewarded for venturing into that terrain.

REPRISE

In 1997 and again in 2008, the administrators we surveyed perceived many enduring challenges in educating future journalists in statistical reasoning, including what they saw as the students' desire to avoid this instruction as well as various difficulties in providing it to them. Outside of the journalism student's actual quantitative ability, he or she may be stymied by anxiety and a lack of confidence in dealing with statistical information, as various studies have shown.

Yet college journalism programs are uniquely positioned to play a critical role in providing tomorrow's journalists with the essential cognitive tools they need to encounter and critically interpret the statistical information that forms the base for a large array of news stories in contemporary society. The journalist's facility in reasoning with statistics seems all the more important given the occasional irruption of heated claims from assorted newsmakers and commentators about those public issues (e.g., the economy, unemployment, environment,

energy, health, education, voting) that can – and should be – validated with data in the public interest.

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Appendix
Percentages and adjusted means for 15 items addressing chairs' attitudes toward statistical reasoning instruction by survey wave

The following are statements that some professors and administrators have made about the teaching of statistical methods and statistical reasoning to undergraduates in journalism. Please indicate the strength of your agreement or disagreement by checking one response to the right of each one.	Wave 1997 n=164 2008 n=135	SD [1] (1) (%)	D (2) (%)	FN/ DK (3) (%)	A (4) (%)	SA (5) (%)	Adjusted Means [2]	$F_{1,293=}$
		(Scale numeric codes)						
1. It is important for our journalism students to be able to reason statistically.	1997	0.6	2.4	5.5	44.5	47.0	4.35	0.05 *ns*
	2008	0.7	1.5	6.7	41.5	49.6	4.38	
2. It is important for our journalism students to take a course in basic statistics.	1997	1.2	6.1	26.8	42.1	23.8	3.80	0.51 *ns*
	2008	2.2	15.6	18.5	42.2	21.5	3.67	
3. Statistical reasoning skills give students a competitive edge in the journalism job market.	1997	1.2	6.7	25.0	45.7	21.3	3.71	3.17 *ns*
	2008	0.7	7.4	20.0	43.7	28.1	4.00	
4. Most of our journalism students lack the mathematical aptitude required to do well in the basic statistics course at our university.	1997	2.4	26.8	23.2	29.3	18.3	3.28	0.00 *ns*
	2008	3.0	26.7	28.1	30.4	11.9	3.29	
5. Some instruction in statistical reasoning should be a part of our journalism courses.	1997	1.8	9.8	14.6	49.4	24.4	3.86	0.30 *ns*
	2008	1.5	3.7	17.8	51.9	25.2	3.95	
6. Most of our journalism students would rather not learn statistical reasoning.	1997	0.0	4.9	17.7	47.0	30.5	3.99	0.04 *ns*
	2008	1.5	8.1	11.9	54.8	23.7	3.96	
7. The statistics courses at our university meet the needs of our journalism students.	1997	6.1	19.5	35.4	32.9	6.1	3.14	0.00 *ns*
	2008	6.7	21.5	30.4	34.8	6.7	3.13	

8. Most of my faculty would have difficulty teaching statistical reasoning as part of their journalism classes.	1997	1.8	26.8	18.3	35.4	17.7	3.31	0.60 *ns*
	2008	5.2	23.0	18.5	37.0	16.3	3.47	
9. The journalism profession does not reward statistical reasoning by journalists.	1997	1.2	25.0	32.3	34.8	6.7	3.21	1.51 *ns*
	2008	5.9	29.6	31.9	25.2	7.4	2.99	
10. The inclusion of statistical reasoning in a reporting course should be up to the faculty member teaching the course.	1997	1.2	23.8	18.9	45.1	11.0	3.34	1.58 *ns*
	2008	3.0	37.8	18.5	34.8	5.9	3.11	
11. Our journalism students receive adequate instruction in the application of statistics to everyday problems.	1997	5.5	43.9	28.0	17.7	4.9	2.69	0.05 ns
	2008	8.9	48.9	17.0	23.7	1.5	2.65	
12. The journalism curriculum is too tight to offer in-house instruction in statistical methods and their applications.	1997	4.3	32.9	14.0	34.8	14.0	3.17	0.39 *ns*
	2008	7.4	35.6	17.0	31.1	8.9	3.04	
13. To the extent I can, I reward faculty who bring statistical reasoning into their classes.	1997	3.0	18.3	53.0	22.6	3.0	2.99	0.00 *ns*
	2008	10.4	18.5	42.2	25.9	3.0	3.00	
14. Our university's goal is to integrate statistical reasoning into the curriculum.	1997	8.5	36.6	31.7	19.5	3.7	2.72	0.77 *ns*
	2008	8.9	32.6	26.7	24.4	7.4	2.89	
15. In general, the news media do a good job of interpreting statistically based information [*e.g.*, polls, health risks] for their audiences.	1997	11.0	47.0	23.2	17.1	1.8	2.48	0.20 *ns*
	2008	15.6	41.5	20.0	23.0	0.0	2.56	

[1] Scale responses were: 1= strongly disagree, 2 = disagree, 3 = feel neutral (or don't know), 4 = agree, 5 = strongly agree.

[2] Tests of differences in means are controlled by number of the size of the program, highest degree offered, and whether questionnaire was completed on line or on hard copy.

Table 1: Average SAT scores for college-bound seniors 2001-2005 combined[1]			
SAT Score:	**All intended college majors**	**All communication majors[2]**	**Journalism**
Verbal	507	526	552
Math	517	506	514

Notes:
1. Source: Derived from data provided by The College Board. Copyright © 2001-2005 The College Board. www.collegeboard.com
2. Includes intended majors in advertising, business and technical writing, communication, film, journalism, public relations, radio-television, and telecommunications.

Table 2: Significant relationships between administrators' main teaching strategies and attitudes toward statistical reasoning instruction for journalism students (1997 and 2008 waves combined)

	Given the opportunity to provide education in statistical reasoning to students in your journalism program, what would be your main strategy?				
	Requiring students to take a statistical reasoning course or courses offered elsewhere in the university.	Offering a statistical reasoning course in my department specifically designed for journalism majors.	Embedding statistical reasoning skills in the various journalism courses in my department.		
	(a) [2]	(b) [2]	(c) [2]		
Attitudes: [1]	Means			$F_{2,265}=$	p≤
Q2. It is important for our journalism students to take a course in basic statistics.	4.09c	4.07c	3.53ab	12.94	.001
Q3. Statistical reasoning skills give students a competitive edge in the journalism job market.	3.90	4.18c	3.86b	3.19	.05
Q5. Some instruction in statistical reasoning should be a part of our journalism courses.	3.76bc	4.21a	4.06a	6.22	.01
Q6. Most of our journalism students would rather not learn statistical reasoning.	4.02	4.20c	3.87b	3.41	.05
Q7. The statistics courses at our university meet the needs of our journalism students.	3.50bc	2.97a	2.94a	8.66	.001
Q8. Most of my faculty would have difficulty teaching statistical reasoning as part of their journalism classes.	3.79c	3.37	3.09a	10.44	.001

Q12. The journalism curriculum is too tight to offer in-house instruction in statistical methods and their applications.	3.60bc	2.68a	2.92a	14.25	.001
N=272. n=	83	59	130		

[1] Scale responses were: 1= strongly disagree, 2 = disagree, 3 = feel neutral (or don't know), 4 = agree, 5 = strongly agree.

[2] Letters (a,b,c) after a mean signify that there is a statistically significant difference in means between columns indicated, based on Bonferroni post-hoc pairwise tests: Letter "a" indicates that there is a difference with the mean in column "a" at $p \leq .05$.

Note: Only statistically significant relationships are shown. Analysis was conducted via SPSS General Linear Model "Multivariate" to control analysis-wide error. Means are adjusted by wave of survey, method of administering questionnaire, size of the program, and level of degree offered. Due to their relatively small numbers, respondents who offered various "other" responses or did not want to do anything to teach statistical reasoning are not included in the above analysis.

NOTES

1 Among the earliest studies is Charnley (1936). For some examples and reviews, see Curtin and Meier (2001), Griffin (1999), Maier (2003a), Maier (2003b), Meyer (2002), Paulos (1995), and Seligman (2002).

2 The reporters also had their analysis and interpretation checked by two university experts. An accompanying story explained the analysis to readers, and included the following: "Linear regression allows statisticians to determine how two or more variables are related, the strengths of those relationships and if one variable predicts another. Using this method, the *Journal Sentinel* was able to control for other variables such as median income and population density to determine that the higher the minority population percentage in a census tract, the longer it took crews to fix potholes."

3 The 2001-2005 SAT data showed that female students who intended to major in journalism scored, on the average, somewhat lower on the math part of the SAT (mean=506) than did their male counterparts (mean=536). However, both of these groups scored close to the mean math scores for their sex among all college-bound seniors. Becker and Graf (1994) reported the same patterns in their analysis of 1989-1993 SAT data.

4 The URL is http://www2.ku.edu/~acejmc/PROGRAM/STANDARDS.SHTML.

5 We will use the terms "chairs," "heads," and "administrators" to refer to the individuals who oversee the undergraduate journalism program, regardless of what their actual titles may be.

6 The response rate for a web survey was comparable to that for a surface mail hard copy survey when each was preceded by surface mail notification, based on a study by Kaplowitz, Hadlock, and Levine (2004). However, there is also evidence from another study that e-mail pre-notification may be superior to surface mail notification for e-mail surveys, perhaps because respondents may not link the surface mail notice with the online survey, based on Schaefer and Dillman (1998). However, the effectiveness of repeated e-mail reminders on response rate for a web survey diminishes fairly quickly, as compared to the effects of surface mail reminders on response to mailed questionnaires, according to Manfreda, Bosnjak, Berzelak, Haas, and Vehovar (2008).

7 Both variables were standardized, after being transformed to reduce positive skew, and then summed to produce the variable representing program size (alpha = .90).

8 The size of their journalism program and the level of highest degree it offered did not seem to influence the administrators' attitudes toward the

value of statistical reasoning to their students in 1997. However, in 2008, administrators in larger programs (partial r= .23, p<.01) held more positive attitudes.

9 Those who tend to disagree that statistical reasoning goes unrewarded are more likely to believe that such reasoning gives students a competitive edge in the journalism job market (partial r = -.31, p≤.001 in 1998, -.24, p<.01, in 2008).

10 The first figure in these and the subsequent results presented in parentheses will be for 1997, and the second for 2008.

11 The willingness of journalism students to learn statistical reasoning was unrelated to the administrators' attitudes toward the value of statistical reasoning to their students (Q1) in 1997. However, in 2008, administrators who felt their students were unwilling to learn this material held less positive attitudes toward the value of it for their students (partial r= - .21, p<.05).

12 These results are generally consistent with those of another recent survey of journalism department chairs in the United States. Cusatis and Martin-Kratzer (2010) found in their 2009 study that these administrators generally believed that their students' math skills were "poor." Nonetheless they were unlikely to offer courses designed to deal with that problem.

13 Administrators in programs offering a bachelor's or master's as the highest degree were more likely to agree with Q4 than administrators in programs offering a doctorate ($F(2,290)=4.26$, $p\leq.05$, including Bonferroni post-hoc comparisons between means at $p\leq.05$, with controls for wave, questionnaire method, and size of the program). In addition, those who believe that their journalism students lack the mathematical aptitude (Q4) are also more likely to perceive (Q6) that the students would rather not learn statistical reasoning (partial r = .47 in 1997, .38 in 2008, both p≤.001).

14 The view that statistical reasoning instruction should be part of their journalism courses (Q5) is negatively related to (Q10) allowing the inclusion of this instruction in a reporting course to be up to the instructor (partial r= -.22, p<.01, in 1997; partial r= -.24, p<.01, in 2008). The mean differences in Q10, showing greater agreement in 1997 than in 2008, were statistically significant until the control variables were applied.

15 Due to their relatively small numbers, respondents who offered various "other" responses or did not want to do anything to teach statistical reasoning are not included in the analysis in Table 1. None of the control variables were associated with the chairs' preferred strategies.

16 In percentage terms, among those who favored students taking a statistical reasoning course elsewhere, more than two thirds (63%, 71%) felt

that most of their journalism faculty would have trouble teaching that content. In comparison, half (50%, 50%) of those who favored teaching a separate statistical reasoning course for journalism students had that concern about their faculty. Similarly, even among those who favored integrating the instruction into various journalism courses, 45% (in 1997) and 47% (in 2008) had that concern.

17 Overall multiple regression results: $F(16,147) = 2.10$, $p<.05$, for 1997; $F(17,117) = 5.13$, $p<.001$, for 2008.

18 None of the other control or attitudinal variables (Q1-15) were significantly related to Q13.

19 In addition, it is likely that many programs, in an ongoing way, appoint as chairs different individuals who embody their long-term values and goals.

20 While many possible outcomes were possible when comparing the 1997 survey to the 2008 version, the similarity of chairs' responses over time is especially noteworthy from the standpoint of validity. If the results had been quite different from one wave to the next, it would have been difficult to determine whether the programs had changed over time or whether programs remained the same but different individuals, as chairs, simply saw things differently in 1997 as compared to 2008.

21 An excellent source for materials related to teaching statistical reasoning is the Chance project at Dartmouth College (www.dartmouth.edu/~chance). In particular, their online Chance News archives and the current Chance Wiki contain a wealth of examples, mostly taken from the news and other media fare, of statistical reasoning. Most are accompanied by class discussion questions.

22 Respondents could choose only one option. Some might have preferred a mixture, however.

23 Also see Ashcraft (2002), Bessant (1995), and Humbree (2000).