The purpose of this research is to assess interdisciplinary agreement about the content of an introductory course in statistics and research methods. We compiled a set of methodological and statistical topics from relevant research, introductory textbooks, and course descriptions. Eighteen professors in the natural sciences, social sciences, and education assessed the importance of these topics for a hypothetical introductory statistics and research methods course. Results indicate agreement across disciplines on the relative importance of 97% of the statistical topics, with 75% of these topics deemed to be important. In contrast, there is agreement on the relative importance of only 48% of the research methods topics. The results are useful in the evaluation of existing statistics courses and texts. In addition, the data provide support for interdisciplinary introductory statistics instruction but also raise questions regarding the apparent discipline-specific nature of instruction in methodology.

Perea-Mendoza and Swift (1981) recognized a need for statistical literacy and asserted that “individuals need a knowledge of statistics and probability to function in our society” (p. 2). Even students interested in becoming practitioners need an understanding of research methodology and statistical techniques to comprehend, critically evaluate, and apply research in their field (Buche & Glover, 1988). Reflecting this trend, Gordon and Gordon (1992) reported that statistics courses have become commonplace in the undergraduate curriculum. Bartz (1981) sampled 147 college and university undergraduate catalogs and found that all but 12 psychology departments either required or recommended a statistics course. Aiken, West, Sechrest, and Reno (1990) found that 9 out of 10 psychology departments offering a doctorate degree required at least one statistics and methods course.

Because many students take only a single introductory statistics course, their future use of statistical and methodological tools will reflect largely what was learned in that course. As such, it is vital that statistical instruction be relevant and focus on core domain knowledge. Recent research recognized this need and sought to identify which topics are essential in statistics and research methods instruction. Mittag (1993) relied on educators in statistics to identify a list of essential topics in 11 categories (e.g., probability) for a noncalculus-based introductory statistics course. Jackson (as cited in Mittag, 1993) also generated a list of mathematical topics recommended in such a course. Hogg (1992) discussed the shortcomings of existing statistics courses, provided suggestions for improving instruction in the area, and identified some important topics he believed should be included in an introductory course. Lopez and Mertens (1993) surveyed professors of educational research and identified the topics currently covered and the teaching techniques utilized in educational research courses. The results of this research support current practice, in that general and specific topics in summarizing data, probability, estimation, experimental design, and hypothesis testing are viewed as integral to the curriculum.

With the exception of Lopez and Mertens (1993), researchers have not explored the importance of research methods topics. This omission is at odds with the common teaching practice of integrating research methods with descriptive and inferential statistics in the curriculum. Therefore, in this study, we assess the perceived importance of topics in both areas. A second contribution of this research is that the sample consisted of teaching professors in the natural and social sciences as well as education. If results from this broad cross-
section of educators indicate considerable commonality, they may support initiatives for interdisciplinary instruction in the domain.

Method

Participants

The target group of respondents consisted of 44 professors at a major Canadian research-based university who taught at least one introductory statistics or research methods course between 1992 and 1994. Of that group, 18 professors (41%) responded. The sample came from mathematics and statistics (6), social sciences (7), education (3), and engineering (1). One participant did not provide a departmental affiliation. Respondents had taught their courses an average of four times in the past 5 years (SD = 2, range = 1–10).

Instruments and Procedure

We compiled a list of methodological and statistical topics from relevant research (e.g., Mittag, 1993), introductory statistics and methodology texts (e.g., Diekhoff, 1992; Elmes, Kantowitz, & Roediger, 1985; Ghiselli, Campbell, & Zedeck, 1981; Judd, Smith, & Kidder, 1991; Kirk, 1990; Shavelson, 1988), and University of Calgary course descriptions. Respondents rated the importance of each statistical topic in a hypothetical first-level noncalculus statistics course. They also rated the importance of research methods topics in a hypothetical first-level research design course. In both cases, respondents used a 5-point Likert-type scale ranging from 1 (not needed) to 5 (critical). They also indicated whether they presently covered the topics in their courses.

Results

Most respondents indicated that class enrollments reflected a cross-section of disciplines. Class sizes varied considerably, with education courses reporting an average enrollment of 11 to 30 students, social science courses usually having 31 to 100 students, and mathematics and statistics courses reporting 51 to over 100 students per class. Three respondents indicated their mean class size was over 100 students.

Sixteen of 18 respondents (89%) indicated that their course included a laboratory component. The lab component averaged 2 hr per week (SD = 2), and 14 courses (78%) incorporated a computer-based statistical package in the laboratory work.

We considered topics to be important if they had an overall mean rank of 3.5 or greater and all departmental means were 3.0 or greater. (A median analysis produced similar results. To facilitate across-study comparisons, we report data based on means.) We based these cut-off points on the fact that a mean value greater than 3.5 corresponded to an average rating of fairly important or critical, and a mean value of 3.0 corresponded to an average rating of somewhat important. As well, interdisciplinary efforts in curriculum development are likely to succeed to the extent that all contributors share the assessment of topic importance. When at least 50% of the respondents in each department indicated that they currently taught a topic in their course, we rated that topic as included in course content.

Statistical Topic Importance

Across all departments represented, there was agreement on the importance for 63 of 65 statistical topics (97%). Forty-nine important topics (75%) emerged (i.e., had an overall mean of 3.5 or greater and all department means greater than 3.0). Nine of the topics (14%) received a rating of unimportant (i.e., overall and departmental means all less than 3.0) with most of these items listed under the categories of analysis of variance (ANOVA) and nonparametric tests. Table 1 lists the important topics by category label used in the questionnaire.

Research Methods Topic Importance

The various departments agreed on the importance of 50 of 104 research methods topics (48%). However, all departments considered only 20 topics (19%) to be important. These tended to fall under the categories of theories and hypotheses, control and randomization, and report and manuscript writing (see Table 2). To a large extent, the small proportion of topics deemed important resulted because only 23 topics (22%) received a mean rating of 3.0 or higher from respondents in the area of mathematics and statistics. All departments identified 29 research methods topics (28%) as unimportant. Most of these were in the categories of experimental and quasi-experimental designs, interviews, and questionnaires, and scale development.

When we restricted the analysis to respondents from social sciences and education, there was agreement regarding topic importance for 81 of 104 items (78%). This subsample rated 56 topics (54%) as important and these topics tended to fall into the categories of philosophies of science, research development, research strategies, variables and constructs, measurement, and sampling. The group considered 25 topics (24%) to be unimportant, including blocking, change scores, structured interviews, reliability, and specific types of validity.

We also rank-ordered research methods topics by academic area of the respondent. Those in social sciences rated 63 topics (61%) as important. The corresponding data for respondents from education, and mathematics and statistics were 46 topics (44%) and 20 topics (19%), respectively. Departmental differences were most evident in the validity and reliability category, in which social science respondents rated all 10 topics as important, although respondents from other areas considered these topics to be unimportant.

Current Course Coverage

Within each faculty, course content aligned closely with the importance the faculty assigned to each topic. All three faculties included 40 of the 48 important statistical topics (83%) in their course content. For research methods topics,
Table 1. List of Essential Statistical Topics by Category Label

<table>
<thead>
<tr>
<th>Category Label</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summarizing data and graphs</td>
<td>Frequency histograms, relative frequency histograms, bivariate plotting techniques, regression lines, box plots</td>
</tr>
<tr>
<td>Characteristics of sample distributions</td>
<td>Population parameters versus sample statistics, measures of dispersion, measures of center, outliers, percentiles</td>
</tr>
<tr>
<td>Probability and probability distributions</td>
<td>Normal distribution, expected value, simulation of possible outcomes, binormal distributions, mutually exclusive events, independent events, combining probabilities, central limit theorem, sample space, conditional probability</td>
</tr>
<tr>
<td>Estimation</td>
<td>Meaning of statistically significant, interval estimation and confidence intervals, sampling distributions, effects of sample size, point estimation, least squares estimation, bias and precision</td>
</tr>
<tr>
<td>Hypothesis testing</td>
<td>One population test of means, one population tests of proportion, paired versus nonpaired t-test, two population tests of proportion, one- versus two-tailed tests, introduction to inference, p-values, type I and type II errors, two population test of means</td>
</tr>
<tr>
<td>Categorical data analysis</td>
<td>Chi-squared test for independence, two-way frequency tables</td>
</tr>
<tr>
<td>Correlation and regression</td>
<td>Understanding correlation vs. causation, standard error of regression coefficients, Pearson's product-moment correlation coefficient, prediction</td>
</tr>
<tr>
<td>Residual analysis</td>
<td>Analysis of variance (ANOVA), one-way between-subject design, purpose of ANOVA, nonparametric tests, measures of association</td>
</tr>
</tbody>
</table>

Note. ANOVA = analysis of variance.

Table 2. List of Essential Research Methods Topics by Category Label

<table>
<thead>
<tr>
<th>Category Label</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theories and hypotheses</td>
<td>Null and alternative hypotheses, one-tailed and two-tailed hypotheses, hypotheses, developing a testable hypothesis, hypotheses relating constructs, statistical hypotheses, theories, laws, functional relations, research hypotheses</td>
</tr>
<tr>
<td>Variables and constructs</td>
<td>Independent and dependent variables, operational definitions of constructs, variables and constructs, predictors and criteria</td>
</tr>
<tr>
<td>Control and randomization</td>
<td>Eliminating alternate explanations, random selection and assignment</td>
</tr>
<tr>
<td>Sampling</td>
<td>Convenience and purposive samples, probability sample, stratified random samples, simple random samples, quota samples, cluster samples</td>
</tr>
<tr>
<td>Issues in experimental designs</td>
<td>Practical versus statistical significance, main effects, interactions, conducting ethical research, researcher bias, matching, moderator variables, counterbalancing</td>
</tr>
<tr>
<td>Report and manuscript writing</td>
<td>Use of graphs and tables, discussion, method and results, introduction, use of references, writing style (e.g., APA)</td>
</tr>
<tr>
<td>Philosophies of science</td>
<td>Science versus conventional wisdom, induction and deduction, prediction and explanation, empiricism</td>
</tr>
<tr>
<td>Research development</td>
<td>Reviewing the literature, evaluating research, correlational (ex post facto) studies, experiments, sources of research ideas, research strategies, field and controlled field studies, observation</td>
</tr>
<tr>
<td>Experimental and quasi-experimental designs</td>
<td>Between-subject and within-subject designs, single factor designs</td>
</tr>
<tr>
<td>Measurement</td>
<td>Scales of measure, validity and reliability, internal validity, precision, external validity</td>
</tr>
</tbody>
</table>

Note. APA = American Psychological Association. *Topics rated as important by professors in social sciences and education only.
the corresponding data were 59 of the 63 (94%) for those in the social sciences, 45 of 46 (98%) for those in education, and 11 of 13 (85%) for those in the natural sciences.

Discussion

This study found interdepartmental agreement on the relative importance of 97% of the statistics topics, with 74% of those topics deemed to be important. The statistical topics considered important tended to fall into the categories of summarizing data and graphs, probability and probability distributions, estimation, hypothesis testing, and correlation and regression. The least important statistical topics were in the categories of ANOVA and nonparametric tests. The assessed importance of these topics was consistent with findings reported by both Mittag (1993) and Lopez and Mertens (1993). Both within this study and across different studies, agreement on topic importance suggests a consensus that bodes well for interdisciplinary approaches to curriculum development and instruction. Although our sample was small and restricted to one university, the results also provide a resource that instructors can use to evaluate introductory statistics courses and texts.

It is important to note that respondents did not view as unimportant the topics of ANOVA and nonparametric tests. Rather, the topics considered relatively unimportant (e.g., higher order ANOVA designs and log-linear modeling) fell in these categories. Respondents still believed it important that an introduction to the area include coverage of one-way, between-subject ANOVA and chi-square tests, two of the more commonly used tools in psychology today.

This study found less consensus regarding the importance of research methods topics. All respondents agreed on the relative importance of 48% of the topics but only 19% of the methods topics were deemed important in all three departments. The topics rated as important by all respondents were in the categories of theories and hypotheses and report and manuscript writing. The areas considered least important were in the categories of philosophies of science, research development, research strategies, experimental and quasi-experimental designs, measurement, validity and reliability, interviews, and questionnaire and scale development. The lower level of overall agreement regarding research topics was due primarily to the fact that respondents from the natural sciences (in this case, mathematicians and statisticians) rated only 13% of the research methods topics as important. In contrast, between the social sciences and education there was agreement on 78% of the topics with 56 topics (54%) of these topics considered important.

Our data suggest that research methods are more discipline specific than statistical techniques. There is a long-standing tradition in psychology to view the randomized experiment as the research prototype, whereas other social sciences emphasize quasi-experimentation, survey research, and secondary data analysis. To the degree that commonly used methods evolve in response to the central issues of a content area, an interdisciplinary approach to education in methodology is analogous to using a screwdriver as hammer, chisel, and drill.

Although it is doubtless the case that advanced research in an academic area is quite specific, we believe that at an introductory level, a general approach to methodology is justified on several grounds. First, the conventional wisdom is that adults experience several changes of career in their lifetimes. As such, more general familiarity with research methods allows for better transfer of skills between jobs. Second, exposure to nontraditional methods enables students to develop and test hypotheses that would not occur to them if they relied only on traditional training. Third, the economic benefits of a general approach are various and straightforward. In addition, one may question on pedagogical grounds the value of teaching statistical techniques in isolation (see Jackson, as cited in Mittag, 1993).

Students often take introductory statistics courses within their major area, but course descriptions reveal considerable interdisciplinary overlap in content. Universities consider many of these courses to be interchangeable in fulfilling degree requirements. The across-discipline agreement in topic importance and the commonality of course content suggests that universities and students may be better served by a shared interdisciplinary curriculum in statistics.

The potential benefits of a common curriculum are several. Large numbers of students could provide a motivation for software and hardware producers to discount the prices on their products. Students would worry less about being admitted to a critical course in their major department, knowing that they would receive equivalent training in any department offering the core curriculum. A university's considerable talent in statistics and research design could be used more effectively than this isolated approach allows. The interdisciplinary nature of courses would compel instructors and students alike to apply their knowledge outside their major fields, and this generalization could only serve to foster disciplinary cross-fertilization. Furthermore, a core curriculum simplifies transfer of credit to other institutions and can lay the groundwork for a standardized distance learning curriculum.

We recommend that further research explore the development of an introductory statistics and methods course curriculum. Such research could investigate the feasibility of a common modular core curriculum with discipline-specific concerns addressed through a combination of example problems, sample research articles, homework exercises, or lab components. An evaluation of texts that could support a common core curriculum would also be beneficial. Development of an across-discipline course focused on critical topics could serve as one vehicle for ensuring that all students develop the skills necessary for comprehending, evaluating, and applying research in their academic disciplines and beyond.

References


Notes
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Elaborating Cognitive Psychology Through Linkages to Psychology as a Helping Profession

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Many psychology students are interested in psychology as a helping profession. Teachers of cognitive psychology can establish links from the cognitive course to psychology as a helping profession that will motivate students both to take the course and to learn more effectively in the course because of personal meaningfulness. Teachers of cognitive psychology can establish at least 6 major links throughout the course.

All of us feel like fish out of water from time to time. Many students feel this way when they take a course in cognitive psychology because what they are really interested in studying is psychology as a helping profession by taking clinical, consulting, counseling, community, or school-based courses. Some students never take the cognitive course, despite the importance of cognitive psychology for almost all areas of contemporary psychological inquiry.

To students interested in psychology as a helping profession, cognitive psychology may seem far removed from their areas of interest. Often, cognitive psychology seems alien to them, having no obvious links to psychology as a helping profession. Cognitive psychology textbooks typically do not provide enough scaffolding that would enable these students to understand how closely intertwined cognitive psychology is with psychology as a helping profession.

This absence of scaffolding is in marked contrast to emphases in many other psychology courses. Abnormal and other clinical psychology courses, of course, deal with the behaviors that most interest many of those students interested in psychology as a helping profession. Social psychology courses deal with the kinds of person-to-person interactions that motivate students interested in the helping professions. Developmental and educational psychology courses are often directly relevant to future teachers and parents. Indeed, many such courses require students to work directly with one or more children. In contrast, cognitive psychology fails to link to the helping profession.

With relatively little effort, cognitive psychology teachers can provide links that will motivate students to become more interested in cognitive psychology and to learn the content of the course better. The key is to help students see the relevance of the field of cognitive psychology for the helping professions and therefore, to some extent, their own lives. In the remainder of the article, we discuss six major links that teachers of cognitive psychology can establish throughout the course.

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