The Expanding Role of Quantitative Methodologists in Advancing Psychology

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Abstract

Research designs in psychology have become increasingly complex, and thus the methods for analyzing the data have also become more complex. It is unrealistic for departments of psychology to expect research psychologists to stay informed of all the advances in statistical methods that apply to their field of research, and therefore departments must improve the profile of quantitative methods in order to ensure that adequate statistical resources are available to faculty. In this paper, we discuss the challenges involved in improving the profile of quantitative methods given the drastic decreases in quantitative methods faculty, students and graduate programs over the past couple decades, and discuss the importance of reversing this trend through improving awareness of the field of quantitative methods in psychology.

The Expanding Role of Quantitative Faculty in Advancing Psychology

Statistics. Who needs it anyway? It is the dreaded course of most psychology undergraduate and graduate students, and even some faculty members cringe when forced to discuss or conduct statistical analyses. Many students who begin studying psychology have the impression that it is a safe haven from the world of mathematics (that many despised having to take in high school). However, this impression could not be farther from the truth, with statistics playing a significant role in almost all research studies in psychology. In fact, training in statistical methods continues to be one of the most important factors for unifying the discipline of psychology (Aiken, West & Millsap, 2008).

Students are thrown into courses full of formulae, p-values, effect sizes, confidence intervals, etc., with the hope that the next generation of psychologists will be well versed in the statistical methodologies of the field. However, of the thousands of psychology graduates each year in Canada, most have only taken one statistics course and therefore have very limited knowledge about data analysis. It is also important to keep in mind that elementary and high school students now have a fairly broad introduction to statistics as part of their curriculum, so statistics courses taken in psychology departments do not go far beyond what these students have already been exposed to. Further, doctoral graduates in psychology, who have usually taken at least

one course in statistics beyond their undergraduate (Aiken et al., 2008, report that the mean number of required statistics courses across all areas of graduate psychology is approximately 1.2), usually still lack the skills necessary to understand many of the statistical approaches adopted in psychological research. In other words, due to the complexity of modern psychological statistics, even those with advanced training often require assistance with many of the analyses they need to conduct. In light of this, where are psychologists expected to receive the type of statistical assistance they require?

The most common statistical resources are: 1) psychologists that specialize in quantitative methods; 2) professional statistical consultants (that are often psychologists that specialize in quantitative methods); or 3) statistical texts/articles. When referring to psychologists that specialize in quantitative methods, we are referring to a researcher who specializes in a particular type of quantitative analysis (e.g., structural equation modeling), and therefore would likely be sought after for consultation on topics in their area of specialization; in other words, he/she need not (and could not) be an expert in all areas of psychological statistics. We are also not saying that psychologists that do not specialize in a type of quantitative analysis lack any knowledge about statistics; in fact many psychological researchers have considerable skill in both their substantive area of psychology and the quantitative methods used to analyze the data in that field.

Unfortunately, as we discuss below, there are very few quantitative

methodologists in psychology, and therefore the statistical resources that are required by research psychologists are often nowhere to be found. Further, Mills, Abdulla and Cribbie (2008) report that very few applied psychological articles make any reference to statistical texts or articles, so it is unlikely that applied psychologists are routinely utilizing published materials on quantitative methods to assist them with statistical issues.

The purpose of this paper is to outline the problems that exist regarding quantitative methods in psychology departments, as well as to discuss the role that quantitative methodologists will play in improving quantitative training and advancing the field of psychology as a discipline. It is important to point out that we will be emphasizing the role that quantitative methodologists play as consultants and teachers of statistics, and all but avoiding the role that quantitative methodologists play in the development of, and research into, advanced data analysis methods. This is not to say that the latter is any less important, only that the former roles are the focus of this discussion. In preparation for this manuscript (i.e., in order to gain information about the types of statistical assistance received by psychological researchers), the first author of this paper spent a few months shadowing quantitative methodologists from psychology departments that were providing statistical consulting to psychology researchers. The consultants were both psychology faculty and advanced graduate students who worked at the on-campus statistical consulting service, and the clients were psychology thesis students, graduate students and faculty members who booked

appointments through this consulting service. The topics included statistical software use, as well as ANOVA, regression and structural equation modeling issues, and each session was one hour in length. The observations made during these sessions helped to frame much of the discussion below, as they provide insight into the type of assistance being sought and the type of assistance received.

Research on, and a survey of, Canadian departments of psychology was also conducted in order to gain information into recent hires in quantitative methods, future plans for hires in quantitative methods, current faculty specializing in quantitative methods, and the types of statistical course work offered to students. Details on, and the results of, these surveys are discussed within the appropriate sections below. We also compare and contrast many of the results of these surveys of Canadian departments of psychology with a recent survey of doctoral programs in the United States and Canada by Aiken et al. (2008).

Complexity of Statistics

Research designs in psychology are becoming increasingly complex. Single predictor designs have been replaced by large multivariate and longitudinal designs that often require complex analyses to answer the equally complex research questions. In turn, advanced statistical procedures, such as structural equation modeling, hierarchical linear modeling, etc., are used to test hypotheses regarding moderation, mediation, growth, etc. Further, new statistical approaches are being developed to deal with the

complex data that arises from functional MRI, DNA microarray, and other innovative approaches to exploring psychological phenomenon. Although these tests (and the software programs that conduct them) have provided researchers with the opportunity to devise and test complex research hypotheses, there is still the question of whether researchers have the background to be able to understand these analyses appropriately and, if not, whether qualified consultants are available to the researchers. As was noted above, doctoral students in psychology are only required to take an average of 1.2 statistics course in graduate school, and graduate programs indicate that very few of their graduates would be competent in topics such as logistic regression, structural equation modeling, longitudinal data analysis, hierarchical modelling or meta-analysis (Aiken et al., 2008). It is important to point out here that course work is only one way to gain knowledge in statistical methods, and students may be learning statistical topics outside of the classroom (and therefore graduate programs may underestimate the competencies of their graduates); however, in our opinion it is unlikely that a significant number of psychology students are gaining extensive knowledge in quantitative methods in a self-taught manner (although we are unaware of any studies that have investigated this claim).

What is being taught in graduate psychology statistics courses? In order to evaluate the type of training received by graduate psychology students at Canadian universities, we conducted a survey of the online course descriptions for all graduate statistics courses offered by these departments. Twenty of the 35 psychology

departments offering graduate programs had online course descriptions for all available statistics courses. The information gathered from these surveys, along with comparison data from a recent survey of Canadian and United States graduate programs by Aiken et al. (2008) is provided in Table 1. The survey highlighted some deficiencies in the material being taught in graduate psychology statistics courses. For example, many of the consulting sessions observed by the first author involved structural equation modeling (SEM), and yet of the Canadian universities that offer graduate programs in psychology, only 3 (15%) of 20 offer formal SEM training to their students. Further, and in support of the findings of Aiken et al., results of this survey indicate that although all graduate courses cover ANOVA and regression, very few cover advanced topics such as hierarchical modeling. Thompson & Edelstein (2004) point out that even classes that do teach advanced statistics often teach them in a theoretical and abstract manner, which leaves students ill prepared to deal with the practicalities of analyzing real-life data (e.g., missing data, assumption violation, software issues, etc.).

There is also the issue that many of the traditional test statistics taught in undergraduate (and often graduate) statistics courses are inappropriate. As Wilcox (2002) explains, “all of the hypothesis testing methods taught in a typical introductory statistics course, and routinely used by applied researchers, are obsolete; there are no exceptions” (p. 1). In other words, significant advances have been made in robust approaches to data analysis (from simple two- independent sample designs to more complex regression and modeling approaches), yet the gap between cutting edge robust

methods and the methods typically adopted by researchers continues to widen. Wilcox explains that there are several factors that have contributed to the lack of familiarity of robust methods by applied psychologists, including textbooks that have ignored advances in statistics and software packages that make it very easy to conduct simple (but in most cases incorrect) tests, but difficult (or in most cases impossible) to conduct the appropriate analyses.

A review of the data analytic practices of psychologists. To examine the extent of this problem, we conducted a survey of the one-way and factorial independent groups ANOVA analyses conducted in popular psychology journals (*Child Development, Journal of Abnormal Psychology, Journal of Consulting and Clinical Psychology, Journal of Experimental Psychology: General, Journal of Personality and Social Psychology*) in the 2000 publishing year. In total we found 140 articles (out of 486 total articles reviewed) that conducted one-way or factorial ANOVA analyses. In instances where multiple ANOVAs were performed we only recorded information from the first set of analyses in order to avoid issues of nonindependence. The results are presented in Table 2. It was found that most articles ignored (or at least did not discuss) even the basics of exploring data. For example, very few articles mentioned the normality or variance homogeneity assumptions, even though numerous articles and books (e.g., Keselman et al., 1998; Wilcox, 2005) have highlighted the sensitivity of ANOVA F tests to nonnormality and/or variance heterogeneity. Interestingly, of the 11 articles that mentioned the normality assumption, ten found distributions that were nonnormal. Although it is possible that

the remaining articles that did not mention the normality assumption all found no evidence of nonnormality, that seems highly unlikely give that Micceri (1989), who examined 440 variables from published articles in education and psychology, found that 84% showed moderate to extreme skew. In our review, we also found that even though only three researchers mentioned the homogeneity of variance assumption, 27 of the 65 articles that presented information on group variances had largest to smallest variance ratios greater than 2:1 (with one study having a largest to smallest variance ratio of 104:1!). This is especially problematic given that, in 75% of the studies we reviewed, sample sizes were unequal, and the combination of unequal sample sizes and variances has a drastic effect on the empirical Type I and Type II error rates of ANOVA F test (Boneau, 1960).

Wilcox also explains that the disciplinary attitude that 'anyone can teach stats' is a major contributor to the lack of statistical literacy in psychology researchers. When psychologists without a strong quantitative methodology background teach statistics they often lack the enthusiasm for, and knowledge of, modern statistical approaches. Staying on top of advances in quantitative methods demands a fair amount of effort and it is difficult for psychologists that do not specialize in quantitative methods to keep up with the important advances in procedures for analyzing a broad range of psychological data.

Further, of the instructors who are aware of advances in statistics, many are of the belief that trying to teach these complex topics to psychology students is a waste of

time; however, are we better off teaching them outdated and inappropriate methods?

To keep up with the complex research designs and analyses, new (and in some cases user-friendly) software programs have become available, and many of the statistical consulting sessions observed by the first author included time spent by the consultant instructing the client on how to utilize specific statistical software programs. However, in addition to the time required to learn how to operate these new programs, there is more to analyzing data than just plugging it into a software package. In other words, you must to be able to assess whether assumptions are met, interpret the output from the program and do a careful check of whether or not the results make sense.

This is an especially important issue with more complex programs such as structural equation modeling software, where model identification, improper solutions, and other important issues can make running analyses and interpreting results extremely cumbersome.

The issue of modern data analysis in psychology was discussed in detail by a task force that was set up by the Board of Scientific Affairs (BSA) of the American Psychological Association (APA) in the mid 1990s. The task force was named the Task Force on Statistical Inference (TFSI), and was asked to make recommendations on how to properly conduct, analyze and write up research studies (Wilkinson & TFSI, 1999). The TFSI discussed numerous issues from sampling, assignment and measurement to assumptions, effect sizes, multiplicities and graphs. The task force also dealt with

complex issues such as banning null hypothesis significance tests (although, as you may have guessed by now, decided against such a drastic measure). It is hoped that the recommendations of the task force will lead to improvement in the nature of data analysis in psychology, although recent evidence seems to indicate that these improvements may take a long time to appear (Cumming et al., 2008).

The important question that still remains is how, without having proper training in advanced statistical methods, are applied researchers in psychology supposed to be able analyze the data that they collect from their increasingly complex research designs?

Quantitative Methodologists as Statistical Consultants

The role of a quantitative methodologist within a psychology department is increasingly four-fold. The traditional roles of teaching, research, and service are often supplemented by a significant amount of time being spent working as a statistical consultant. This is in addition to regularly serving as the methodologist on MA and PhD thesis committees, faculty research teams and grant applications. Thompson & Edelstein (2004) indicate that the aim of statistical consulting is not to teach statistics itself, but to provide users with the practical knowledge needed to carry out their research; however, as discussed above, the plan of the session depends a lot on the statistical background of the client. For example, Thompson & Edelstein (2004) give a good example of a not-so-uncommon statistical consultantion session in action:

A student comes in and asks the consultant to show him how to 'get

> means in SPSS.' Rather than immediately providing the answer, the consultant first asks the student about his dataset and research problem, and realizes that in fact he wants to do a t-test for the difference between means of some dependent variable grouped by some subgroup variable, such as gender. And given the type of research project the student is working on and the departmental standards for that type of work, the student needs to control for several other variables, so the consultant explains these issues and helps him to run and interpret multiple regression instead" (p. 36).

Ostapski and Superville (2005) explain that the most important role in any consulting session is probably to ensure that the client understands and can properly interpret the results of the analyses that the consultant has recommended that he/she conduct, however this task is becoming increasingly difficult for statistical consultants given that psychologists, as discussed above, often have very little (or no) training in modern data analysis methods. Given that it is impossible to expect applied psychologists to obtain all of the skills in advanced statistics that they require to properly analyze their data, while still keeping up with advances in their field of specialization (i.e., even psychologists that specialize in quantitative methods cannot keep up with advances in all methodological areas), we must look to a model of consulting that is advantageous for both the client and consultant. For the client's needs

to be met, departments of psychology need to staff quantitative methodologists that specialize in many of the major quantitative approaches adopted in psychology, and ensure that they are available for consultation on these methods. A colleague reading an early draft of this paper very interestingly added that the consultant must also be able to speak the language of psychology, or in other words, be able to describe and explain the necessary statistical methods in a manner that can be understood by the client. One of the major complaints of many statistical consulting clients is that they leave the consulting session without understanding anything the consultant said, and are therefore unable to incorporate any of the potentially helpful recommendations of the consultant.

For the consulting model to be effective, from the quantitative methodologists point of view, it is important that the number of consultants available be proportional to the number of clients seeking assistance, meaning that the amount of time being spent on consulting does not impact the faculty member's ability to continue to be productive in research. This is a substantial problem in departments where there is only one psychologist that specializes in quantitative methods, and he/she is expected to be able to consult with all potential faculty and student clients on every possible topic in quantitative methods. As a colleague of mine in this less than optimal position explains, you can get burned out pretty fast trying to meet everyone's consulting needs. An anonymous reviewer of this paper also correctly pointed out that, in addition to 'burning out', quantitative methods specialists who spend a great deal of time in

consulting also alter the sensitive balance between time spent on research, teaching, and service in academia. This imbalance can have important consequences. First, spending a significant amount of time on consulting (which might be considered a 'service' activity) would likely be weighted very low in promotion, tenure or salary review. Second, since less time is being devoted to individual research, the field of quantitative methods suffers from a decrease in the number of theoretical developments.

Where Are All the Quantitative Methodologists?

Clay (2005) points out that as quantitative methods become more sophisticated and specialized, the need for properly trained quantitative methodologists increases dramatically. Unfortunately, the number of quantitative methodologists in departments of psychology has dropped significantly over the past few years, and thus there are not nearly enough quantitative methodologists to fill the demand for their services. As Mark Appelbaum, a psychology professor at the University of California, San Diego specializing in quantitative methods, states "there aren't enough of us quantitative people, and many of us are getting to be more senior" (in Clay, 2005, p. 26).

How many psychologists are specializing in quantitative methods in Canada? An important question is whether Canadian psychology departments are also experiencing a shortage of quantitative methodologists. To answer this question we surveyed Canadian departments of psychology that offered graduate degrees to determine the

number (and proportion) of faculty conducting research on quantitative methods. This survey was conducted by reviewing the research interests of faculty members from departmental or faculty web pages at universities that offered graduate studies. Of 34 departments surveyed, 18 had either no, or only one, quantitative methodologist(s), and no department had more than six faculty members that did research on quantitative methods. The median number of faculty conducting research on quantitative methods was 1, and the mean proportion of the number of faculty members conducting research on quantitative methods is .06 (it is important to point out that it was not required that quantitative methods be the faculty member's exclusive, or even primary, research specialization). These numbers are supported by the findings of Aiken et al. (2008) who found that only half of all the doctoral psychology programs they surveyed had at least one quantitative methodologist. Appelbaum also reports that with the dwindling number of quantitative methodologists available, it has become increasingly difficult to find faculty to do quantitative reviews of journal articles. This point is extremely important when you consider the increasing complexity of many of the statistical approaches being used by psychologists, and the need for specialists to be able to determine if the approach was implemented correctly (or even if the correct approach was adopted).

The American Psychological Assocaition (APA) recently published data on the drastic differences in employment opportunities for psychologists specializing in quantitative methods relative to other specializations in psychology. These data were

drawn from the 'Survey of Earned Doctorates' conducted by the National Science Foundation. The Survey of Earned Doctorates gathers information annually from new U.S. research doctorate graduates about their educational histories, funding sources, and post-doctoral plans. From 1991 to 1996 the ratio of the number of jobs advertised to the number of doctorates earned was 0.47 across other specializations in psychology, but 2.40 for a quantitative methodology specialization (APA, 2008). In other words, there were more than twice the number of positions advertised for quantitative methodologists as there were quantitative methodology graduates.

Are quantitative methodologists in demand in Canadian departments of psychology? To determine how these APA results relate to the recent hiring practices in departments of psychology at Canadian universities, we surveyed department chairs regarding recent hires in quantitative methods, as well as the specialization of the candidate that was hired. Specifically, a survey was sent to all psychology department chairs at Canadian universities through the department chairs listserv asking: 1) Have you advertised for a quantitative methodologist in the past five years?; 2) If you advertised for a quantitative methodologist in the past five years, was the position filled?; and 3) If you filled the position for a quantitative methodologist, was the primary research area of the candidate quantitative methodology? Department chairs from 24 universities responded to the survey and the results are presented in Table 3. The results paint a picture of extreme demand for quantitative methodologists, as well as a willingness on the part of psychology departments to fill quantitative methodology

positions with faculty members that do not specialize in quantitative methods. This is extremely problematic because filling quantitative methodology positions with faculty who are potentially not passionate or knowledgeable about the subject can have a detrimental effect on the teaching of, and profile of, quantitative methods in departments of psychology.

This demand for quantitative methodologists would lead us to hope that more graduate programs in psychology are starting to offer specializations in quantitative methods, and that students are flooding into these programs. However, that is far from the case. Recently, Norcross, Kohourt, and Wicherski (2005) summarized data regarding the numbers of students commencing specialist PhD programs in quantitative methods within psychology departments in the United States. In 1992, there were 76 programs enrolling an average of 3.9 students each, but in 2003, there were only 17 programs enrolling an average of 1.9 students. Over about a 10 year period that's a drop from approximately 300 to just 30 students a year enrolling in quantitative methods graduate programs. Clay (2005) provides data that support these results, stating that in the US, “there are fewer than 10 major [doctoral] programs producing quantitative psychologists,” (p. 26) and finds that even those are having trouble filling their spots. In Canada there are only two psychology graduate programs (University of British Columbia, McGill University) offering specialized degrees in quantitative methods (APA, 2008). There are also other programs that offer related programs, such as the Theory and Methods specialization at Simon Fraser University, and the Personality and

Methods specialization at the University of Western Ontario.

The lack of psychologists specializing in quantitative methods and the increasing complexity of statistics within psychology recently led the APA to convene a task force (appropriately titled the 'Task Force to Increase the Number of Quantitative Psychologists") to investigate the problem. "Acknowledging the fact that the number of quantitative psychologists is dwindling at the same time that there is a pressing need for training and education in all aspects of quantitative methods, the APA Council of Representatives authorized a special task force in 2006" (American Psychological Association, 2008). This task force is involved with making students aware of graduate programs in quantitative methods, and how students can best prepare for entrance into these programs. The goals of this task force overlap extensively with the goals of this paper, namely, highlighting the importance of quantitative methods to psychology, and the need to develop more psychologists that specialize in quantitative methods (this issue is discussed in more detail in the conclusions below).

Where Do We Go From Here?

The discussion above highlights some of the problems in regards to quantitative methods within departments of psychology. From our research, and the research of others, we have isolated a few recommendations for departments of psychology that we believe will be helpful in improving the field of quantitative methods. These are not ground-breaking discoveries, but simply intuitive ingredients for advancing psychology.

1) *Increase the Number of Faculty Specializing in Quantitative Methods.* With advances in statistics coming at an unimaginable pace, it is going to be impossible to ensure that psychologists are properly trained in all statistical methods. However, with more quantitative specialists available, departments of psychology can ensure that statistical resources are available to applied researchers, and that statistics courses are being taught by quantitative methods specialists who are passionate and knowledgeable about the material. In order to have a qualified pool of applicants available for these positions though, it is necessary that the visibility of the field of quantitative methods be improved (discussed below).

2) *Improve Statistical Consulting Resources*. There are many different ways in which a statistical consulting service can operate, from drop in hours with a departmental colleague who specializes in quantitative methods, to a large university wide consulting service with consultants who come from many different departments and specialize in many different quantitative approaches. The nature of the service (departmental, university wide, etc.) is less important than the fact that qualified consultants are available to provide consulting on a wide range of statistical problems, and that applied researchers are aware of, and make use of, the service.

3) *Improve Quantitative Methodology Training.* Improving quantitative methods training can take different avenues. First, undergraduate programs need to focus more on developing quantitative skills. From improving undergraduate courses (discussed above) to improving the visibility and importance of quantitative skills (discussed below), improving these skills must be on the radar of all departments of psychology. An anonymous reviewer took a different angle on this problem by suggesting that training in quantitative methods be handled by mathematics and statistics departments. Essentially, psychology students would receive their statistics course work from pure mathematicians/statisticians, as opposed to psychologists that specialize in quantitative methods. Although this may be the best model, and may end up being the model of choice for many psychology departments, we hold on to the hope that quantitative methodologists from psychology departments can effectively train students of psychology in statistics, as we believe that psychologists who specialize in quantitative methods are better able to understand the goals of research psychologists and are therefore able to design statistics courses that more directly relate to the procedures and methods required by psychologists. A second way to improve quantitative methods training is for departments to highlight conferences and workshops that focus on training researchers in advanced quantitative methods [e.g., the 'Summer Program in Data Analysis' (SPIDA) has been held at York University every year for the past decade, and trains behavioural scientists in cutting edge quantitative methods], and make resources available to faculty and graduate students who are interested in attending

these events. Aiken et al. (2008) found that 43% of psychology departments in the United States and Canada have funds available for faculty to attend methodological workshops. Developing strong quantitative skills in faculty members will help them build confidence to conduct sophisticated analyses in their own research and reinforce the need to teach quantitative skills at the undergraduate level. Further, when the resources are available, it is recommended that departments of psychology supplement graduate course work in statistics with regular short courses or workshops on advanced quantitative methods.

To summarize, an anonymous reviewer pointed out that, although it is not expected that all psychologists will be experts in quantitative methods, they should have a solid understanding of basic statistics, and it is this foundation that will provide them with the confidence to attempt more advanced methods (even if in conjunction with a consultant).

4) *Increase Awareness of the Field of Quantitative Methods for Psychology*. Probably the most important recommendation is that we increase awareness of the field of quantitative methodology. Why is this most important? The first two recommendations above rely on there being a large, qualified pool of psychology doctoral graduates that specialize in quantitative methods. Before that can happen we have to ensure that undergraduate students are aware that they have the opportunity to specialize in quantitative methods for psychology, we have to provide them with a positive

experience in their statistics courses, and we have to increase the number of graduate programs that offer a specialization in quantitative methods.

Making undergraduate students aware of the field of quantitative methods can start right from the introduction to psychology class where instructors (and textbook authors) can highlight the importance of quantitative methods (and quantitative methodologists) in psychological research, as well as the importance of strong quantitative skills for getting accepted to graduate school and obtaining research-based occupations. It is also important that personnel from psychology departments inform students of interesting occupational opportunities in quantitative methods, which can be introduced in classes, by campus career centres, etc. We can also improve the experience of undergraduates in their first statistics course by noting the importance of statistics to psychological research. Students often have the impression that statistics is hard, boring and does not relate to careers in psychology. However, once they realize how important understanding statistics will be to their career, their impressions may change.

In order to stimulate interest in the field of quantitative methods, it is important that the instructor be passionate about the material so that the students do not get the feeling that even the instructor has little interest in statistics. Schuenemeyer (2001) points out that stimulating students to learn statistics can start with using real world data sets in class. These data sets stimulate the student to think about how statistics can be used to solve real world problems. In other words, substituting income, depression,

and perfectionism for X, Y and Z might have a significant impact on the level of interest of the students. Improving the visibility and reputation of statistics in departments of psychology may also increase the likelihood that students will get involved with quantitative faculty for research projects, will get involved with the department/campus statistical consulting service or even start student organizations/clubs regarding quantitative methods.

An important point to highlight is that stimulating student interest in statistics will not be an easy goal. Numerous factors contribute to psychology students' lack of interest in statistics, although 'statistics anxiety' is one of the more significant contributors. Past researchers have found that statistics is one of the most anxiety producing courses in psychology (Zeidner, 1991) and that enrolling in statistics classes is regarded by many students as *extremely negative* (Onwuegbuzie & Wilson, 2003). In fact, Lalonde and Gardner (1993) suggest that learning statistics is akin to learning a second language. Therefore, although it is important to acknowledge that making all psychology students 'love' statistics is unrealistic, improving the experience of just a few can make significant strides toward improving the field of quantitative methods.

Implication of the Recommendations: The Research, Teaching and Service Balance

It is our hope that the suggestions that we provide will be deliberated and acted upon by psychology department chairs/executive committees. However, it is necessary that we discuss an important implication of our recommendations, namely the service,

teaching and research balance of quantitative methodology faculty. When you flesh out the recommendations of this paper it is easy to realize that a new quantitative methods faculty member will have a long list of departmental priorities to act upon, including improving statistical consulting resources, assisting departmental colleagues with research grants/projects and improving departmental statistics courses. The problem is that none of these priorities will satisfy institutional tenure and promotion research requirements, and therefore as valuable as a quantitative methods faculty member may be to the department in a service and teaching role, this will not be enough for them to retain a faculty position.

A new quantitative methods faculty member simultaneously experiences both the pressure to improve the quantitative reputation of the department and the pressure to publish research papers. This situation can be addressed from many different angles. On one hand, many would argue that all faculty members have to balance teaching, service and research commitments and that the challenges facing quantitative methods faculty are no different than those facing faculty in other substantive areas of psychology. For example, clinicians often have to balance the significant amount of time they spend supervising/training graduate students with conducting their independent research. However, others would argue that the demands on quantitative methodologists are becoming increasingly cumbersome and that departments need to consider this fact in evaluating these faculty members. Departments that agree with this latter contention may want to create unique positions for quantitative methods faculty.

One possibility is a 'teaching and service' only position. The advantage of such a position is that these individuals will have more time to spend in consulting and teaching roles, although the disadvantage is that it may be harder to find quantitative methodologists that are interested in positions that are not research based. Another possibility is to adjust the weighting of research, teaching and service for quantitative methods faculty. Traditional rules usually suggest that a faculty member spend 40%, 40% and 20% of their time on research, teaching and service, respectively; however, unique positions may be created for quantitative methods faculty where they are instead expected to spend only 20% of their time on research, freeing up more time for consulting and teaching.

How these issues are addressed will depend on several factors, including the needs of the departments and the motivations of each quantitative methods faculty member; although the important point is that these issues be discussed extensively at the time of appointment. For example, departments may indicate to a new quantitative methods faculty member that they need expanded consulting resources and improved statistics courses, but this may put the candidate in a difficult situation if he/she does not build up a strong enough research record to attain tenure and promotion. Alternatively, a faculty member with little or no interest in consulting may be hired into a department with a desperate need for more consulting, due to a lack of communication during the hiring process. In order for a quantitative methods hire to mutually benefit both the department and the candidate there needs to be a good fit

between the priorities of each party, and, as discussed above, in some instances positions with nontraditional research, teaching and service requirements may be necessary to meet both parties needs.

Conclusion

As research designs in psychology become more complex, it will become increasingly difficult for researchers to stay informed of the advanced methods and software required to properly analyze their data. Over the next couple decades it is expected that progress in psychological research will be heavily tied to the relationship between substantive area researchers and quantitative methodologists. In order for this relationship to blossom, it is important that departments of psychology take the necessary steps to increase the profile of quantitative methods.

However, raising the profile of quantitative methods in psychology departments may be much more difficult than it might seem. More specifically, raising the profile of quantitative methods requires that departments hire more quantitative methodologists, and that these quantitative methodologists improve the teaching and consulting resources of these departments. However, before this can occur there needs to be a dedicated effort by all involved in psychology (instructors, authors, publishers, career counselors, conference organizers, etc.) to increase awareness of the field of quantitative methods. More specifically, it is not only imperative that the drastic decrease in the number of students and faculty specializing in quantitative methods

stop, it is necessary for the trend to reverse and that there be a significant increase in the number of psychology students and faculty specializing in quantitative methods. The American Psychological Association has recognized the difficulties that lie ahead, and the 'Task Force for Increasing the Number of Quantitative Psychologists' is hopefully going to have an effect on increasing the profile of quantitative methods. However, this same recognition of the demise of the field of quantitative methods in Canada is necessary in order to ensure the growth of the discipline of psychology.

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Table 1.

Statistical topics covered in graduate courses in departments of psychology.

Topic	Canadian[1]	US/Canadian (Aiken et al., 2008)[2]
ANOVA	100%	95%
Correlation/Regression[3]	100%	95%
Structural Equation Modeling	15%	52%
Factor Analysis	75%	74%
Nonparametric Statistics	30%	50%
Hierarchical Modeling[4]	5%	34%

Note: 1. Results from the current Canadian study were taken from online course websites (n = 20); 2. Results from the Aiken et al. (2008) study were received through a mail out survey (n = 201); 3. Entitled 'Multiple Regression' in the Aiken et al. (2008) study; 4. Entitled 'Multilevel Modeling' in the Aiken et al. (2008) study.

Table 2.

Review of the data analytic practices for ANOVA designs in popular Psychology journals[1]

(n=140).

Information Reviewed			
Type of Design (%):	One-way		40
	Factorial		60
Total Sample Size (median)			87
Sample Size Equality (%) Across Levels or Cells:	Equal n		26
	Unequal n		74
Performed a Variance Homogeneity Test (%):	Yes		2
	No		98
Largest to Smallest Variance Ratio Across Levels or Cells (%) :		< 2	58
		> 2	42
Performed a Test of Normality (%):	Yes		8
	No		92
When a Test of Normality was Performed[2] (%):	Normal		9
	Nonnormal		91

Note: 1. Child Development, Journal of Abnormal Psychology, Journal of Consulting and Clinical Psychology, Journal of Experimental Psychology: General, Journal of Personality and Social Psychology; 2. Results indicate whether all distributions were normal (Normal) or if at least one of the distributions were nonnormal (Nonnormal).

Table 3.

Recent Job Searches for Quantitative Methodologists in Canadian Departments of Psychology (n = 24).

Question	Yes	No
Have you advertised for a quantitative methodologist in the past five years?	46%	54%
If you advertised for a quantitative methodologist, was the position filled?	77%	23%
If you filled the position for a quantitative methodologist, was the primary research area of the candidate quantitative methodology?	44%	56%