

Report of the Task Force for Increasing the Number of Quantitative Psychologists

American Psychological Association

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EXECUTIVE SUMMARY AND RECOMMENDATIONS

Background and Charge to the Task Force

Over the years, and increasingly in recent years, concern about the shortage of quantitative psychologists has emerged in academic settings, in industry, in government agencies, and in research centers within the public and private sector. Data from the 1990s show that there were on average 2.5 times the number of primarily academic quantitative psychology positions advertised for every quantitative psychology Ph.D. graduated. This ratio was about .50 for other substantive specializations in psychology, among them cognitive, developmental, experimental, industrial/organizational, and social psychology.

Beyond the marketplace, a matter of great concern is the state of quantitative training for Ph.D.s in all areas of psychology. Simply put, training in cutting edge methodology is critical for psychology to move forward as a science.

In August, 2005, APA Division 5 (Evaluation, Measurement, and Statistics) proposed the creation of a Task Force to study the issue of the shortage of quantitative psychologists and to propose mechanisms to ameliorate the problem. In February, 2006, the APA Council and Board of Directors allocated funding to implement the Task Force. The Board of Scientific Affairs selected the Task Force members and its chair. The Science Directorate housed the Task Force. The Task Force met twice, in July, 2006 and November, 2006.

The charge to the Task Force had two critical elements: (1) to assess the resources to train a notably increased number of quantitative psychology Ph.D. students, and (2) to develop strategies to increase the number of students with appropriate backgrounds who seek to enter doctoral training in quantitative psychology.

Definition of the Discipline of Quantitative Psychology

The Task Force developed the following working definition of quantitative psychology:

Quantitative psychology is the study of methods and techniques for the measurement of human attributes, the statistical and mathematical modeling of psychological processes, the design of research studies, and the analysis of psychological data.

Within each of these areas—measurement, statistical and mathematical modeling, design, and analysis—quantitative psychologists develop new methodologies; they also evaluate existing methodologies to examine their behavior under conditions that exist in psychological data. These activities are fundamental to all areas of psychological research and understanding.

Task Force Deliberations

The Task Force identified critical factors that apparently have led to the small pipeline of quantitative psychologists and that the Task Force could reasonably undertake to change: (1) lack of understanding of quantitative psychology in the field of psychology, and (2) lack of well organized information on the nature of quantitative psychology as a field and training resources in quantitative psychology.

Documentation of Quantitative Psychology Training Resources and Diversity

Through an extensive process, the Task Force identified 23 doctoral programs in North America that grant the Ph.D. in quantitative psychology. The Task Force surveyed these programs twice, once to document resources for training an increased number of Ph.D.s in quantitative psychology, and second, to characterize diversity in the quantitative psychology academic setting.

Quantitative programs are small, with a median of just over 3 faculty members and just over 5 Ph.D. students per program. Almost all programs wish to increase faculty size. Programs reported that with current resources they are able to train almost twice the number of students they train now. The greatest impediment to increasing class size is the lack of adequately qualified applicants from the U.S. (or from Canada, for Canadian programs). In addition, the quantitative faculty role involves much activity beyond the training of quantitative Ph.D.s., including the substantial service teaching load, the advisement load for students outside quantitative psychology, and the extensive role as methodological consultants.

In all 80% of quantitative faculty but only 45% of Ph.D. students are male; 83% of faculty and 62% of students are non-Hispanic Caucasian. In comparison with National Science Foundation data for the Sciences and Engineering, quantitative psychology lags behind in ethnic diversity.

Task Force Actions to Date to Address the Pipeline Challenge

In the year between the first Task Force meeting and the preparation of this report, the Task Force has generated a number of products:

- (1) The first scholarly website in existence on quantitative psychology, with the support of the APA Science Directorate at <http://www.apa.org/science/quant.html>
- (2) An assessment of resources for training an increased number of quantitative psychologists and impediments to increased training;
- (3) A list of all currently functioning Ph.D. programs in quantitative psychology, including a preliminary list of programs with concentrations in mathematical psychology;
- (4) A list of quantitative Ph.D. programs in educational psychology;
- (5) Revision of the indexing of the APA book *Careers in Quantitative Psychology 2008*, yielding indexing of programs under the uniform entry, “quantitative psychology”, in cooperation with the Education Directorate of APA and with support of the directors of all the quantitative psychology Ph.D. programs;

- (6) A narrative describing access mechanisms to reach the multiple communities (high school teachers through chairs of graduate programs) that we must reach to increase the pipeline, with a special focus on increasing inclusiveness;
- (7) Presentations at Eastern Psychological Association and at the 2007 APA convention to Teachers of Psychology in the Secondary Schools (TOPSS) on careers in quantitative psychology;
- (8) A handout suitable for distribution to students and teachers of psychology in high school, two-year and four-year colleges describing the field of quantitative psychology and how to prepare for doctoral study in quantitative psychology;
- (9) A document, Careers in Quantitative Psychology, with development in progress at the present time.

Recommendations of the Task Force: Products and Strategies to Enhance the Quantitative Pipeline

Recommendation 1. Continue to build and maintain a website for Quantitative Psychology that will be a central repository for information on the field of quantitative psychology.

Recommendation 2. Develop instructional materials concerning quantitative psychology targeted to particular audiences (e.g., DVD, PowerPoint).

Recommendation 3. Develop articles on quantitative psychology for a number of outlets and audiences.

Recommendation 4. Develop mechanisms for accessible and affordable offerings in quantitative psychology at the APA convention.

Recommendation 5. Foster ongoing relationships between the quantitative psychology community and important organizations that provide access to both teachers of potential students of quantitative psychology and the potential students themselves.

Recommendation 6. Implement direct outreach to potential graduate students in quantitative psychology.

Recommendation 7. Focus on recruitment of students of color into quantitative psychology.

Recommendation 8. Improve the information in Wikipedia about quantitative psychology.

Recommendation 9. Develop a textbook that is an introduction to quantitative psychology.

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BACKGROUND OF THE TASK FORCE AND OVERVIEW OF THE CHARGE

The Shortage of Quantitative Psychologists

Over the years, and increasingly in recent years, concern about the shortage of quantitative psychologists has surfaced in multiple arenas. Most obvious is the job market. Universities, even top-tier research institutions, have found that their attempts to hire in quantitative psychology are often met with failure to fill positions, perhaps for several years running. The lack of sufficient quantitative faculty negatively impacts the training of every doctorate in psychology. Industries whose product is based in quantitative methodology, for example the psychological testing and assessment industry, have found themselves unable to hire qualified quantitative psychologists. Actions of the Federal Government have created job demand that is unparalleled. The "No Child Left Behind" legislation, for example, has created an ongoing demand for quantitative methodologists trained in psychometrics to be hired in the school systems of every state in the nation. Forces within the academy have created other demands, for example the issues concerning high stakes testing for college admission that led to a redesign of the SAT. Over time, quantitative methodology has become more and more complex; experts are needed to tailor and to apply new methodologies to critical research. Quantitative

psychologists are in demand as part of research teams for large scale research projects that require large amounts of research funding. Journal editors provide an interesting perspective on the lack of quantitative psychologists when they attempt to find reviewers to evaluate manuscripts that employ new quantitative methodologies

The Market for Quantitative Psychologists

Quantitative psychologists enjoy a broad range of career opportunities in a variety of settings. These include academic positions in traditional research intensive universities, but also in more teaching focused departments of psychology. Research centers in universities and colleges, including medical schools, employ quantitative psychologists as research methodologists in large collaborative research groups. Beyond the academy, opportunities exist at federal, state, and local government agencies. The test publishing industry employs many quantitative psychologists. The health services sector, including medical research centers, health-care agencies, and pharmaceutical companies employ quantitative psychologists. Quantitative methodologists also find employment in private research and consulting firms, market-research companies, and beyond.

The demographics of quantitative psychology reflect our aging population. A large cohort of quantitative psychologists, trained in the 1960s when there was great federal support for graduate education, are approaching retirement; 50% of all members of APA Division 5 (Evaluation, Measurement, and Statistics) are 55 years of age or older. As we will document, only a very few doctoral students receive Ph.D.s in quantitative psychology each year. Simply put, the availability of excellent positions within and beyond the academy exceeds the supply of new doctorates in the field of quantitative psychology.

The collective experience of faculty in quantitative Ph.D. programs is that new Ph.D.s in quantitative psychology receive multiple offers of excellent positions in strong research institutions in every year; this has been so for many years. We also note that the number of excellent academic positions in quantitative psychology is proliferating, while the production of quantitative Ph.D.s is essentially flat over time.

Some historical market data on job advertisements in various areas of psychology (Gordie & Bell, 1997; <http://www.socialpsychology.org/market.htm>) versus data on earned doctorates in various sub-disciplines of psychology (NSF survey of Earned Doctorates) show that over the period 1991-1996 the ratio of number of job advertisements to number of earned doctorates in particular substantive areas of psychology was close to 2.5 for quantitative psychologists versus about .50 for other substantive specializations in psychology, among them cognitive, developmental, experimental, industrial/organizational, or social psychology (see Table 1). This may well suggest that there have been more jobs in quantitative psychology than individuals to fill them. Specifically, Bell and Goodie (1997) reported 292 jobs for quantitative psychologists advertised in the American Psychological Society (APS) *Observer* from 1991-1996, which represents 5.3% of all jobs advertised in psychology. The NSF reported 122 earned doctorates in Psychometrics and Quantitative Psychology during that

same period. Stated again, as we show in detail in Table 1, the number of job ads exceeded the number of new doctorates in quantitative psychology but not in cognitive, developmental, experimental, industrial/organizational, or social psychology.

The Need for More Quantitative Psychologists from the Perspective of Psychological Science

While market forces are important, a matter of great concern is the state of quantitative training for Ph.D.s in all areas of psychology, not merely quantitative psychology. Training in cutting edge methodology is critical for psychology to move forward as a science and to maintain a leading edge (or even an equal edge) in research with other sciences. Aiken, West, Sechrest, and Reno (1990) surfaced many gaps in the quantitative training of all Ph.D.s in psychology. These gaps included the fundamental area of psychological measurement (Meier, 1993; Merenda, 2005). The gaps have persisted over time (Aiken, 2001a; Aiken, West, & Millsap, 2008). The importance of training in quantitative methodology has been noted by former editors of leading APA journals (Kendall, 2001, for clinical psychology; Parke, 2001, for developmental psychology; Reis, 2001, for social psychology). Being able to provide cutting edge methodological training to Ph.D. students in all the sub-disciplines of psychology in the over 225 Ph.D. programs in Psychology in North America requires an extensive pipeline of Ph.D.s in quantitative psychology. The spate of expected retirements of quantitative psychology leaders in the within the next decade will intensify pressure on this pipeline.

Creation of an APA Task Force for Increasing the Number of Quantitative Psychologists

Development of the Proposal for a Task Force

Division 5 of APA, the Division of Evaluation, Measurement, and Statistics, has long been concerned with both the central place of quantitative psychology within our discipline and the training of quantitative psychologists. For example, it was Division 5 that pressed for the creation of the journal *Psychological Methods*, as a central quantitative publication outlet within the family of prestigious APA journals.

In August, 2005, Division 5 past-presidents Leona Aiken and Liora Schmelkin and then President-elect Lisa Harlow submitted a proposal to APA Council requesting Council discretionary funding to initiate a Task Force of quantitative psychologists that would study the issue of the shortage of quantitative psychologists and propose mechanisms to ameliorate the problem. Council representatives from spheres outside Division 5 signed on as designated co-sponsors of the proposal, including divisions 1, 6, 7, 8, 10, 12, 13, 16, 28, 29, 38, 39, 40, 41, 42, 43, 44, 49, 54 as well as states including Massachusetts, Michigan, and California, and the District of Columbia. It was gratifying to find the clinical practice community and the scientific/academic community in support of the proposal. Strong support and advocacy for the proposal was provided by the Board of

Scientific Affairs, the Board of Educational Affairs, and the Publication and Communication Board of APA.

Funding of the Task Force

In February, 2006, the American Psychological Association (APA) Council of Representatives (COR) and the APA Board of Directors (BOD) implemented the Task Force, charged to consider the problem of a lack of sufficient quantitative psychologists to serve the needs of the broad discipline of psychology. While the original proposal requested funds sufficient to support one meeting of the Task Force, the BOD allocated additional funds, having judged that two meetings of the Task Force would be required.

Charge to the Task Force

The enabling legislation for the Task Force provided the following charge:

The Task Force for Increasing the Number of Quantitative Psychologists will be charged with addressing both the pipeline of qualified students and opportunities for training in quantitative psychology (with an emphasis on early undergraduate education through postdoctoral training). One of the products of the task force will be a report detailing approaches for making qualified students aware of the discipline of quantitative psychology. The report will contain an analysis of sources of students (within and beyond psychology) and will include strategies to inform those who mentor undergraduate students into graduate disciplines about the field of quantitative psychology. Other Task Force products will include various informational materials about training opportunities in quantitative psychology.

Council of Representatives, February 17-19, 2006
Agenda Item No. 15, Task Force for Increasing
the Number of Quantitative Psychologists
(NBI#31E): Request for Discretionary Funds
Council Agenda, pp. 245-247.

The charge has two critical elements:

- (1) Do we have the resources to train a notably increased number of quantitative Ph.D. students?
- (2) How do we increase the number of students with appropriate backgrounds who seek to enter doctoral training in quantitative psychology?

Formation of the Task Force

Administrative responsibility for the Task Force fell to the Science Directorate. The APA Board of Scientific Affairs (BSA) was given responsibility for selection of Task Force members. In spring, 2006, BSA solicited nominations for Task Force members from a broad community within and beyond Psychology.

When soliciting nominees for the Task Force, BSA, in keeping with the spirit of the charge of the original proposal approved by the APA Board of Directors and Council of Representatives, contacted representatives of all the APA Governing Boards as well as the other Boards who supported the proposal for the development of the Task Force. These included the Board for the Advancement of Psychology in the Public Interest (BAPPI), the Board of Educational Affairs (BEA), the Board of Professional Affairs (BPA), the Board of Scientific Affairs (BSA), and the Publications and Communications Board (P&C).

APA Committees that were contacted included the Committee on Psychological Tests and Assessment (CPTA), the Committee on Animal Research and Ethics (CARE), the Ad Hoc Committee to Advance Research (CAR), and the Teachers of Psychology in Secondary Schools (TOPSS).

The APA Divisions whose work and interests include quantitative psychology were also contacted. These included the Society for General Psychology (1), Experimental Psychology (3), Evaluation, Measurement & Statistics (5), Behavioral Neuroscience and Comparative Psychology (6), Developmental Psychology (7), The Society for Personality and Social Psychology (8), The Society of Clinical Psychology (12), and the Society for Industrial and Organizational Psychology (14).

Other psychological associations that were contacted included the Asian American Psychology Association, the Association of Black Psychologists, the National Latina/o Psychological Association, and the Association of Indian Psychologists.

Representatives from industry who were contacted include individuals from the Psychological Corporation, the Educational Testing Service, and the College Board.

Scientific organizations that were contacted included the National Science Foundation.

The Science Directorate selected the nine individuals named at the outset of this report. The Board of Scientific Affairs named Leona Aiken chair of the Task Force.

Marianne Ernesto of the Science Directorate served as staff liaison for the Task Force. Paul Nelson of the Education Directorate served as a second APA staff liaison. The Task Force is grateful for the work of these two individuals.

In November, 2006, Glenn Milewski, The College Board, New York, New York, represented Thanos Patelis at the second Task Force meeting. The Task Force is grateful for his contributions.

SETTING THE STAGE

Definition of Quantitative Psychology

Prior to addressing the specific charges to the Task Force, Task Force members considered the current state of quantitative psychology in North America. As part of this process, the Task Force generated a definition of the field of quantitative psychology. We have defined quantitative psychology as follows:

- Quantitative psychology is the study of methods and techniques for the measurement of human attributes, the statistical and mathematical modeling of psychological processes, the design of research studies, and the analysis of psychological data.
- These activities are fundamental to all areas of psychological research and understanding.
- Quantitative psychology is central to all aspects of psychology: science, education, public interest, and practice. This essential role of quantitative psychology is reflected in the fact that Division 5 – Evaluation, Measurement, and Statistics – is one of the Charter Divisions of the APA.

Quantitative psychology includes research and development in a number of broad areas: measurement, research design, and statistical analysis (see Aiken, West, Sechrest, & Reno, 1990), as well as mathematical and statistical modeling of psychological processes. Within each of these areas, quantitative psychologists develop new methodologies; they also evaluate existing methodologies to examine their behavior under conditions that exist in psychological data (e.g., with small samples). As explained in the descriptions of activities in quantitative psychology given below, the work of quantitative psychologists supports the substantive research of all areas within psychology.

Measurement

Quantitative psychologists are active in the development and validation of tests, scales, questionnaires, and other procedures used to measure human attributes. Underlying the development of tests are mathematical theories of how the scores we observe on tests relate to the underlying human attributes we are measuring, for example how scores on IQ test items relate to the attribute of intelligence. Classical test theory, developed primarily by quantitative psychologists in the last century, has formed the basis for measurement in psychology until recently. Newer developments such as item response theory, generalizability theory, and the integration of cognitive process models with measurement modeling have begun to influence measurement practice in several domains within psychology. Quantitative psychologists act as both developers of measurement theory and as translators of this theory into forms that are applicable to the diverse subfields within psychology. For example, computerized adaptive testing is now used extensively for high-stakes cognitive testing, but it is also being modified for use in

clinical surveys, where reliable, short questionnaire forms are needed. In these translation efforts, quantitative psychologists may work with a team of substantive psychologists, tailoring measurement theory to the needs of a particular research project, developing appropriate software solutions, helping to develop research proposals, and interpreting data.

Research design

Quantitative psychologists develop research designs that allow research projects to provide valid answers to research questions. Research design focuses on four aspects of the validity of research to answer important basic and applied scientific questions. (1) How can researchers design data collection so that they can detect and properly estimate relationships between variables when they exist? (statistical conclusion validity) (2) How can researchers design studies so that they can conclude that a treatment caused an effect? (internal validity) (3) How can researchers design studies so that the treatments and outcome measures represent the intended constructs? (construct validity) (4) How can researchers design studies so that the effects that are found be generalized to the population and settings of interest? (external validity). Traditionally, work in research design has primarily focused on the second question, internal validity, with experiments in which participants are randomly assigned to conditions. However, for many important research questions, randomized experiments cannot be implemented for ethical, legal, or practical reasons. Furthermore, even with randomized experiments, the validity of conclusions is threatened by refusal of individuals to participate and by dropout of participants. These problems often give rise to plausible alternative explanations of the obtained results that need to be addressed by the researcher. Quantitative psychologists working in research design focus on taking steps that can minimize the plausibility of alternative explanations. These steps can include design features like the inclusion of additional comparison groups, implementation of multiple waves of measurement prior to the intervention. Alternatively, they can include statistical solutions like equating treatment and control groups on pretest scores, modeling treatment noncompliance, or adjusting for potential bias due to missing data. These strategies can lead to more accurate estimates of treatment effects and greater confidence that the treatment caused the outcome. Newer approaches have focused on developing methods that help maximize both internal and external validity of psychological research.

Analysis of Psychological Data

Quantitative psychologists encounter a wide variety of types of data intended to answer diverse psychological questions. As a result, quantitative psychologists receive training in fundamentals of statistical analysis but also develop the expertise to conduct research in a specialized area of statistics. Most quantitative psychologists whose work involves statistical analysis are engaged in a combination of three types of activities. First, many quantitative psychologists rely on mathematics to prove certain facts about statistical methods. For example, a quantitative psychologist might prove that a new method of analyzing data is superior to a traditional approach. Second, quantitative psychologists

often use computer simulation to discover properties of various statistical techniques. For example, a quantitative psychologist might conduct a computer simulation to show that a common statistical technique performs poorly when its assumptions are not met. Third, many quantitative psychologists collaborate with individuals in other areas of psychology to collect and analyze data in a manner that can allow them either to obtain a better answer to a research question or even to formulate the question itself in a more appropriate way.

Statistical and Mathematical Modeling in Psychology

Statistical and mathematical modeling is the area of Quantitative Psychology devoted to the development of models for examining psychological processes. These models are representations of psychological phenomena written in mathematical and statistical language. Quantitative psychologists who work in this area develop, test, and apply statistical and mathematical techniques that are suited for investigating psychological processes. These techniques allow researchers to describe the events of interest, form and evaluate precise hypotheses, and build psychological theory using tools from mathematics. Examples of psychological processes suited for mathematical modeling are the development of cognitive abilities over the life-span, the mechanisms underlying attention control, decision making processes, or the patterns of interactions between an infant and his caregiver. Statistical and mathematical modeling in psychology also serves as a bridge between psychology on the one hand and statistics and mathematics on the other. Oftentimes, models developed in statistics or mathematics need to be refined to apply to problems that are unique to psychological research. In these instances, quantitative psychologists adapt those models for application in psychology. Statistical and mathematical modeling is used in all fields of psychology.

Why is the Supply of Quantitative Psychologists Limited?

Several recent articles suggest that the demand for quantitative psychologists, both from academia and industry, is at an all-time high (Clay, 2005; Herszenhorn, 2006). Yet, despite this increase in demand, the available data suggest that the number of doctorates awarded in quantitative psychology has remained relatively flat. To exacerbate the problem, the number of Ph.D.s awarded in quantitative psychology is also fairly small. Data compiled by the APA Research Office suggests that only once in the past 25 years have there been more than 30 such degrees granted in a given year. In 2003, for example, there were 1221 Ph.D.s awarded in clinical psychology, 144 in cognitive, 186 in developmental, 163 in social, and 29 in quantitative. In fact, of the 18 subfields tracked by APA only two subfields (comparative and personality) awarded fewer Ph.D.s (6 and 18, respectively) than quantitative psychology. Table 2 provides further detail on the number of earned doctorates in quantitative psychology doctorates over a 26-year period from 1978 through 2004, as documented by the National Science Foundation Survey of Earned Doctorates; this survey is a population census of all earned doctorates, which has enjoyed a 91% response rate over the last five years (see <http://www.nsf.gov/statistics/srvydoctorates/>). Figure 1 plots number of Ph.D.s in quantitative psychology as a function of year with a linear regression and lowess

(nonparametric smooth) line imposed. The regression line shows a trend from slightly fewer than 20 per year in 1978 and slightly more than 20 per year in 2005.

Considering the increase in demand for quantitative psychologists in the past two decades, it is surprising to see the number of individuals receiving doctorates in the area remain both stagnant and small.

Informal discussions among faculty members of quantitative programs suggest several factors that have led to this state of affairs. First, there are a small number of Ph.D. programs in quantitative psychology in North America, fewer than 30, with only a dozen or so of those producing most of the new Ph.D.s. In addition, of the two or three dozen applicants these programs are likely to attract, many are likely to overlap with other quantitative programs. This relatively small applicant pool, as well as the high degree of overlap among candidates at different schools, makes it very difficult for quantitative psychology programs to grow in size without accepting less qualified students. Why is it that despite the importance of quantitative psychology to the field at large, not to mention the excellent prospect of finding a well compensated job after graduating, few undergraduates pursue advanced study in quantitative psychology? We illuminate three aspects of the issue of the relatively small number of Ph.D. students in the pipeline in quantitative psychology: (1) *lack of understanding of quantitative psychology in the field of psychology*, (2) *non-mathematical orientation of undergraduate psychology majors in North America*, (3) *lack of well organized information on the nature of quantitative psychology as a field and training resources in quantitative psychology*.

Lack of Understanding of Quantitative Psychology in the Field of Psychology

Informal evidence suggests that most psychologists have a very poor understanding of quantitative psychology as a research concentration within psychology. For many Ph.D. psychologists, the only exposure they have had to quantitative psychology as a field is an introductory statistics sequence, modally a year in length and most often taught by faculty members whose research programs are in substantive areas of psychology rather than in quantitative methodology (Aiken, 2001b, Aiken et al., 1990; 2008). The almost universally required introductory course sequence in statistics is focused on learning how to employ existing statistical techniques, rather than on research on how new statistical methodologies are developed and evaluated. Students study textbooks rather than original sources. This makes sense from the perspective of bringing students “up to speed” at some level of data analysis, the goal of the introductory statistics sequence. However, such training, expedient as it may be, does not introduce doctoral students to the nature of quantitative psychology as a research and scholarly area in its own right.

Psychology faculty who, in their own training, have experienced quantitative methods as a set of techniques rather than as a research enterprise cannot transmit the nature of quantitative psychology as a scholarly concentration to undergraduate students. Undergraduate students often engage in research in a substantive area of psychology, working in the laboratories of faculty members in these areas and in collaboration with graduate students. In this way, undergraduate students gain an appreciation for research

and scholarship in one or another substantive area, an appreciation that leads them to pursue graduate study in a substantive area. Given the rarity of faculty who are quantitative researchers coupled with the rarity of undergraduate psychology majors who are quantitatively oriented, similar undergraduate experiences in quantitative methods are not commonly available. While almost every undergraduate psychology major will know about social psychology and clinical psychology, it is our experience that only a tiny fraction will have ever heard of quantitative psychology. Even if an undergraduate, in psychology or any other major, does discover quantitative psychology, the available information on the field is often confusing, incorrect, or both. Only in August, 2007, has a scholarly website devoted to quantitative psychology been implemented (as a product of this Task Force); this website project is in its nascent form. Until this time, there has not been a reliable and clear central repository of information about quantitative psychology for prospective applicants.

Non-mathematical orientation of undergraduate psychology majors in North America

The majority of undergraduate psychology majors are non-mathematically oriented. Undergraduate programs in psychology often have only one semester of college mathematics as the mathematics requirement; even one semester of calculus is typically not required. Some undergraduate programs have moved to dividing psychology students to those who receive a Bachelor of Arts Degree (BA) versus a Bachelor of Science Degree (BS) in psychology; those receiving the BS degree may be required to take one semester of calculus. This non-mathematical orientation of the strong majority of undergraduates in psychology coupled with the typically limited curriculum in quantitative methods in psychology at the undergraduate level imposes a limitation on the number of mathematically talented students directed to the field of quantitative psychology as they approach graduate training.

Lack of Resources to Learn about Quantitative Psychology

There is at present no organized source of information on quantitative psychology as a sub-discipline of psychology. Until August, 2007, there was not even a website devoted to Quantitative Psychology that provided a definition of the field and a list of Ph.D. programs in quantitative psychology in North America. Until August, 2007, there was no section of the American Psychological Association website that provided information on quantitative psychology as a Ph.D. concentration. If one “googles” Quantitative Psychology, the first entry that appears is <http://www.gradschools.com>, a commercial website. This website provides an inaccurate and incomplete list of quantitative Ph.D. programs in North America. Another website <http://www.petersons.com/> lists only two schools, neither of which has a Ph.D. program in quantitative Psychology; www.schoolfinder.com mentions none of the major quantitative psychology Ph.D. programs (nor those in Educational Psychology). The website <http://www.allpsychologyschools.com/> is the most accurate repository of current quantitative psychology programs; it identifies half of the current Ph.D. programs in quantitative psychology in North America, but also includes departments that do not currently offer the Ph.D. in quantitative psychology. The APA book *Graduate Study in*

Psychology published every year by APA, indexes quantitative psychology programs. Over the years the index terms have varied greatly, with quantitative, psychometrics, measurement, research methods, quantitative (including measurement) and quantitative methods among the terms over the years. The changing and complex terminology reflects the complexity of the structure of the broad field. Only in June, 2007, did the APA book *Graduate Student in Psychology 2008* appear with most quantitative psychology programs listed under the index entry “quantitative psychology”. This cohesive indexing is a direct result of a cooperative project between the Task Force and the APA Education Directorate, coupled with the support of the directors of the majority of quantitative Ph.D. programs. Appendix A provides a narrative from one bright young undergraduate who sought to find information on quantitative psychology Ph.D. programs; the narrative illuminates the disarray in information about quantitative psychology. (Note that all the URLs given in this paragraph were accessed on December 21, 2007).

Although the current status of quantitative psychology in the United States is not what we would hope, it is by no means bleak. There is a core group of healthy and productive Ph.D. programs in quantitative psychology, some of which have existed for over 50 years, others of which are newer and growing in strength. The number of individuals receiving doctorates in quantitative psychology, while not increasing, has not decreased either.

The remainder of this document focuses on the specific charges to the Task Force with an eye towards alleviating some of the problems highlighted in this section. The remaining two sections of the document focus on the specific charges to the task force from our two intertwined perspectives: (a) whether we have the resources to train larger numbers of quantitative psychologists, and (b) how to increase the number of students with appropriate backgrounds who seek to enter doctoral training in quantitative psychology.

QUESTION I: DO WE HAVE THE RESOURCES TO TRAIN A NOTABLY INCREASED NUMBER OF QUANTITATIVE PH.D STUDENTS?

Increasing the number of quantitative psychologists requires a training infrastructure of doctoral programs in quantitative psychology. As we have indicated, the number of these programs in North America is small. The first question we asked was whether the present infrastructure of doctoral programs in quantitative psychology could support the training of an increased number of quantitative Ph.D. students. Assessing available and potential training resources required our developing a conceptualization of quantitative psychology from the perspective of the assumptions underlying the proposal to APA Council for the Task Force. This conceptualization underlay our assessment of training resources. For its work, the Task Force conceptualized as quantitative Ph.D. programs, those providing training in research design, in statistical methodology, and measurement. These topics comprise the core of Ph.D. training in quantitative methodology provided to doctoral students within departments of psychology (Aiken, et al., 1990, 2008).

Developing a List of Quantitative Psychology Ph.D. Programs

Following this conceptualization, we began our resource analysis by developing a list of the Ph.D. concentrations in quantitative psychology that are housed in Departments of Psychology. We used a number of sources to develop the list.

- (1) *A list of training programs in quantitative methods developed by APA Division 5, Evaluation, Measurement, and Statistics.* In March, 2005, Division 5 undertook the project of creating a list of training programs in quantitative methods, to include programs in psychology and education. Division 5 made a call for program identification from the listserv of its members.
- (2) *Graduate Study in Psychology, 2007.* The Task Force received an advance copy of Graduate Study 2007 in July, 2006. From this we culled all programs indexed under “Quantitative Psychology/Psychometrics.” A number of well recognized quantitative Ph.D. programs were not listed in the index. We reviewed the actual narratives of individual departments in the *Graduate Study in Psychology, 2007* book to determine whether these departments listed a quantitative concentration.
- (3) *Departmental websites.* We reviewed websites of departments that historically had had a quantitative concentration but were not identified by the above sources.
- (4) *Self-identified programs in a survey by Aiken, West, and Millsap (2008).* Aiken et al. (2008) had carried out a survey of the quantitative curriculum of all Ph.D. programs in North America, N=234 in all. Data collection was completed in 1999 and with an 86% response rate (n=201). In that survey departments were asked whether they had Ph.D. programs in any area of quantitative methods. In fall, 2006, we reviewed the websites of all programs that had answered affirmatively to determine whether the quantitative programs still existed. We also contacted

quantitative faculty in those departments to determine whether the programs were still functioning.

The list of quantitative psychology Ph.D. programs that emerged from this exercise is given in Table 3. Table 3 first lists 23 quantitative programs that are official concentrations within their departments, that admit and graduate quantitative Ph.D. students. A second group of 4 quantitative concentrations draws students from substantive areas; these students are admitted through the substantive areas and also train in quantitative methods, with a range of levels of intensity of quantitative training. Third, we identify 5 Ph.D. programs with a mathematical psychology emphasis (see the next section of this report). Finally, we list one related doctoral program in quantitative methods in Human Development.

Mathematical Psychology and Quantitative Psychology

Mathematical psychology is an approach to scientific research across multiple sub-disciplines of psychology that “is broadly defined to include work of a theoretical character that uses mathematical methods, formal logic, or computer simulation” (Society for Mathematical Psychology website, <http://www.cogs.indiana.edu/socmathpsych/>, accessed August 1, 2007). Scholarly work involving approaches of mathematical psychology includes research in complex decision making, neural networks and brain mechanisms, models of perception, psycholinguistics and computational models of language, learning, subjective probability, game theory, psychophysics, problem solving, and beyond. In fact, quantitative programs in some departments of psychology include tracks in both traditional areas of quantitative psychology (measurement, research design, and statistical analysis) and in mathematical and statistical modeling. In other programs, quantitative methods training for the Ph.D. is focused on the traditional areas; mathematical psychology exists as a separate concentration. In all, only a handful of psychology departments identify a distinct mathematical psychology concentration, most notably University of California, Irvine; University of Illinois; Indiana University; Ohio State University; and Purdue University.

Educational Psychology Programs in Quantitative Methodology

Departments of Educational Psychology often house concentrations in quantitative methods. There is a strong tradition of methodological training in Educational Psychology, with research focused toward educational issues (e.g., educational measurement). Individuals trained in quantitative methods in education “bridge the gap between the theoretical statistician/psychometrician and the educational researcher. They teach, act as consultants to the educational researcher, and conduct their own research on statistics and psychometrics as applied to education” (University of Wisconsin, Department of Educational Psychology website, <http://www.education.wisc.edu/edpsych/gradprog/quant.htm>, accessed December 21, 2007). To understand quantitative methodology training in Departments of Educational Psychology, the Task Force reviewed the websites of 81 Departments of Educational Psychology included in a compendium of Educational Psychology programs at website

<http://www.personal.psu.edu/users/d/m/dmr/links.htm>. We also consulted with quantitative colleagues in Departments of Educational Psychology to insure that we had reviewed major quantitative methodology programs in Educational Psychology. Examination of the program websites led to three observations. First, for some but by no means all of the Educational Psychology based training programs in methodology, there is substantial overlap with training in methodology in quantitative programs within Departments of Psychology. Second, the focus of application of methodology training in Departments of Educational Psychology is in educational research—educational measurement, evaluation of educational programs and educational policy. Third, while exceptions exist, our observation is that hiring of quantitative methodologists within departments of psychology is mainly confined to individuals with doctorates in psychology who have familiarity with psychology as a discipline; it is rare that a methodologist with a Ph.D. in educational methodology is hired by a psychology Ph.D. program. A list of quantitative programs housed in Departments of Educational Psychology is provided in Appendix Table B.

Task Force Focus and Quantitative Methodology Programs beyond Psychology

There is an array of programs in quantitative methodology outside psychology—in other social sciences, in the biological sciences, in education, in business, in statistics and biostatistics, in economics, in decision science, in medical-related fields, and beyond. All these programs offer advanced training leading to the Ph.D. in some aspect of quantitative methodology. Our Task Force did not have the resources to undertake a study of this vast array of training resources for quantitative methodology; nor was this our mission.

Given the Task Force’s concern with the ability to train Ph.D. quantitative psychologists who are most likely to be employed as faculty in departments of psychology and in psychology-oriented research settings, we focused our efforts to document training resources of programs that offer the Ph.D. in quantitative psychology.

Survey of Ph.D. Training Programs in Quantitative Psychology: Resources and Diversity

In order to characterize the existing resources to train Ph.D.s in quantitative psychology and to characterize the potential for training an increased number of quantitative psychologists, the Task Force surveyed the population of Ph.D. programs identified as training Ph.D.s in quantitative psychology. The complete survey instrument is given in Appendix C. The survey instrument and all procedures for data collection and data management were approved by the Institutional Review Board of Arizona State University. Data reported here are based on the 23 doctoral programs in quantitative psychology listed in the first section of Table 3. These programs grant the Ph.D. in quantitative psychology, and all are housed in Departments of Psychology. Results of the survey are provided in Tables 4 through 6. The survey was administered in two sections over time. The first section on resources was administered to the majority of programs in fall, 2006; pages 2-3 of the survey instrument in Appendix C address resources. The

second section on diversity (pages 4-5 of the survey instrument in Appendix C) was administered in early 2007. The time lapse between data collection points accounts for slight discrepancies between data sets (e.g., due to hiring of and resignation of quantitative faculty during this period).

Table 4 shows the size of quantitative programs from the perspective of both faculty and doctoral students. It also documents judgments by quantitative faculty of the capacity of their programs to train more quantitative Ph.D.s with their current resources. Further, it documents quantitative program wishes for growth, and judgments of ideal program size. Totals, medians, and means are reported for all counts in Table 4.

Faculty

As shown in both Table 3 and Figure 2, quantitative programs are small, with a median of 3.3 full time equivalent (FTE) faculty (mean=3.83). Of the 85 faculty across all programs, 89% are involved in training quantitative doctoral students. Quantitative faculty members often have responsibilities in other areas; this is so for 58% of quantitative faculty, who serve as mentors for Ph.D. students in substantive areas of psychology as well.

Doctoral Students

As shown in both Table 3 and Figure 3, the student bodies of quantitative doctoral programs are also small, with a median of 5.3 Ph.D. students in all years (mean = 7.5) due to two outlying large programs). In all 17% of programs have 2 or fewer students; 35% have 3 to 5 students; 26% have 8 to 10 students, and only 17% have over 10 students. In all, 65% of the quantitative Ph.D. students entered their doctoral programs within the past 3 years. What is worrisome is that 32% of the 23 programs had no students enter in fall, 2006, with a median of just over one student entering in fall, 2006 per program.

Maximum Student Capacity with Current Training Resources

Only 3 of the 23 programs indicated that their current number of students was the maximum number the program could train effectively with current resources. The remainder indicated that they could train more students with the current resources. *Compared to a median of 5.3 students per program, programs reported that they could train almost twice that number, a median of 10.3 in all.* The ideal number of students, given current resources was slightly less than that, a median of 9.2 students.

Desire for Growth

Fully 91% of programs reported that they wished to increase the number of faculty. The median desired increase in number of faculty was approximately two. The same percent of programs reported that they wished to increase the number of students from current levels. Given growth in number of faculty, the median desired number of students of

10.38 was slightly more than double the current median number of 5.00. Looked at another way, collectively 23 programs reported that they have a total of 173 students, and that with increased resources they would like to have 251 students, or 45% more students. *There is substantial desire for growth of quantitative training programs among the programs themselves.*

Limitations on Ability of Programs to Increase the Number of Ph.D.s.

Table 5 documents limitations programs experience that impede their growth in production of Ph.D.s. In the survey we asked respondents to rate the extent to which each of 10 factors set limits on Ph.D. production. Lack of qualified applicants from the United States was the most frequently articulated limitation of all, endorsed by 83% of all programs. The supply of qualified international students is apparently much greater; only 48% of programs mentioned lack of qualified international students as an impediment to growth. Lack of sufficient faculty to train more Ph.D. students was mentioned by 84% of programs. Lack of sufficient research or teaching assistantships to support more students was also a concern (65% of programs). While the student/faculty ratio in quantitative psychology is small, quantitative faculty have heavy service teaching loads (mentioned by 83% of programs), heavy advisement loads for students outside quantitative psychology (57% of programs), heavy research service loads on grants as methodologists or methodological consultants (56% of programs). Finally, 61% of programs experience resistance from other programs within the department to increasing quantitative class size.

Diversity of Quantitative Doctoral Students and Faculty

Table 6 provides data on the ethnic/racial and gender diversity of students and faculty in the quantitative field. In all 22 of the 23 programs that grant the Ph.D. in quantitative psychology reported. Among doctoral students, gender is fairly evenly distributed; 55% of students are female. Just under two thirds of students (66% in all) are US citizens. In all, 62% are Non-Hispanic Caucasian, most of the remainder, Asian or Asian-American (32%). Together Hispanic and Black students comprise 4.7% of the total students reporting. Among faculty, the vast majority (80%) are male. With regard to faculty race/ethnicity, 83% are non-Hispanic Caucasian; 14% are Asian; 2% are Hispanic, there is one native American. As we document in more detail in a later section of this report, the diversity of doctoral students in quantitative psychology falls below that of doctoral students in Science and Engineering, as reported by the National Science Foundation.

QUESTION 2. HOW DO WE INCREASE THE NUMBER OF STUDENTS WITH APPROPRIATE BACKGROUNDS WHO SEEK TO ENTER DOCTORAL TRAINING IN QUANTITATIVE PSYCHOLOGY?

As the beginning of the first meeting of this task force we took some time to review how each quantitative psychologist in the group discovered the field. Despite the vast differences in backgrounds, both geographically and educationally, each and every member had basically stumbled onto the field by chance. In each case there was a pivotal individual who directed each of us along our path. Many task force members entered graduate school in a substantive area of psychology and were redirected to quantitative psychology by an important mentor who brought them into the quantitative field. In certain instances this was a practicing quantitative psychologist, and in others it was someone who had simply heard about quantitative psychology. In one case, after finishing her undergraduate studies, one of the committee members sent a letter to a graduate college explaining her desire to pursue higher education; she did not apply to any particular program. As fortune would have it, this letter found its way into the hands of a world renowned psychometrician who enthusiastically accepted this eager young student. In another case, after discovering the job prospects for Ph.D.s in literature were less than fantastic, one of our task force members sought advice from his undergraduate psychology advisor. When asked what part of psychology he found the most interesting, this member responded, "Well, I'd like to stay as far away as possible from clinical psychology." This led his advisor, who had received his Ph.D. from a department that had a concentration in quantitative psychology and was thus vaguely aware of the specialization, to suggest that perhaps quantitative psychology would be worth looking into.

These stories help to illustrate two very important points. First, there is already a somewhat extensive social network that has supplied prospective students to the field of quantitative psychology for quite some time. This is encouraging in that it has provided a steady, albeit small, stream of qualified students over the years. In addition, if we can find ways to extend this network or increase its efficacy, then there is reason to be hopeful that it will direct more students towards our area. The second point is not as encouraging. What this also means about quantitative psychology is that, by and large, most people find their way to our field by accident. One is forced to wonder how many potential quantitative psychologists have gone on to pursue other careers for lack of that one fortuitous brush with our field.

In the next sections we will address what we have deemed to be the four critical aspects to answer the committee's first charge. We begin with a discussion of what constitutes an appropriate background. This allows us to provide guidance to undergraduates who are interested in our field with respect to what kinds of skills they should develop. A benefit of this description is that it can suggest other areas where we might find prospective graduate applicants for our quantitative programs. This leads quite naturally to a

discussion of the various routes into quantitative psychology and the ways our field can be more proactive to encourage a diverse applicant pool. Finally, we present several ideas we feel could increase the visibility of our field.

How to Prepare for Doctoral Study in Quantitative Psychology

Once a student has decided that quantitative psychology may be an area of possible doctoral study, our Task Force advises students to consider the following academic and research experiences to prepare for the doctoral programs in North America. It is important to note that doctoral programs in quantitative psychology vary in the background and experience that they require for their applicants, so it is important to visit individual program websites for specific requirements and to contact program administrators for further clarification.

As an undergraduate, wherever possible, it is useful to identify a faculty member who has quantitative interests to supervise and mentor during the preparation for graduate school. At many schools this may be difficult because there are not faculty whose focus is on quantitative methods. If this is the case, it is useful to align oneself with a faculty mentor who is an active researcher from whom one can receive advice and gain experience as a research apprentice.

Coursework in Mathematics and Statistics in Undergraduate School

Among the frequently asked questions of undergraduate students who are considering the field of quantitative psychology is what mathematics is required. In fact, this answer varies widely by quantitative program. Quantitative programs do not state minimum mathematics and statistics requirements for entry to quantitative programs. Yet, admissions committees carefully review transcripts for evidence that the applicant has studied mathematics and/or statistics and has talent in this area. It is useful, and for admission to some quantitative programs essentially mandatory, that students have demonstrated that they successfully completed college-level calculus. A course in linear algebra is particularly useful. A sustained interest in mathematics and/or statistics is important. Many undergraduates place out of college mathematics courses through advanced placement tests and coursework completed during high school. It is also possible that students have pursued majors during college that require few mathematics requirements. If this is the case, it is still important show evidence that there is an adequate interest and good performance in mathematics.

Coursework in mathematics in graduate school

Some quantitative graduate programs will encourage applicants, once accepted to the doctoral program, either to brush up or strengthen their mathematics abilities by taking courses in the mathematics, statistics, or biostatistics departments. In addition to calculus and linear algebra, math courses might include advanced calculus, and multivariate calculus. Statistics courses might include introduction to statistics, statistical methods and theory, numerical methods, statistical linear models, or probability.

Undergraduate coursework in quantitative methodology in psychology

There are courses in the psychology department that would be very useful to take prior to applying to a quantitative doctoral program. The number of these courses available within the department of psychology varies widely across departments. They may consist of a one semester/quarter introductory statistics course, an advanced undergraduate statistics, tests and measurement, and research methods. Sometimes these courses are offered in other departments as well. We recommend that students show very good to excellent performance in the following types of psychology courses: statistics for the behavioral sciences, research methods, tests and measurements (psychometric theory), and any advanced psychological statistics course that is offered.

Taking graduate methodology courses as an undergraduate.

Some psychology departments at universities will allow (with permission) qualified undergraduates to enroll in graduate-level statistics courses such as a two-semester first year doctoral sequence or upper-level quantitative courses (e.g., multivariate analysis, structural equation modeling, psychometric theory). These experiences are extremely valuable and demonstrate to an admissions committee a student's ability to perform as a graduate student.

Independent research project

If there is an opportunity to conduct an honors thesis, capstone experience, or master's thesis, this independent research is an excellent way to demonstrate the ability to conceptualize a research problem, select an appropriate design, obtain data, conduct analyses, and report findings. Honors theses that involve data-intensive experiences involving statistical/quantitative modeling are strongly encouraged.

Data-intensive research experience

Another important experience that can help an undergraduate or master's student prepare for a quantitative program is simply joining a professor's laboratory where there is a chance for significant involvement in a research project (e.g., as a research assistant). While research participation is always useful, for a doctoral program in quantitative a student's involvement should ideally be focused on the data component of the research, including assisting with research design, item writing, data management, planning for statistical analyses, conducting analyses using common and specialized statistical software, and reporting findings.

Other valuable experience

The following additional activities are useful ways to help an admissions committee see a student's commitment to quantitative. Sometimes there are opportunities to participate in additional educational experiences, such as multi-day workshops in quantitative methods, that are offered either at one's own institution, prior to a national conference, or

in some other forum. These workshops do not substitute for a course, but they provide a valuable overview of quantitative area. Students are encouraged to present their research (preferably with a quantitative emphasis) at a professional conference and/or publish their research. Most often, it is expected that these professional activities will be conducted under the supervision of a mentor or research advisor. Some students have the opportunity to be a paid (or unpaid) teaching assistant for a research methods course, a statistics course, or other related course.

Routes into Quantitative Psychology

Undergraduates in psychology

Undergraduates in psychology from the United States are a potential source of doctoral students in quantitative psychology. Undergraduate psychology majors find their way to quantitative psychology through contact with faculty mentors who draw them to quantitative psychology through advisement or research experiences. Interplay between the relative rarity of quantitative faculty coupled with the low rate of interest of psychology majors in the quantitative aspects of the field means that the yield here is small. Our experience is that highly qualified psychology undergraduates constitute a relatively small component of the applicants for quantitative psychology. Quantitative Ph.D. programs compete mightily for these students. In contrast there is a richer pool of international students, almost exclusively Asian, who are psychology majors and who also have excellent mathematics backgrounds. There is a steady stream of such students into Quantitative Ph.D. programs.

As we have indicated, we attribute part of the lack of interest of undergraduate psychology majors in quantitative psychology to a lack of awareness of the field of quantitative psychology. As we have indicated there is an information vacuum that pervades undergraduate psychology—advisors are unaware of the field; moreover, faculty not in quantitative are often unaware of the field, except in those relatively few departments that house quantitative programs.

Other undergraduate majors

Relevant skills for graduate training can be acquired in a wide range of other undergraduate majors that require some study of mathematics, statistics, and/or computing as part of the major. A potential source is students who come to college or university in mathematics or more frequently engineering and who switch majors. While these students are mathematically talented, a goodly number discover that they do not want to be mathematicians or engineers. Seymour and Hewitt (1997) found that reasons students in science and engineering left their majors was that other majors offered better education and held more interest (60% of female students leaving science and engineering, 57% of male students); discouragement and lost confidence attributable to poor academic performance was less a reason (37% of females, 32% of males). Some universities (e.g., U.C. San Diego, University of Michigan) have been proactive in attracting these students to other disciplines that may draw on talents and backgrounds.

The field of psychology might well capitalize on the exodus from engineering and science to attract talented students to psychology in general and to more quantitative aspects of psychology in particular. Students who are dissatisfied with their engineering or mathematics curriculum may be attracted to pursue careers in quantitative psychology. A few prominent quantitative psychologists were originally trained in mathematics, physics or engineering, though this is not a necessary background as there are prominent quantitative psychologists who have educational backgrounds in psychology, English, and anthropology. It may be useful for quantitative faculty to attend career fairs in colleges of engineering, mathematics departments, and other science departments in order to advertise quantitative psychology as a career path. Similarly, a well-placed quantitative psychology course may satisfy curriculum requirements for students in engineering. Such a course has the potential to generate relatively high enrollments. Further, the course could be taught at a relatively high mathematical level. There could be both undergraduate and graduate versions of such a course. It has been our experience that courses such as these have many advantages, including generating new collaborations between quantitative psychologists and faculty in engineering and the sciences and providing a solid pool of undergraduate and graduate students with strong mathematical and analytic backgrounds who work on research teams with students in psychology. At the University of Washington there was an experimental course that paired a student from the social sciences with a student from applied mathematics with each pair working on a class project. The social science students brought their research problems to the table and the applied math students brought their modeling skills. There are many opportunities available on college campuses for advertising quantitative psychology among engineering and mathematics students, as well as opportunities for creative courses and educational experiences that go beyond the usual statistics courses that characterize many required methods courses in psychology curricula.

Students with mathematics majors do apply to quantitative Ph.D. programs. Often they have some relationship to psychology as well, perhaps through a psychology minor, perhaps through a course in psychology and a faculty member in psychology who captured the interest of the student. In fact, faculty from quantitative psychology specifically reach out to mathematics majors and inform them about quantitative psychology.

A Creative Model for Attracting Undergraduate Students: The University of Kansas Minor in Social and Behavioral Sciences Methodology (SBSM)

Very recently, several undergraduate social science departments at the University of Kansas have created an interdisciplinary minor in quantitative behavioral social sciences. The program provides an interesting model for attracting students to the quantitative psychology field. Talented undergraduate students complete their undergraduate social science quantitative courses early and then move into graduate courses in quantitative methods, now taught primarily in the Department of Psychology (due to the availability of these courses in Psychology). These students also carry out quantitatively intensive independent research in their own disciplines with mentors from their own departments.

The program could well serve as a pipeline into doctoral training programs in Quantitative Psychology.

As described in the proposal for the program, “The Minor in Quantitative Behavioral and Social Sciences is a program that provides undergraduate students a broadened and coordinated platform for advanced training in research methodology and practical research experience. Students electing to minor in SBSM are provided with an opportunity to receive advanced training in quantitative and qualitative methods as applied in the behavioral and social sciences. This Minor allows students to develop graduate-level expertise in applied statistical methods. Students who graduate with this Minor acquire skills that will significantly enhance their career opportunities in areas related to their primary major (e.g., sociology, political science, psychology, a foreign language).”

Little, Schrodtt, Keyton, Templin, and Preacher (2007, p.1).

Students with master’s degrees

There are a few Master’s programs in the U.S. that offers a master’s degree with quantitative emphasis (e.g. James Madison University; Middle Tennessee State University). Ph.D. programs in quantitative psychology now recruit students who have received their degrees from these programs. In a number of instances, international students have obtained master’s degrees in some form of quantitative methodology in their native countries; they then come to the U.S. for Ph.D. level training. Other more general Masters programs in psychology plus more specialized masters programs such as statistics are additional potential sources of Ph.D. students in quantitative psychology.

Doctoral students from other graduate concentrations within psychology

A not uncommon occurrence is that doctoral students begin their Ph.D. study in psychology in a substantive area but transfer to the quantitative Ph.D. program during the course of their training. Doctoral students who have not received exciting training in quantitative methods at their undergraduate institutions discover an interest in quantitative methods from their doctoral training. Quantitative faculty are always on the lookout for talented Ph.D. students in their classes and may actively recruit them into their quantitative programs. One eventuality is that students in substantive areas of the Ph.D. program double train, that is, in both their substantive area and in quantitative methods. These Ph.D. students are often sought after on the academic job market because they bring to a department both a substantive area of research and potential teaching and a strong knowledge of quantitative methodology (see Aiken et al, 2000, 2008 for further discussion).

Advisors and faculty and quantitative student recruitment

Undergraduate advisors and faculty have an important role to play in introducing bright undergraduate students to quantitative psychology. We believe that lack of awareness of

the quantitative field among academic advisors and among faculty in substantive areas of psychology limits this potential source of recruitment.

National Science Foundation Integrative Graduate Education and Research Traineeship Program

Another potential route of mathematically talented students into quantitative psychology is through programs such as the NSF Integrative Graduate Education and Research Traineeship (IGERT) program,

http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=12759, which funds new models for graduate education and training. Students are trained in a cross disciplinary manner while having deep knowledge in their chosen discipline. This could allow, for example, study in quantitative psychology which includes, for example, engineering courses. Such routes may be appealing to students who have not been heretofore tapped for entering the quantitative field.

Post-doctoral training in Quantitative Psychology

There are post-doctoral training resources for quantitative psychology, though they are not plentiful. Some are funded by federal agencies. Three examples are as follows: (1) the joint postdoctoral training program of the Methodology Center and the Prevention Research Center at Pennsylvania State University, funded by the National Institute on Drug Abuse (NIDA); (2) the postdoctoral training program in quantitative methods for behavior research at University of Illinois, Urbana-Champaign funded by the National Institute for Mental Health (NIMH); (3) the postdoctoral program in advanced quantitative methods at the University of Virginia, funded by National Institute on Aging (NIA). Arizona State University has a training program in Prevention Research funded by NIMH; the focus is not on quantitative training per se, but some postdoctoral fellows have taken advantage of the training opportunities in the Arizona State University quantitative Ph.D. program. A traditional source of post-doctoral training is post-doctoral positions on individual research grants. Taken together, a number of the postdoctoral positions are designed for students who already have quantitative training and want to enhance this training. Other positions are open to those with substantive training in psychology (with some quantitative training, characteristic of the Ph.D. degree in psychology broadly defined) who wish to add focus on quantitative methods.

Industry sponsored or industry prompted entry into quantitative psychology

In testing, research, and educational organizations, where quantitative psychologists and similar applied researchers and measurement experts are needed, it is difficult to hire scientists at any level (i.e., entry, some experience, and seasoned professionals). In an effort to build the pipeline of aspiring students into the work force, organizations around the country are establishing internship programs for graduate students (i.e., ACT, College Board, ETS, Law School Admissions Council, etc.).

The most popular internship is a summer internship in which graduate students across the country apply for a summer-long experience within these organizations and companies. The summer offers a wonderful opportunity for students across the country to travel to the location of the headquarters of these organizations and become immersed in projects and experience the day-to-day activities of these organizations. Larger programs offer opportunities for undergraduate students, as well.

Far more rare, but available, are year-long internships for graduate students. Because of course schedules during the academic year, the proximity of the organization/company to a university with a graduate program in quantitative psychology is the major limiting factor for these programs. An example of such an internship (founded by one of the members of the Task Force) is at the College Board, which supports advanced students from the Psychometrics Program at Fordham University. Others may exist of this sort (e.g., University of Iowa and the Iowa Testing Programs or University of North Carolina at Greensboro and the State of North Carolina testing program.). The year-long internship experience gives graduate students the opportunity to involve themselves more fully in research projects and to obtain significant experience that the constraints of a summer experience do not offer. The College Board finds that the program is not only beneficial to students, but also contributes to the ability to find fully trained, entry-level professionals for open positions.

There are two other ways that organizations offer opportunities for students to become engaged in the field of quantitative psychology. The first is grants to students for quantitative research to be carried out at the students' home institutions; the College Board has such a program. A second way that is common for many organizations (e.g., the American Institutes of Research) is to hire students who have just graduated from college and get them involved in projects as research assistants. After a short time in these positions, these entry-level professionals are encouraged to return to graduate school to secure more advanced training in quantitative methods in the hopes of their returning to secure positions as researchers.

Organizations and companies make a direct contribution in building the pipeline of quantitative psychology by offering students internship experiences, funding sources, and employment opportunities. Additionally, these organizations supply other means of supporting the field by permitting professionals in these organizations to be adjuncts offering both conceptual and applied experiences to prospect students. These organizations also offer both human and financial resources to support the profession.

Increasing the Visibility of Quantitative Psychology

We consider strategies to increase the visibility of quantitative psychology as a field and career path in psychology from two perspectives. First we consider the structure of communities within the educational system that can be utilized to disseminate information about quantitative psychology. Second we recommend products that would be of use for disseminating information. We begin by acknowledging the Education

Directorate of APA as a central organization with reach into all levels of the educational system, and a resource for the quantitative psychology community.

Structure of communities within the educational system

The number of students interested in psychology as a major appears to be ever increasing. In high schools across the nation, over 100,000 students took AP Psychology exams in 2006. Introducing high school students to the many career opportunities for quantitative psychologists is the beginning point for the pipeline into quantitative psychology. Students who enter community colleges, as well as attending four-year institutions, often take an Introduction to Psychology course, regardless of their major. Information and resources should be made available that can be used by teachers and students that will introduce them to the field of quantitative psychology and motivate them to investigate and pursue graduate programs.

Dissemination of information about quantitative psychology can be targeted at the following levels within the educational system:

- (1) within high schools, to students taking psychology in high school, teachers of high school psychology, guidance counselors in high schools;
- (2) within community colleges, to chairs of psychology departments, psychology faculty, advisors, and to students taking psychology courses;
- (3) within four year colleges and comprehensive universities, to chairs of psychology departments, psychology faculty, advisors, and to students taking psychology courses.

Reaching high school students and high school teachers of psychology

Teachers of Psychology in the Secondary Schools (TOPSS) is a national organization of high school teachers; its mission is to “promote the scientific nature of introductory and advanced high school psychology, to meet curricular needs of secondary school teachers, and to provide opportunities for high school students to be recognized for the academic excellence” (www.apa.org/ed/topss). There are 2000 members of TOPSS, high school teacher affiliates of the APA. Utilizing the TOPSS resources that are already available to high school psychology teachers and their students, information on the field of Quantitative Psychology can be distributed. Members of TOPSS receive the APA Monitor and the PTN (Psychology Teachers Network) in which articles about quantitative psychology can be published. In “Ask the Doctor” section of the PTN a specific question about quantitative psychology could be answered by a member of the Task Force addressing a specific issue or area of research. All TOPSS members receive mass mailings that can include links, articles, and other resources that quantitative psychology could produce that could be disseminated to high school students. Resources that would be helpful could include the following: (1) articles about the field, (2) materials on college programs that may prepare students for advanced quantitative training, (3) advice on undergraduate coursework to prepare for advanced training, (4) the identities of quantitative Ph.D. programs, (5) PowerPoint presentations about the field of

quantitative psychology that could be used in the classroom. All TOPSS members receive unit plans that are now issued on CD; it would be advantageous for the teachers and students to receive materials that could be introduced into the Introduction to Psychology or Advanced Placement (AP) Psychology course. This could be accomplished with supplemental lesson plans that could be introduced into the curriculum when appropriate to help students understand the discipline. TOPSS has a Speakers Bureau that provides an opportunity for high school and community college teachers to find and contact local psychologists who are available to visit psychology classrooms to speak with students. Quantitative Psychology could be placed on this link for teachers and students to contact. On the TOPSS website there are links to the APA Education Directorate and PT@CC. There is a separate section for students with links to many career resources including APA resources, books and materials. At the APA convention each year TOPSS holds invited lectures to inform high school psychology teachers about aspects of psychology; this is a potential mechanism for informing high school psychology teachers about quantitative psychology. Finally, TOPSS has a listserv for information dissemination to members.

The College Board AP Central for Educators is the portal for all advanced placement (AP) teachers and students. Resources for quantitative psychology could be produced and possibly approved by the College Board to be linked to the main pages for the AP Psychology and AP Statistics course pages (apcentral.collegeboard.com).

Reaching teachers and students in two year (community) colleges.

In 2001 the organization PT@CC (Psychology Teachers at Community Colleges, www.ptatcc.org) was established. It is a group of community college psychology teachers who are members and affiliates of the American Psychological Association. Members of PT@CC also receive the APA Monitor and the PTN (Psychology Teachers Network) in which articles about quantitative psychology can be published. The PT@CC (www.ptatcc.org) provides website links for students from two-year community colleges to investigate careers, *Career Pathways in Psychology*. PT@CC has a listserv for members where information is disseminated. PT@CC develops partnerships “with Psi Beta (the National Honor Society in Psychology for Community and Junior Colleges) and STP (The Society for the Teaching of Psychology) for the encouragement of excellence in teaching and learning of psychology” (www.apa.org/ed/pt@cc_update.html). “The mission of the Psi Beta honor society is professional development of psychology students in two-year colleges through promotion and recognition of excellence in scholarship, leadership, research, and community service.” (<http://psibeta.org/>) Regional chapter advisors are a point of contact for providing information about quantitative psychology that they can share with their students.

Reaching undergraduate psychology departments, faculty, and students in four-year colleges and universities

Division 2 of APA is the Society for the Teaching of Psychology (STP). The Society “promotes excellence in the teaching of psychology by encouraging research and

reflection on teaching and learning, helping teachers share effective teaching techniques, and honoring the dedication and professionalism of teachers of psychology. The Society co-sponsors teaching programs at national and regional conferences, disseminates teaching and advising materials through its Office of Teaching Resources in Psychology and OTRP Web Site” (<http://www.lemoyne.edu/OTRP/index.html>; <http://www.apa.org/about/division/div2.html>) The Society publishes a quarterly journal *Teaching of Psychology*, as well as a Newsletter, *Society for the Teaching of Psychology News*, published twice a year.

Psi Chi(<http://psichi.org/>) “is the National Honor Society in Psychology, founded in 1929 for the purposes of encouraging, stimulating, and maintaining excellence in scholarship, and advancing the science of psychology. Membership is open to graduate and undergraduate men and women who are making the study of psychology one of their major interests, and who meet the minimum qualifications” (Psi Chi website). Information should be provided to members and advisors. Articles could be written for their publications. Psi Chi publishes two quarterly publications, *Eye on Psi Chi* and the *Psi Chi Journal of Undergraduate Research*.

The Council of Undergraduate Psychology Programs (CUPP) provides a means of accessing undergraduate departments of psychology. CUPP “is an organization that was established in 1989 to promote quality undergraduate education in psychology. CUPP provides forums for discussion of matters of interest and concern to undergraduate programs in psychology and has also been a source of assistance to those who chair or coordinate the activities of these programs”. CUPP frequently organizes “conference sessions that provide member psychology departments an opportunity to feature and share the special ways in which they try to enhance undergraduate education in psychology.” (www.am.org/cupp).

Reaching chairs of graduate departments of psychology.

The Council of Graduate Departments of Psychology (COGDOP) “is a society constituted of Chairs and Heads of Departments of Psychology or other equivalent administrative units which are authorized to offer graduate degrees in psychology in institutions accredited by their regional accrediting association.” (www.psych.wfu.edu/cogdop). COGDOP meets annually and maintains an electronic forum.

Major conferences directed to undergraduate psychology education.

A number of conferences on undergraduate psychology education provide a potential forum for information about quantitative psychology. First is the Psi Chi Annual Conference on Undergraduate Teaching of Psychology (www.psichi.org/conventions). Second is the convention of the National Institute for the Teaching of Psychology (NITOP, www.nitop.org).

The American Psychological Association Board of Educational Affairs (BEA) is developing plans to convene a National Conference on Undergraduate Education in Psychology in June, 2008. Provision of materials for distribution at this conference on the field of Quantitative Psychology could be helpful to provide information to the psychology professors who teach in undergraduate psychology programs.

Regional psychological associations.

Annual meetings of Regional Psychological Associations draw a large number of students, especially presenting poster sessions. A session there on quantitative psychology would be very well received. Students are there, as well as the advisors to Psi Chi and Psi Beta. Many students from community colleges and in four-year colleges get their first experience presenting and attending a psychology convention in this way. Regional association meetings provide an excellent venue for to disseminate information about graduate programs.

Other conferences for “advertising” quantitative psychology. Each year the Education Directorate sponsors an Educational Leadership Conference that draws together educators from multiple organizations that are involved in the teaching of Psychology.

APA Directorate Publications as outlets for information on quantitative psychology. The *Educator* is the newsletter of the American Psychological Association’s Education Directorate and will be published in the fall and spring of each year. APA Science Directorate homepage could be utilized and an article could be published there, or linked to the *Science Agenda* (online newsletter of the Science Directorate)

*Working toward Inclusiveness:
Gender and Ethnicity, Educational Background,
and Geography*

As we have indicated, the Task Force addressed the issue of inclusiveness within the discipline of quantitative psychology. APA Division 5, which represents the areas of Evaluation, Measurement and Statistics, has a membership of approximately 1200; 70% of members are male, and 20% are minority. These percentages are vastly different from the current graduate body and future projections of the country’s demographics. Students recruited into the field of Quantitative Psychology will contribute to the measurement of human attributes of an increasingly diversified population.

Our study of demographics of quantitative Ph.D. students and faculty surfaces that only 4.7% of Ph.D. students in quantitative psychology can be characterized as minority (Black, Hispanic, Native American); another 32% of students are Asian. Only 3.3% of faculty in quantitative Ph.D. programs are minority (Black, Hispanic, Native American).

Appendix D provides a summary of some relevant information on current and projected population demographics from the Census Bureau, trends in public school, undergraduate

and graduate student demographics from the National Center for Educational Statistics (NCES). In addition, Appendix D gives racial/ethnic and gender breakdowns for graduate students in Psychology, both US and non-US students (Appendix Table D1) and on graduate students in all of Science and Engineering more generally (Appendix Table D2), taken from the National Science Foundation. We caution that the data on race/ethnicity reported in Appendix Tables D1 and D2 are only for U.S. citizens and permanent residents, and 37% of quantitative students in our survey are international students.

The ethnic diversity of Ph.D. students in quantitative psychology does not parallel that for all of psychology. Maton, Kohout, Wicherski, Leary and Vonokurov (2006) documented the representation of ethnic minority students in Ph.D. programs in psychology and also Ph.D. graduates. In 2003, 6% of all Ph.D. students in psychology were African American/Black; 5.1% were Hispanic/Latino(a); 8.7% were Asian/Pacific Islander, and .8% were Native American. Of all those who received the Ph.D. in psychology in 2003, 5.1% were Black; 5.2% were Hispanic, 3.8% were Asian, and 7.% were Native American. Clearly, at the present time, the field of quantitative psychology is much more under-represented in terms of minority students, with the exception of Asian students.

Maton et al (2006) also reported on the percentage of minority students who received bachelor's degrees in psychology. In 2002, 10.1% of all students receiving bachelor's degrees in psychology were African American/Black; 7.9% were Hispanic/Latino(a); 5.6% were Asian/Pacific Islander, and .7% were Native American. There is a small but notable pipeline of minority students who hold the baccalaureate degree in psychology; they are not entering the quantitative psychology field.

One might argue that, in fact, students of color are underrepresented in the aggregate of science and mathematics related disciplines, of which quantitative psychology is one. To explore this possibility, we compared the Task Force data of Table 6 on quantitative student race/ethnicity with that in the National Science Foundation tables, reproduced as Appendix Tables D1 and D2. Tables D1 and D2 pertained to only U.S. citizens and permanent residents. For comparison purposes, we assumed that all Hispanic, Black, and American Indian students in our quantitative sample were U.S. citizens. Of the 170 quantitative students included in Table 6, in all 107 are U.S. citizens, and 8 are Hispanic, Black, or Native American; that is, 8/107 or 7.5% in all of the inferred U.S. citizens. Quantitative psychology falls behind the aggregate of science and engineering disciplines more generally. *In 2003, students of color comprised 13.6% of U.S. citizens and permanent residents who were students in the aggregate of science and engineering graduate programs (excluding Psychology), or almost double the percentage in quantitative programs.* Of the students in science and engineering, Black students comprised 7.0 %; Hispanic students, 6.0%, and American Indian/Alaskan Natives, 0.6%. (To compute these last percentages we subtracted the data from Psychology in Appendix Table D1 from the total science and engineering students in Appendix Table D2).

Our consideration for recruitment of talented young scholars into quantitative psychology goes beyond these demographic considerations to a consideration of inclusiveness along

the following dimensions: (a) ethnic and gender, (b) educational background, and (c) geography. Resources exist within and outside of psychology that can be employed to address the issue of enhancing inclusiveness in the pipeline of students entering doctoral programs in quantitative psychology.

Ethnic and gender diversity of doctoral students.

APA's Committee of Ethnic Minority Affairs (CEMA) offers resources that can be helpful in designing strategies for improving ethnic and gender diversity. See <http://www.apa.org/pi/publicat.html#ethnic>. A number of these documents are focused on recruiting students of color, among them the "Psychology Education & Careers Guidebook For College Students of Color Applying to Graduate & Professional Programs, 1998" <http://www.apa.org/pi/oema/diversity/book3/>

A project that specifically works at engaging and ultimately including a wide range of psychologists in the field of Quantitative Psychology is the *Minority Student Multivariate Statistics Conference* which was developed in 2004 to interest and entice underrepresented students into the field. The goals of the conference are to interest students from underrepresented groups in the field of quantitative psychology (including African-American, Hispanic-American, Native American) so that there is increased awareness, use of, and for some, graduate study (Masters, Doctoral) in quantitative areas of psychology; and to help broaden and diversify the base of trained quantitative individuals and enhance the nature of, approaches to, and questions asked in scientific research. This is carried out by faculty presentations concentrating on how quantitative methods allow us to solve real world problems; student presentations were added in the second year and workshop on Structural Equation Models in the third year. The conference is usually held in the same location as the APA convention, and the students attend part of the convention, particularly sessions that address quantitative psychology. This conference has been primarily sponsored by the Society for Multivariate Experimental Psychology for the past three years, <http://www.smep.org/>, at Morehouse College, 2004 (30 students); Howard University, 2005 (39 students); Southern University, Baton Rouge, 2006 (40 students). In 2005 the conference was jointly sponsored by APA Commission on Ethnic Minority Recruitment, Retention and Training in Psychology (CEMRRAT) <http://www.apa.org/pi/oema/>. And in 2005 and 2006 the APA Science Directorate provided APA conference registration for the students.

Models for recruitment and retention of minority students—parallel activities in the field of mathematics

Quantitative psychology is not alone among mathematically oriented fields in holding conferences to recruitment of minority students. The Infinite Possibilities Conferences (IPC) is "a national conference designed to celebrate, promote, support, and encourage under-represented minority women in the mathematical sciences." (American Statistical Association, 2007). The website for this conference is <http://ipcmath.org>. Financial support for this conference is broad and extensive.

Models for recruitment and retention of minority students—lessons for Psychology from the NSF Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring (PAESMEM)

Each year the National Science Foundation gives a series of awards to individuals who have performed “outstanding mentoring efforts that enhance the participation of groups (i.e., women, minorities, and persons with disabilities) that are underrepresented in science, technology, engineering, and mathematics. The awardees serve as leaders in the national effort to fully develop the Nation’s human resources in science, technology, engineering and mathematics.”

http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5473). Abstracts of recent awards made through the program highlight the range of activities that encompass educational opportunities for teachers of K-12, for undergraduate and graduate students, and postdoctoral fellows. These programs serve as models on which psychology might draw for recruitment and retention of minority students in quantitatively oriented fields.

Inclusiveness regarding students with educational backgrounds beyond psychology

A previous section of this report points to sources of students beyond psychology, including mathematics majors and engineering students. Individual universities have developed programs to attract a range of students to quantitative methods, for example, the University of Kansas undergraduate quantitative concentration, described above.

Inclusiveness regarding geography (North America and beyond)

The APA Office of International Affairs <http://www.apa.org/international/contactus.html> has a bi-monthly newsletter, *Psychology International*, and also has links to international organizations and resources that could assist in increasing the numbers of and diversity international students. At present, the international Ph.D. students in quantitative psychology are almost exclusively Asian.

Ethnic and gender diversity of quantitative faculty

Models from other disciplines inform strategies for increasing the number of minority faculty in quantitative psychology. Within Colleges of Business, The Ph.D. Project, founded about 11 years ago, was a catalyst for a dramatic increase in the number of minority business school faculty—from 294 to 812, with approximately 400 more candidates currently immersed in doctoral studies. This is a highly successful model. See <http://www.phdproject.org/>

TASK FORCE STEPS ALREADY TAKEN TO INCREASE THE PIPELINE OF QUANTITATIVE PSYCHOLOGISTS

Observations on Enhancing the Quantitative Pipeline

Two broad observations emerge from the Task Force's examination of training in the field of quantitative psychology and awareness of quantitative psychology as a specialization within psychology. These observations can be characterized in terms of informational and organizational activities in order to increase the quantitative pipeline.

Accessible Information on Quantitative Psychology

First is that the field of quantitative psychology is a "well guarded secret" within our own psychology family and beyond. We must focus on providing easily accessible information on the field, on training opportunities, and on career opportunities. We must also provide materials that support the dissemination of information about quantitative psychology in forms that serve populations who reach the students who will form the enhanced pipeline.

Cooperative Connections with Existing Organizational Structures

Second is that there are powerful and far-reaching organizational structures that exist within or are associated with high schools, two-year institutions of higher education, colleges and comprehensive universities that may provide vehicles for increasing the visibility of our field and to access potential students of quantitative psychology. We must reach out to these organizations and work with the organizations to provide forums for dissemination of information about quantitative psychology. Beyond these structures are professional organizations that may serve as sources for creation of information about the field and its dissemination.

In this section we describe activities the Task Force has already accomplished and initiated that are associated with creating accessible information on quantitative psychology and on building cooperative relationships with existing organizational structures. Then in the final section of this report, we make recommendations for further actions in support of the quantitative pipeline.

Creating Accessible Information on Quantitative Psychology

Two tasks have been completed (Tasks 1 and 2) and three are underway at the time of writing this report (Tasks 3, 4, and 5).

1. Develop uniform indexing for quantitative psychology programs in the annually published book, APA Graduate Study in Psychology (completed).

Over the years, a plethora of different terms have been used to index programs in

quantitative psychology in *APA Graduate Study in Psychology*. This book is the bible of resources for graduate training, and the indexing of quantitative programs requires uniformity to increase visibility of quantitative programs. It is also the case that leading programs in quantitative psychology have been deleted from the index, due to failure of the departments in which these programs are housed to report correctly to APA. One of the first activities of the Task Force to improve resource reporting was to work with the APA and with the quantitative psychology community to improve indexing of quantitative psychology Ph.D. programs for the APA 2008 Graduate Study in Psychology edition. In November, 2007 the Task Force met with the Education Directorate to discuss indexing of quantitative training programs. One index term, "quantitative", was selected for use. In early February, 2007, when APA contacted Departments of Psychology to gather information for APA Graduate Study in Psychology 2008, the Task Force contacted faculty members in every quantitative Ph.D. program in North America to alert them to the uniform index system and to exhort them to work with their department administrators to insure that the quantitative programs were properly indexed.

The new *APA Graduate Study in Psychology 2008* book appeared in June, 2007. In all, 17 of the 23 programs from Table 3 that grant the Ph.D. in quantitative psychology had responded to APA to be indexed under quantitative psychology and are so indexed. Also included under this index term are a number of quantitative programs in Educational Psychology.

2. Develop a list of Ph.D. programs in quantitative psychology (completed).

In October, 2006, the Task Force compiled a list of Ph.D. programs in quantitative psychology. The list, given in Table 3, also includes graduate programs in which students matriculate into substantive areas of psychology and then undertake a training focus in quantitative methods relevant to their substantive discipline. The list was compiled from multiple sources and has been reviewed by a large number of quantitative psychologists for accuracy and inclusiveness. Where questions about an individual program existed, the Task Force contacted faculty members of the program for clarification and for review of the placement of the program on the list.

In January, 2007, the Task Force consulted with quantitative methodologists in the Educational Psychology community to generate a list of Ph.D. programs in methodology within Educational Psychology. This list is provided in Appendix Table B1. We acknowledge the contributions of Debra Bandalos, University of Georgia, David Kaplan, University of Wisconsin, and David Rindskopf, Graduate Center of the City University of New York for providing information for compilation of the list and for review of the list.

3. Implement a Webpage for Quantitative Psychology that will be a repository of information about the field, training, careers, and much more. (in progress).

Beyond the first two activities given above, the highest priority activity of the Task Force is the implementation of a Website for Quantitative Psychology. As of August 1, 2007,

the preliminary website is in place, at <http://www.apa.org/science/quant.html>.

While there is much to add to the website, and the issue of continued development over time and maintenance of the website remains before us, this is an important step for the field of quantitative psychology.

4. Develop a handout about quantitative psychology suitable for distribution to teachers of psychology and students at conventions, meetings, lectures, etc. (draft completed)

The Task Force has developed a draft handout on quantitative psychology. It was distributed at Eastern Psychological Association in April, 2007 and was also distributed to TOPSS at the American Psychological Association meeting in August, 2007.

5.. Develop a comprehensive document on Careers in Quantitative Psychology (in progress)

To form the basis of future materials, the Task Force has worked on the development of a comprehensive document on Careers in Quantitative Psychology. The document includes the following components. First is a definition of quantitative psychology and expanded characterization of each aspect of quantitative psychology in that definition—measurement, research design, data analysis, and statistical and mathematical modeling. Members of the quantitative psychology community contributed to the expanded characterizations; we thank Emilio Ferrer, University of California, Davis; Roger Millsap, Arizona State University, Stephen G. West, Arizona State University, and Scott Maxwell, University of Notre Dame, for their contributions. Second is the comprehensive list of training programs in quantitative psychology. Third is a section on preparing for graduate study in quantitative psychology. Fourth is a description of the many employment settings in which quantitative psychologists work. The draft document is undergoing further development at the time of the submission of this report. Once the narrative is complete, Task Force members will work with APA to produce the document.

*Building Cooperative Relationships with
Existing Organizational Structures*

Task Force members are also members of professional organizations and thus provide natural linkages to these organizations for future efforts to enhance the visibility of quantitative psychology.

Cooperation with APA Division 5, Evaluation, Measurement, and Statistics

Division 5 houses the measurement, research design, statistical analysis, and evaluation communities, as well as members of the assessment community. It was the source of the proposal for this Task Force. Almost all members of the Task Force are also members of Division 5. A longstanding focus of Division 5 has been on training issues and on attracting people to the quantitative field. Division 5 brochures on careers in quantitative psychology date back to the early 1980s. Division 5 contributed substantially to

preparation of the 1995 pamphlet *Graduate Study in Educational and Psychological Measurement, Quantitative Psychology, and Related Fields*. Division 5 created a broad list of quantitative training programs for its website in 2005. Division 5 continues to be involved in educational issues and will continue to contribute to preparation of educational materials about quantitative psychology. Division 5 will also continue its longstanding tradition of presenting materials about quantitative psychology as a field at the annual APA convention. Each year the Division gives a dissertation award.

Cooperation with Society for Multivariate Experimental Psychology

The Society for Multivariate Experimental Psychology (SMEP) is an organization of quantitatively oriented psychologists. Among them are chairs of the majority of quantitative Ph.D. programs in North America, as well as a substantial number of faculty of these programs. Other members have leadership in quantitative methodology in educational psychology. Four members of the APA Task Force are members of SMEP. In June, 2006, the Trustees of SMEP voted to support the activities of the APA Task Force. In October, 2006, Task Force member Aiken provided a presentation about the Task Force at the annual SMEP meeting. To date, members have been responsive in completing the Task Force survey, in providing information on many aspects of quantitative training. SMEP is supportive of activities of the Task Force and highly responsive to requests for help, which have been numerous during the course of creating this report. For example, all writers external to the Task Force who have contributed to the development of this Task Force Report are members of SMEP. SMEP members created and continue to staff the Minority Student Multivariate Statistics Conference, now in its fourth year; SMEP has also provided continuous substantial financial support for this activity. At each annual SMEP meeting, there is a student-administered student paper session, showcasing the work of quantitative Ph.D. students.

Cooperation with Eastern Psychological Association, a regional psychological association.

Task Force Member Debra Parks created a symposium on careers in Psychology, co-sponsored by TOPSS, Psi Chi, and Psi Beta that was presented at the Eastern Psychological Association in April, 2007. Task Force member Gwyneth Boodoo presented on quantitative psychology careers and distributed written materials on quantitative psychology as a career.

Cooperation with Western Psychological Association, a regional psychological association.

Task Force Member Leona Aiken created a statistics workshop series for Western Psychological Association in 2002, during her presidency of WPA. This series is now institutionalized as a yearly event. Task Force member Aiken maintains a working relationship with WPA that contributes to sustained coverage of quantitative psychology. Quantitative psychologist Peter Bentler is currently president of WPA, one of several quantitative psychologists who have served as president within recent years.

Cooperation with Teachers of Psychology in the Secondary Schools (TOPSS)

Task Force member Debra Parks is past president of TOPSS and provides a liaison to this organization. Task Force Member Leona Aiken served as an invited speaker for TOPSS at the APA convention in August, 2007. The title her presentation was “Combining Psychology and Quantitative Methods into One Exciting Career.” This reached high school teachers, as well as faculty of two-year colleges. Supplemental information was provided to the audience that is suitable for presentation to students at the home institutions of the audience.

Cooperation with the Psychometric Society

The Psychometric Society is an international organization that meets in North America on alternate years. It maintains a substantial U.S. membership, and also has a substantial number of student members. Two members of the Task Force are members of the Society. Each year the Society gives a Dissertation Award for the best student dissertation in that year, as decided by a committee of former Presidents of the Society.

The Society also awards at least two Travel Grants to students annually for travel to the annual meeting for paper presentations. There is currently a plan to expand the number of Dissertation Awards given annually, but a vote has not yet been taken by the Board of Trustees. The Society maintains an employment listing that is actively updated on its website.

RECOMMENDATIONS OF THE TASK FORCE: PRODUCTS AND STRATEGIES TO ENHANCE THE QUANTITATIVE PIPELINE

There is much to be done to enhance the visibility of the field of quantitative psychology and to build relationships with existing organizations. In this final section of the report the Task Force proposes a number of activities for the future. The aggregate of these activities support the needs to enhance visibility of the field of quantitative psychology and to build cooperative structures with existing organizations that relate to faculty, advisors, and students of psychology. Carrying out these activities will require the support of the APA, particularly the Science Directorate and Education Directorate and technical offices within APA (e.g., Information Technology).

Recommendation 1. Continue to build a website for Quantitative Psychology that will be a central repository for information on the field of quantitative psychology

This is the highest single priority of the task force for providing information about resources. As indicated above, the webpage was implemented in August, 2007, accessible through the APA website at <http://www.apa.org/science/quant.html>. It now contains definition of quantitative psychology, lists of quantitative psychology training programs and related programs, information on preparing for a career in quantitative psychology, and links to appropriate professional association web pages. Construction of the website must continue. It should include information about careers in quantitative psychology, biographical sketches of quantitative psychologists to illuminate training and career paths. It should provide information about relevant professional meetings, funding sources, job announcements, updated on an ongoing basis. The Social Psychology Network (<http://www.socialpsychology.org/>) provides a model for this website.

Recommendation 2. Develop instructional materials concerning quantitative psychology targeted to particular audiences (e.g., DVD, PowerPoint)

2a. Powerpoint presentation/DVD. At its simplest, we propose to create a PowerPoint presentation on the field of quantitative psychology that explains the field, provides information on training programs, gives career information, and describes the careers of quantitative psychologists. This should be made available on websites of organizations documented above that provide access to appropriate communities of faculty and students. The presentation could be produced on DVD available through APA. The DVD form could contain supporting material as well. The presentation should be suitable for use in introductory psychology classes and in undergraduate statistics classes.

2b. Unit lesson plans on quantitative psychology. A unit lesson plan should be developed that can be used by teachers of psychology, to inform their students about the field of quantitative psychology. A lesson plan for the teaching of

methods and statistics, suitable for use in high school classes and introductory psychology classes might also be developed. As of the writing of this report, the unit plan for high school teachers on methods/statistics is under revision.

2c. Pamphlet on the Field of Quantitative Psychology. This product is in progress (see previous section of this report, activity 4), that is, a comprehensive document on Careers in Quantitative Psychology. This pamphlet should be produced and made widely available. One important audience is psychology undergraduate advisors and members of the Council of Undergraduate Programs in Psychology (CUPP).

2d. Informational Document of Website Linkages. An informational document should be created that provides relevant website linkages to training programs in quantitative psychology, to relevant organizations, to webpages of organizations that provide quantitative training workshops. This document should be incorporated into the website on quantitative psychology (Recommendation 1 above).

Appendix E provides a summary list of potential products for a range of constituencies.

Recommendation 3. Develop articles on quantitative psychology for a number of outlets and audiences.

3a. Article for *PTN (Psychology Teacher Network)*, produced by APA for teachers of introductory psychology.

3b. Article for the *Teaching of Psychology*, the official publication of the Society for the Teaching of Psychology.

3c. Articles in newsletters of educational organizations, including TOPSS, PT@CC

3d. Article for the *College Board AP Central* website for advanced placement courses and examinations

3e. Article for Psi Chi magazine, *Eye on Psi Chi*

3f. Article for the *APA Monitor*

3g. Article for the *American Psychologist*

Recommendation 4. Develop mechanisms for accessible and affordable offerings on quantitative psychology at the APA convention.

Historically Division 5 of APA presented high quality quantitative workshops at the APA convention, taught by excellent scholars in quantitative psychology at very low cost to participants (\$10 to \$20 each). Division 5 worked to sustain this program over the years. However, Division 5, comprised of 1200 members, and with essentially no financial resources for the workshop program, was unable to sustain the program and thus terminated its workshop program some years ago.

The Task Force is aware of the six half-day Continuing Education workshops in statistics that were presented at the 2007 convention. The Task Force is also aware that for the 2007 convention, over 175 individual sessions at the APA convention were designated to give continuing education credit; of these, three one-hour sessions cover topics in methodology.

The Task Force recommends that a mechanism be established to provide workshops in quantitative methodology at the APA convention outside the relatively high-cost APA Continuing Education Workshop framework. Many, if not most, academic psychologists do not need to accrue continuing education credits for licensure. The Task Force recommends that consideration be given by APA to creating an alternative mechanism for workshops in statistical methodology during the convention. We note that Steven Breckler, Executive Director of the Science Directorate, called for devoting “more of our professional meetings and conventions to scientific continuing education” (Breckler, 2007, online document).

We acknowledge that there are now several one-hour plenary sessions at each APA convention on quantitative methods. These are extremely well attended. Task Force member Mark Appelbaum has the leadership role in implementing these plenary sessions each year. The workshops we propose for the APA convention are beyond these plenary sessions (not replacing these highly successful sessions).

We note that the Association for Psychological Science (APS) has already taken the step we are recommending for the creation of quantitative workshops during the APS convention. At the 2008 APS convention there will be two statistics workshops on cutting edge topics (Bayesian inference and longitudinal models) and one workshop on teaching statistics; the cost to participants for each workshop is \$30 for APS members and \$15 for students.

The highly successful methodology workshop program of Western Psychological Association provides a model; the workshops attract a broad range of faculty and graduate students from across psychology each year at a cost of \$10 per two-hour workshop.

Recommendation 5. Foster ongoing relationships between the quantitative psychology community and important organizations that provide access to both teachers of potential students of quantitative psychology and the potential students themselves.

As described above, such work has already been initiated with TOPSS, with Eastern

Psychological Association and with Western Psychological Association.

5a. Recommend to the Board of Educational Affairs (BEA) a suggested theme on “quantitative methodology in psychology and beyond” for the Educational Leadership Conference.

5b. Contact the work group for the Undergraduate Psychology Conference on Teaching (BEA) to discuss how quantitative psychology can be involved (possible session or keynote address).

5c. Contact NITOP and propose a session for the National Institute for the Teaching of Psychology.

5d. Inform COGDOP of the work of the Task Force and the efforts in quantitative psychology.

Recommendation 6. Implement direct outreach to potential graduate students in quantitative psychology

Direct outreach can be accomplished through fostering ongoing relationships between the quantitative psychology community and existing organizations: Psi Chi, Psi Beta, PT@CC, TOPSS, and regional psychological associations. The Task Force should explore cooperating with the College Board to provide direct outreach to students who take the Advanced Placement (AP) Psychology, Statistics, and Calculus examinations.

Recommendation 7. Focus on recruitment of students from underrepresented groups into quantitative psychology.

7a. Include information on quantitative psychology in “Psychology Education & Careers Guidebook For College Students of Color Applying to Graduate & Professional Programs, 1998” <http://www.apa.org/pi/oema/diversity/book3/>

7b. Inform CEMA members about quantitative psychology and send flyers/information on quantitative psychology to all CEMA members

7c. Request inclusion of Quantitative Psychology in the APA/National Institute of General Medical Sciences program Grant Project administered by Office of Ethnic Minority Affairs (OEMA); the program is designed to expose minority students to research early in their academic careers.

7d. Coordinate work with the Science Directorate’s Student Programs and Quantitative Training Courses. See <http://www.apa.org/science/infostu.html>

7e. Build on the work started by the special recruitment project of the Society of Multivariate Experimental Psychology to interest and entice students from

underrepresented groups into the field.

7f. Create program similar to the business schools' Ph.D. Project to recruit faculty of color for the field of Psychology, including quantitative psychology. See the report "How to Recruit and Hire Ethnic Minority Faculty" (1997) available at <http://www.apa.org/pi/oema/handbook/introduction.html>

Recommendation 8. Improve the information in Wikipedia about quantitative psychology.

Recommendation 9. Develop a textbook that is an introduction to quantitative psychology.

A text to introduce undergraduate students to the field of Quantitative Psychology would include a discussion of the history of the field and descriptions of the major areas studied: Experimental Design and Methodology; Applied Statistics and Mathematics; Psychometric Theories, Measurement and Assessment and Evaluation. Many examples are given to demonstrate the ways in which these areas contribute to the measurement of human abilities. Appendix F provides one example of the topics to be covered. Such a product is a commercial venture.

References

- Aiken, L. S. Methodological Training for Ph.D. Psychologists: Current Status, Needs, Potential Mechanisms. Symposium Chair, American Psychological Association, San Francisco, CA, August, 2001 (a).
- Aiken, L. S. Statistics, Measurement, and Methods Training: Survey of 201 Ph.D. Programs. Paper presented at American Psychological Association, San Francisco, CA, August, 2001 (b) .
- Aiken, L. S., West, S. G., & Millsap, R. E. (2008). Doctoral Training in Statistics, Measurement, and Methodology in Psychology: Replication and Extension of the Aiken, West, Sechrest, and Reno (1990) Survey of Ph.D. Programs in North America . *American Psychologist*, 62, forthcoming, January, 2008.
- Aiken, L. S., & West, S. G., Sechrest, L. B., and Reno, R. R. (1990). Graduate training in statistics, methodology, and measurement in psychology: an international survey. *American Psychologist*, 45, 721-734.
- American Statistical Association. (2007). Women gather at IPC for inspiration, math. *AMSTAT News*, Issue #366, December 2007, p.8.
- Bell, M.C., & Gordie, A., S. (1997, September). A comparative survey of job prospects for the period 1991-1996. *APS Observer*, 16-18.
- Breckler, S. (2007). Continuing education for scientists. APA Psychological Science Agenda, Online, Volume 21(8). http://www.apa.org/science/psa/sep07_edprnt.html, accessed September 21, 2007.
- Clay, R. (2005). Too few in quantitative psychology. *Monitor on Psychology*, 36 (8), 26-28.

- Herszenhorn, D. M. (2006). As Test-Taking Grows, Test-Makers Grow Rarer. *The New York Times*. Friday, May 5, 2006. Vol. CLV....No. 53,570. P.A1, A19.
- Kendall, P. Issues in methodological training in clinical psychology. Paper presented in the symposium Methodological Training for Ph.D. Psychologists: Current Status, Needs, Potential Mechanisms. American Psychological Association, San Francisco, CA, August, 2001.
- Little, T., Schrot, P., Keyton, J., Templin, J., & Preacher, K. (2007) Re: Proposed Undergraduate Minor in Social and Behavioral Sciences Methodology (SBSM), University of Kansas. Unpublished document.
- Maton, K. I., Kohout, J. L., Wicherski, M., Leary, G. E., & Vinokurov, A. (2006). Minority Students of Color and the Psychology Graduate Pipeline: Disquieting and Encouraging Trends, 1989-2003. *American Psychologist*, 61, 117-132.
- Merenda, P. F. (2005). Psychometrics and Psychometricians in the 20th and 21st Centuries: How it was in the 20th Century and how it is now. Invited paper presented at the American Psychological Association, August 20, 2006, Washington, D.C.
- Meier, S. T. (1993). Revitalizing the measurement curriculum: Four approaches for emphasis in graduate education. *American Psychologist*, 48, 886-891.
- Mooney, C. (2006). Black mathematicians, still a rarity, see light at the end of the pipeline. *Chronicle of Higher Education*. September 29, 2006. Section: Diversity in Academic Careers, 53(6), page B12.
- Parke, R. Issues in methodological training in developmental psychology. Paper presented in the symposium Methodological Training for Ph.D. Psychologists: Current Status, Needs, Potential Mechanisms. American Psychological Association,

San Francisco, CA, August, 2001

Reis, H. Issues in methodological training in social psychology. Paper presented in the symposium Methodological Training for Ph.D. Psychologists: Current Status, Needs, Potential Mechanisms. American Psychological Association, San Francisco, CA, August, 2001.

Table 1. Number of Job Advertisements in Various Areas of Psychology in 1991-1996 versus number of earned doctorates in these areas during the same six years.

Area	Number of Job Advertisements	Number of Earned Doctorates	Job Advertisements per Earned Doctorate
Cognitive	413	674	.61
Developmental	401	1040	.39
Experimental	408	844	.48
Industrial Organizational	349	876	.40
Physiological	135	446	.30
Social	553	877	.63
TOTAL OF ABOVE	2259	4757	.47
Quantitative	292	122	2.40

Note: Counts of Job Ads taken from Bell and Gordie (1997).
Counts of Earned Doctorates taken from NSF Survey of Earned Doctorates, as compiled by the APA Office of Research, January, 2006.

Table 2. Number of Doctorates Awarded in Quantitative Psychology (1978-2004).
Mean=21.74, Median = 22.33; SD = 6.14

Year	Number of Doctorates		Year	Number of Doctorates
1978	15		1994	22
1980	21		1995	23
1982	8		1996	30
1984	22		1997	28
1986	34		1998	24
1988	23		1999	29
1989	17		2000	21
1990	23		2001	12
1991	16		2002	22
1992	15		2003	18
1993	25		2004	29
			2005	23

Note. Data are taken from the National Science Foundation (NSF) /Division of Science Resources Statistics, Survey of Earned Doctorates. From 1978 through 1982, Quantitative was the only coding category employed by NSF. From 1984 through 2003, NSF employed two categories, psychometrics and quantitative. Beginning in 2004, NSF has reverted to using only the code quantitative. The APA Research Office contributed to compiling these data.

Table 3. Doctoral Programs in Quantitative Psychology and Related Programs
(revised table, 7/31/07)

University	Program Name
PROGRAMS OFFERING A PH.D. IN QUANTITATIVE PSYCHOLOGY	
Arizona State University	Quantitative Research Methods in Psychology
University of British Columbia	Quantitative Methods
University of California, Davis	Quantitative Psychology
University of California, Los Angeles	Quantitative Psychology
Fordham University	Psychometrics
Georgia Institute of Technology	Quantitative Psychology
University of Illinois, Urbana-Champaign	Quantitative Psychology
University of Kansas	Quantitative Training Program
McGill University	Quantitative Psychology
University of Minnesota	Quantitative and Psychometric Methods
University of Missouri	Quantitative Psychology
University of New Mexico	Quantitative/Methodology
University of North Carolina, Chapel Hill	Quantitative Psychology
Notre Dame University	Quantitative Psychology
Ohio State University	Quantitative Psychology
University of Oklahoma	Quantitative Psychology
Purdue University	Quantitative Psychology
University of Rhode Island	Research Methods
Simon Fraser University	Theory and Methods
University of Southern California	Quantitative
Vanderbilt University	Quantitative Methods and Evaluation
University of Virginia	Quantitative
University of Western Ontario	Personality and Measurement
PROGRAMS WITH A CONCENTRATION IN QUANTITATIVE METHODS IN COMBINATION WITH SUBSTANTIVE AREAS—STUDENTS ADMITTED TO SUBSTANTIVE AREA OR COMBINED SUBSTANTIVE/QUANTITATIVE AREA	
Michigan State University	Concentration in Quantitative Methods and Evaluation Science Concentration— “qualification above and beyond students’ specializations in the Department of Psychology” (from Michigan State University Psychology website)

New York University	Minor in Quantitative Psychology “Psychology students who wish to obtain certification of their interest and expertise in either mathematical psychology or quantitative methods for psychological research may establish a Minor in Quantitative Psychology.” (from New York University Psychology website)
Ohio University	Applied Quantitative – “track offers advanced training in quantitative methods to graduate students who are concurrently studying in one of the other experimental or clinical psychology tracks” (from Ohio University Psychology website).
University of Washington	Quantitative—Students are admitted to a substantive area. “Students from any area may specialize in quantitative psychology”. (from University of Washington Psychology website)
MATHEMATICAL PSYCHOLOGY PROGRAMS OR QUANTITATIVE PROGRAMS WITH A MATHEMATICAL PSYCHOLOGY EMPHASIS: A PRELIMINARY LIST	
University of California, Irvine	Department of Cognitive Sciences (mathematical behavioral science)
Indiana University	Concentration in Mathematical Psychology
University of Illinois, Urbana-Champaign	Quantitative
Ohio State University	Quantitative Psychology/Judgment and Decision Making
Purdue University	Quantitative/Mathematical
DEVELOPMENTAL PROGRAM OFFERING METHODOLOGY CONCENTRATION	
Pennsylvania State University	Department of Human Development and Family Studies, Developmental Research Methodology Concentration

a. Researchers at many universities take a mathematical psychology modeling approach to the study of substantive questions in psychology. See the Society for Mathematical Psychology website, <http://www.cogs.indiana.edu/socmathpsych/>, accessed August 1, 2007).

Table 4. Size and Desired Size of Ph.D. programs in Quantitative Psychology as of fall, 2006
(n=23 programs that grant the Ph.D. in quantitative psychology, listed in Table 3.)
(Revised Table, 7/31/07)

Item	Total	Median	Mean
FACULTY			
Number of full time equivalent quantitative faculty at present	84.8	3.31	3.69
Number of full time equivalent quantitative faculty who are involved in training Ph.D. students in quantitative psychology	75.8	3.06	3.30
Number of full time equivalent quantitative faculty who serve as mentors or Ph.D. advisors to students in other concentrations (e.g., social, cognitive, clinical, etc).	49.5	2.25	2.25
QUANTITATIVE PH.D. STUDENTS			
Number of students enrolled in quantitative Ph.D. program	173	5.33	7.52
Number of students who have entered in the past 3 years	113	4.62	4.91
Number of students who entered the program in fall, 2006	39	1.14	1.70
Maximum number of quantitative students the program could train effectively with current resources	268	10.33	11.65
Ideal number of quantitative students the program could train effectively with current resources	228	9.25	9.94
DESIRED NUMBER OF QUANTITATIVE FACULTY AND STUDENTS			
Number of fulltime quantitative faculty the program would like to have	126.5	5.25	5.75
Number of quantitative student the program would like to have	251.5	10.25	11.43

Data taken from a survey of Ph.D. programs in quantitative psychology in North America completed by the Task Force in February, 2007.

Table 5. Factors that Impose Limitations on Increased Production of Quantitative Ph.D.s.
(n=23 programs that grant the Ph.D. in quantitative psychology, listed in Table 3.)
(Revised Table, 7/31/07)

FACTOR THAT MAY POSE LIMITATION ON INCREASING THE NUMBER OF PH.DS PRODUCED IN QUANTITATIVE PSYCHOLOGY	Not at all a source of limitation	Somewhat a source of limitation	Very much a source of limitation
a. Our program lacks sufficient qualified applicants to admit more quantitative Ph.D. students	22%	39%	39%
b. Our program lacks qualified applicants <i>from the United States</i> .	17%	39%	44%
c. Our program lacks qualified <i>international</i> applicants.	57%	26%	17%
d. Our program lacks sufficient research or teaching assistantships to support more quantitative Ph.D. students.	35%	39%	26%
e. Our program lacks sufficient faculty to train more quantitative Ph.D. students.	17%	49%	35%
f. The quantitative faculty have heavy service teaching loads.	17%	57%	26%
g. The quantitative faculty have heavy advisement loads outside quantitative (e.g., on dissertation committees in substantive areas).	43%	35%	22%
h. The quantitative faculty have heavy ad hoc consulting loads (e.g., helping other faculty).	52%	30%	17%
i. The faculty have heavy research service loads on grants as methodologists or methodological consultants.	44%	30%	26%
j. There is resistance from other programs within the department to increasing the quantitative class size.	39%	44%	17%

Data were taken from a survey of Ph.D. programs in quantitative psychology in North America completed by the Task Force in late 2006 and very early 2007.

Table 6. Diversity of Ph.D. Students and Faculty in Quantitative Psychology: Ethnicity/Race and Gender (n=22 of the 23 programs that grant the Ph.D. in quantitative psychology, listed in Table 3.) (Revised Table, 8/1/07)

Category	Percent of Individuals Aggregated over all Responding Programs
DOCTORAL STUDENTS	n=170
GENDER	
Male	45.3%
Female	54.7%
CITIZENSHIP	
International Student	37.0%
US citizen	63.0%
ETHNIC/RACIAL GROUP	
Non-Hispanic Caucasian	61.6%
Hispanic or Latino/a	02.9%
Black or African-American	01.8%
American Indian/Alaskan Native	0.0%
Asian or Asian-American	31.8%
Native Hawaiian/Pacific Islander	0.6%
Other/Multi-racial/Ethnic	1.2%
FACULTY	n=90.5
GENDER	
Male	80.3%
Female	19.7%
ETHNIC/RACIAL GROUP	
Non-Hispanic Caucasian	82.8%
Hispanic or Latino/a	2.2%
Black or African-American	0.0%
American Indian/Alaskan Native	1.1%
Asian or Asian-American	13.9%
Native Hawaiian/Pacific Islander	0.0%
Other/Multi-racial/Ethnic	0.0%

Data from diversity survey of Ph.D. programs in quantitative psychology in North America, completed by the Task Force in February, 2007. Discrepancy in faculty counts between Tables 4 and 6 reflect changes in reporting between two data collection episodes, one for Table 4 and the second for Table 6.

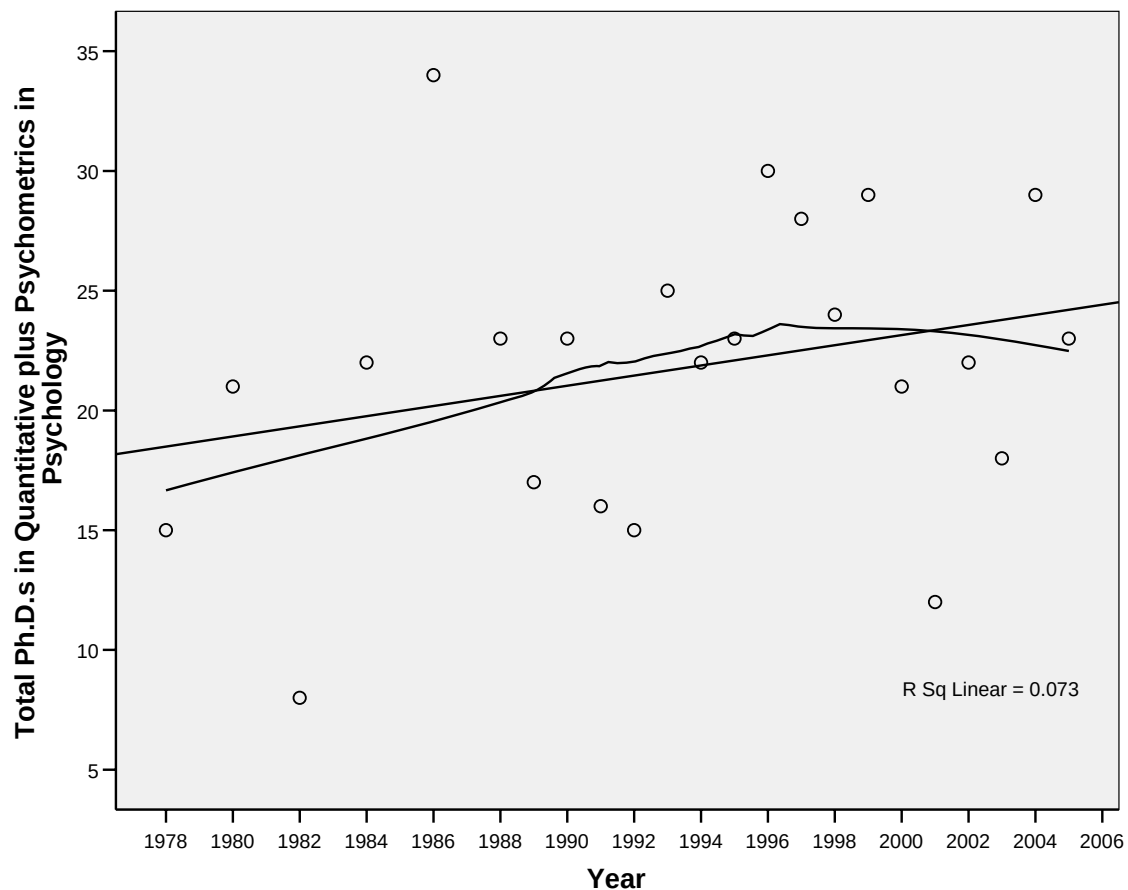


Figure 1. Number of Ph.D.s in Quantitative Psychology produced per year from 1978 through 2005. Linear regression line shows slight positive slope. The imposed lowess smooth (nonparametric smooth) suggests little if any deviation from linearity.

Data are taken from the National Science Foundation (NSF) /Division of Science Resources Statistics, Survey of Earned Doctorates, www.nsf.gov/statistics. Data are collected yearly for NSF by the National Opinion Research Center (NORC), University of Chicago.

Revised figure, July 31, 2007

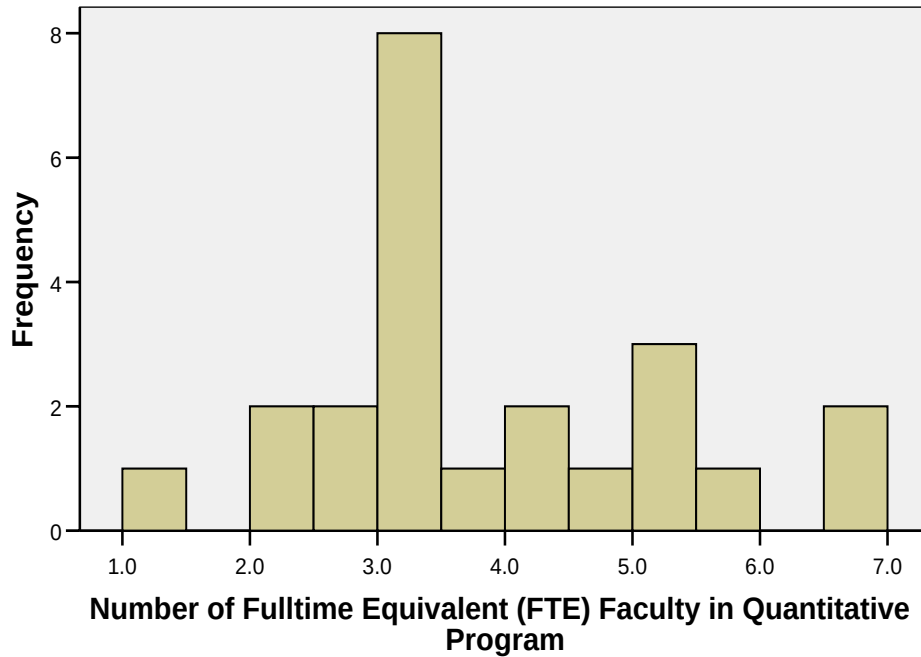


Figure 2. Number of Fulltime Equivalent Faculty Members per Quantitative Program. Mean=3.69, SD=1.54, Median=3.31; N=23 programs listed in Table 3 as granting the Ph.D. in quantitative psychology. Data are taken from the Task Force Survey of Ph.D. programs in quantitative psychology.

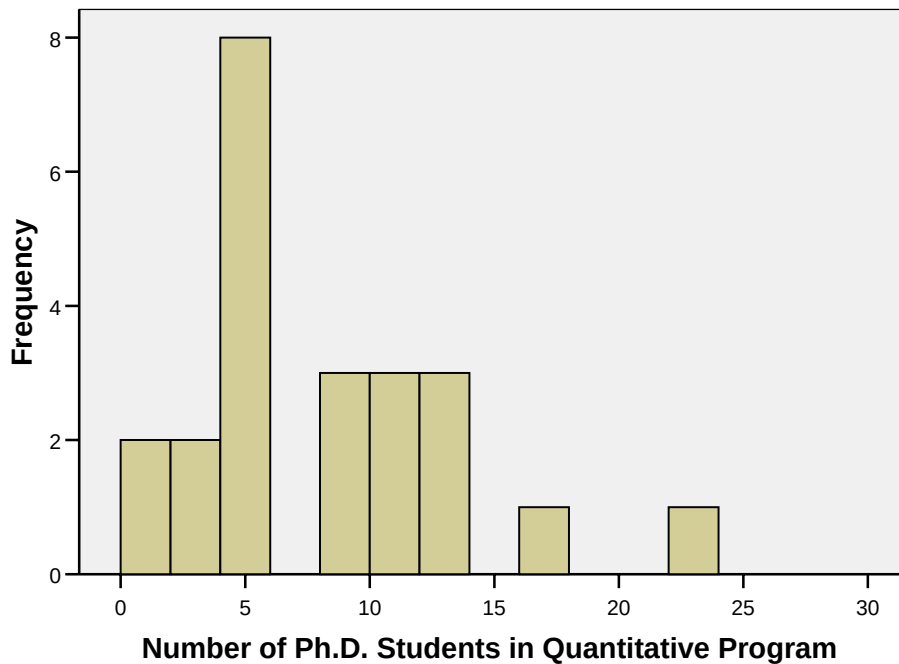


Figure 3. Number of Fulltime Students of all Years per Quantitative Program. Mean=7.52, SD=5.46, Median=5.33; N=23 programs listed in Table 3 as granting the Ph.D. in quantitative psychology. Data are taken from the Task Force Survey of Ph.D. programs in quantitative psychology.

APPENDICES

Appendix A

An Undergraduate Student Seeks Information on Quantitative Psychology—A Conversation with Mike Edwards, Task Force Member, October, 2006

An undergraduate who has recently decided to pursue graduate training in quantitative psychology started doing some online research about quant psych. He ran across a talk I gave last year at APA that I had posted on my website and contacted me to ask some questions about our field. In the process of talking with him it seemed like a good opportunity to see what his search for information was like. His response to that question follows.

In answer to your last question, to be honest I haven't found much information online. Probably the most useful has been the extensive program statistics available at the UMN site, so I can compare GRE scores, acceptance rates, etc between different programs. I wish more schools made that information available easily. I've found articles on the APA site about the shortage of quantitative psychologists, news articles about the shortage of psychometricians. I can't say the lack of information is peculiar to psychometrics though. I have tried to gather information about graduate options in other areas too, philosophy, clinical, social psych, school psych; and typically it is very hard to find. General-graduate school advice books like "Getting what you came for" and "The Compleat Academic" have been the most helpful to me overall.

As for specific program areas, Clinical psych seems to have by far the most information; I suppose this is because getting into these schools is such a popular challenge. There is also quite a large support network of sites about philosophy, <http://www.philosophicalgourmet.com/>, for example, as well as numerous blogs. There doesn't seem to be anything comparable to this in psychology. Blogging doesn't seem to have caught on in psychology quite to the extent it has elsewhere. Number 2 Pencil (<http://www.kimberlyswygert.com/>) is the only psychometrics-related blog I have come across. This is one area where psychology actually feels more old-fashioned than philosophy, considering the virtual explosion of philosophy-related websites and other web activity (such as wikipedia article creation).

Wikipedia has become something of a one-stop information-shop for people in my generation. You might consider beefing up the Wikipedia entries in your area. The 'quantitative psychology' entry is currently a stub, and the best article in the area is 'psychometrics', but unfortunately does not give any information about careers or education or graduate programs. The ed. psych entry is very good already and could be used as a template. Adding a list of current graduate programs to the psychometrics article would be very helpful. Then when thousands of people read news stories about psychometricians on the New York Times, they can bounce to Wikipedia to learn what psychometrics is, then bounce straight to program websites.

It might be that websites for clinical psych and philosophy have proliferated because these areas are so hard to crack into, while the bulk of psychology remains relatively low on unemployment as academic fields go. What I would like to see is an increase in both formal and informal information sources for undergraduates interested in psychometrics and other smaller areas of psychology. Formal sources such as program statistics compiled by APA can be very useful if they are organized right and detailed enough. Too often these listings don't offer much more than program names, addresses, and websites, which means you need to check the website of every program to learn more.

Probably the best example of this kind of information can be found in the "Insider's Guide to Graduate Programs in Clinical and Counseling Psychology". In this guide they have ratings of each program on a 7 point scale from "clinically oriented" to "research oriented", as well as a listing of how many faculty and how many grants each program currently has in every research area. It also has GRE mean scores, mean GPA, racial statistics, gender, clinical opportunities, percentage of students receiving tuition waivers, fellowships, etc. It even lists the percentage of faculty subscribing to each of 5 orientations (psychodynamic, etc). Pretty incredible information source...if I was going into clinical.

Perhaps putting something like this together for psychometric programs would not be that hard since there are so few of them. All it would take is a detailed questionnaire sent to each program. Informal sources are important to. The problem I have is that there is no one at my school who has inside information on psychometrics or ed. meas. programs. That leaves me with the options of either trying to get information from someone at one of the programs I am interested in, in which case they will be biased; or trying to get information from some other party who has no incentive to help me. I know that professors are typically too busy to take care of their own students much less other schools'.

I suppose it would be nice if there were some semi-official spokes-people for the field, who would be expected to offer neutral advice to students like me. Typically when looking for people like that I look for the current head of organizations or APA divisions, but I have no idea if that is the best thing to do. As you know I found you because your name was on that presentation.

Appendix B

Appendix Table B. Methodology Programs in Educational Psychology ^{1,2,3}

University	Program Name
Arizona State University	Measurement, Statistics, and Methodological Studies
University of Arizona	Concentration in Measurement and Methodology
University of California, Los Angeles	Social Research Methodology
University of Colorado	Research and Evaluation Methodology
University of Northern Colorado	Applied Statistics and Research Methods
Columbia University	Measurement, Evaluation, and Statistics
University of Connecticut	Measurement, Evaluation and Assessment:
Florida State University	Measurement and Statistics
University of Florida	Research and Evaluation Methodology
University of South Florida	Educational Measurement and Research
University of Georgia	Research, Evaluation, Measurement, and Statistics
University of Illinois	Queries Division: Studies in interpretive, statistical, measurement and evaluative methodologies for education
Indiana University	Inquiry Methodology
University of Iowa	Educational Measurement and Statistics
University of Maryland	Measurement, Statistics, and Evaluation
University of Massachusetts	Research and Evaluation
Michigan State	Measurement and Quantitative Methods
University of Minnesota	Quantitative Methods in Education

University of Nebraska, Lincoln	Qualitative and Quantitative Methods in Education
City University of New York	Quantitative, Educational Policy
University of North Carolina, Greensboro	Educational Research Methodology
University of Pittsburgh	Research Methodology
University of South Carolina	Educational Psychology and Research
University of Texas	Quantitative Methods
Texas A&M	Research, Measurement, and Statistics
James Madison University, Virginia	Quantitative Methods
University of Wisconsin, Madison	Quantitative Methods Area

1. Disclaimer. We have attempted to capture as many methodology programs housed in Departments of Educational Psychology as possible. We do not claim that this list is complete.
2. We note that there are well-established Ph.D. programs in quantitative methodology within Colleges of Education, for example, at Boston College and at University of California, Berkeley. Given the focus of the Task Force on quantitative psychology, we have limited our consideration here to programs in Educational Psychology.
3. We thank members of the Educational Psychology community, including Deborah Bandalos, University of Georgia, David Kaplan, University of Wisconsin, and David Rindskopf, the Graduate Center, CUNY, for their help in generating this list.

Appendix C

Survey Instrument Devised by Task Force to Assess Resources for Training Ph.D.s
in Quantitative Psychology and Diversity of Doctoral Students and Faculty in
Quantitative Psychology

QUESTIONNAIRE ON RESOURCES TO TRAIN AN INCREASED NUMBER OF QUANTITATIVE PSYCHOLOGISTS

American Psychological Association Task Force to Increase the Quantitative Pipeline
February, 2007

Dear Colleague in Quantitative Psychology:

This questionnaire has been developed by the APA Task Force to Increase the Quantitative Pipeline of qualified Ph.D. quantitative psychologists. One of our aims is to assess the capacity in the U.S. to train an increased number of Ph.D.s in quantitative psychology. The Task Force would greatly appreciate your completing this brief questionnaire that addresses the resources of your Ph.D. program in quantitative psychology, your sense of the possibilities for training an increased number of quantitative psychologists, and demographic characteristics of the quantitative faculty and students.

We will use the responses to this questionnaire in the aggregate as we address the potential for actually increasing the number of quantitative psychologists our quantitative programs produce. Confidentiality of all data is assured. In our data file your program will be identified by case number only. The summary data, but no individual responses, will appear in the Task Force Report to be presented to the APA Council. The Task Force also aims to publish aggregated data from this survey in an academic journal. Thank you in advance for your help.

Cordially,
Leona Aiken, Psychology, Arizona State University, Task Force Chair

**TO RESPOND, SIMPLY TYPE IN THE GREY AREA. AS YOU SELECT THE
GREY AREA, IT WILL TURN BLACK. BEGIN TO TYPE AND YOU WILL SEE
YOUR RESPONSES.**

Name of respondent:

Email of Respondent:

University:

Name of Department:

Name of Quantitative Program:

College (e.g. Liberal Arts, Education):

Date:

Please return questionnaire to Leona Aiken at Leona.Aiken@asu.edu. Entitle your email "QUANTITATIVE TASK FORCE QUESTIONNAIRE".

QUESTIONS BEGIN ON PAGE 2.
(ADMINISTRATIVE)

Case _____

1	As of this fall, 2006, how many students are enrolled in your quantitative Ph.D. program? Please include all students from all years. NUMBER ENROLLED
2	How many new students have entered the quantitative program in the past three years, that is, entering in fall, 2004, or fall, 2005, or fall, 2006? NUMBER NEW STUDENTS IN PAST 3 YRS
3	How many new students entered the quantitative Ph.D. program in fall, 2006? NUMBER NEW
4	What is the <i>maximum</i> number of quantitative Ph.D. students you could train effectively with your current resources? Include all students from all years. NUMBER
5	What is the <i>ideal</i> number of quantitative Ph.D. students you could train effectively with your current resources? Include all students from all years. NUMBER
6	As of fall, 2006, which of the following best describes your Ph.D. student class size? TO RESPOND, DOUBLE CLICK THE BOX BESIDE YOUR ANSWER AND SELECT "CHECKED" ON THE SCREEN THAT APPEARS. ☐ a. We have fewer Ph.D. quantitative students than we would like. ☐ b. We have the right number of Ph.D. quantitative students. ☐ c. We have more Ph.D. students than we would like.
7	As of fall, 2006, how many full time equivalent quantitative faculty are there in the quantitative Ph.D. program? NUMBER
8	How many of the faculty (from question 7) are actively involved in training Ph.D. students in quantitative psychology at the present time? NUMBER
9	How many of all the faculty (from question 7) currently serve as mentors and/or Ph.D. advisors to students in other concentrations (e.g., social, cognitive, clinical, etc)? NUMBER
10	At the present time, would you like to increase the number of quantitative faculty, remain the same size, or decrease the number of quantitative faculty? ☐ a. Increase the number of faculty ☐ b. Remain the same size ☐ c. Decrease the number of faculty
11	How many full-time quantitative faculty would you like to have? NUMBER
12	At the present time, would you like to increase the number of quantitative students you could train, remain the same size, or decrease the number of quantitative Ph.D. students you could train? ☐ a. Increase the number of students we could train ☐ b. Remain the same size ☐ c. Decrease the number of students we could train
13	How many quantitative Ph.D. students would you like to have? NUMBER

This section addresses factors that may limit your program's ability to increase the number of Ph.D.s in quantitative psychology it produces. For each of the following factors, please indicate whether it is (a) not at all a source of limitation, (b) somewhat a source of limitation, or (c) very much a source of limitation. PLEASE DOUBLE CLICK THE BOX TO INDICATE YOUR RESPONSE AND SELECT "CHECKED" ON THE SCREEN THAT APPEARS.

FACTOR THAT MAY POSE LIMITATION ON INCREASING THE NUMBER OF PH.DS PRODUCED IN QUANTITATIVE PSYCHOLOGY	Not at all a source of limitation	Somewhat a source of limitation	Very much a source of limitation
a. Our program lacks sufficient qualified applicants to admit more quantitative Ph.D. students	☐ 1	☐ 2	☐ 3
b. Our program lacks qualified applicants <i>from the United States</i> .	☐ 1	☐ 2	☐ 3
c. Our program lacks qualified <i>international</i> applicants.	☐ 1	☐ 2	☐ 3
d. Our program lacks sufficient research or teaching assistantships to support more quantitative Ph.D. students.	☐ 1	☐ 2	☐ 3
e. Our program lacks sufficient faculty to train more quantitative Ph.D. students.	☐ 1	☐ 2	☐ 3
f. The quantitative faculty have heavy service teaching loads.	☐ 1	☐ 2	☐ 3
g. The quantitative faculty have heavy advisement loads outside quantitative (e.g., on dissertation committees in substantive areas).	☐ 1	☐ 2	☐ 3
h. The quantitative faculty have heavy ad hoc consulting loads (e.g., helping other faculty).	☐ 1	☐ 2	☐ 3
i. The faculty have heavy research service loads on grants as methodologists or methodological consultants.	☐ 1	☐ 2	☐ 3
j. There is resistance from other programs within the department to increasing the quantitative class size.	☐ 1	☐ 2	☐ 3
k. Other factor, please specify	☐ 1	☐ 2	☐ 3
l. Other factor, please specify	☐ 1	☐ 2	☐ 3

An important consideration of the Task Force is the diversity of the current population of doctoral students pursuing Ph.D. degrees in Quantitative Psychology. We would be most grateful if you provide us with information concerning the (1) gender, (2) citizenship (citizen, international student) and (3) ethnic/racial group of the doctoral students in your program.

Please include all the students from all years who are now enrolled in your quantitative Ph.D. program.

Please enter the total number of students enrolled in the quantitative program here.

(1) GENDER

How many of your students are male? (NUMBER)

How many of your students are female? (NUMBER)

(2) CITIZENSHIP (INTERNATIONAL VERSUS CITIZEN)

How many of your students are international students? (NUMBER)

How many of your students are US Citizens? (NUMBER)
(For Canadian schools, indicate number of Canadian citizens)

(3) ETHNIC/RACIAL GROUP

Please indicate the number of your students who fall into each of the following categories:

Non-Hispanic Caucasian	(NUMBER)	(If none, enter zero)
Hispanic or Latino	(NUMBER)	(If none, enter zero)
Black or African-American	(NUMBER)	(If none, enter zero)
American Indian or Alaska Native	(NUMBER)	(If none, enter zero)
Asian or Asian-American	(NUMBER)	(If none, enter zero)
Native Hawaiian or other Pacific Islander	(NUMBER)	(If none, enter zero)
Multi-racial/Ethnic	(NUMBER)	(If none, enter zero)

For each multi-racial/Ethnic student, please specify the multi-racial/Ethnic background.

- (a) Ethnic/racial category: Number
- (b) Ethnic/racial category: Number
- (c) Ethnic/racial category: Number

The Task Force seeks to understand the demographics of the current faculty of quantitative programs. We ask that you answer the following questions concerning gender/ethnicity of the quantitative faculty.

Please enter the total number of fulltime equivalent faculty in the quantitative program.

(1) GENDER

How many of the faculty are male? (NUMBER)

How many of the faculty are female? (NUMBER)

(3) ETHNIC/RACIAL GROUP

Please indicate the number faculty who fall into each of the following categories:

Non-Hispanic Caucasian (NUMBER) (If none, enter zero)

Hispanic or Latino (NUMBER) (If none, enter zero)

Black or African-American (NUMBER) (If none, enter zero)

American Indian or Alaska Native (NUMBER) (If none, enter zero)

Asian or Asian-American (NUMBER) (If none, enter zero)

Native Hawaiian or other Pacific Islander (NUMBER) (If none, enter zero)

Multi-racial/Ethnic (NUMBER) (If none, enter zero)

For each multi-racial/Ethnic faculty member, please specify the multi-racial/Ethnic background.

(a) Ethnic/racial category: Number

(b) Ethnic/racial category: Number

(c) Ethnic/racial category: Number

**QUESTIONNAIRE ON RESOURCES TO TRAIN AN INCREASED
NUMBER OF QUANTITATIVE PSYCHOLOGISTS**

American Psychological Association Task Force to Increase the Quantitative Pipeline
February, 2007

Please add any comments here. Thank you.

Appendix D

Demographic Information on the U.S. Population, on School Students, on Graduate Students in Psychology and Graduate Students in Science and Engineering in the United States

The US Census Bureau (US Interim Projections by Age, Sex, Race, and Hispanic Origin, 2004) projected population changes from 2000 to 2050 by race estimate that by 2050 Hispanics of any race will increase from 12.6% to 24.4% of the population; White non-Hispanic members will decrease from 69.4% to 50.1%; and the remainder will consist of Black, Asian and other races. Projections by age and sex for the same period estimate that while the proportions of males (49%) and females (51%) in the total population will remain unchanged, there will be a decrease in the proportion of the total population represented by the two age groups from which school age and college students are traditionally drawn across both sexes: 5-19 year-olds (overall decrease from 21.7% to 19.3%) and 20-44 year olds (overall decrease from 36.9% to 31.2%).

In 2004 (The Condition of Education 2006, National Center for Education Statistics: Indicator 5) 43% of public schools students were considered to be part of a racial or ethnic minority, an increase of 22% from 1972. This trend is likely to continue. Women's undergraduate enrollment surpassed men's in 1978, and women's undergraduate enrollment is projected to continue growing faster than men's enrollment (The Condition of Education 2006, National Center for Education Statistics: Indicator 9). At the graduate level (The Condition of Education 2006, National Center for Education Statistics: Indicator 10), in 2004, females represented 59% of the graduate enrollment, an increase of 107% from 1976. Minorities represented 22% of total graduate enrollment, an increase of 254% from 1976, with largest increases in Hispanic (377%) and Asian/Pacific Islander (373%) groups. In all 12% were foreign graduate students.

Data for the period 1997 to 2004 for the field of Psychology from the National Science Foundation survey of Science & Engineering graduate programs (NSF 06-325, August, 2006), are summarized in Table 1; there are no data reported as yet for the subfield of Quantitative Psychology. The proportion of female graduate students increased from 71% in 1997 to 74% in 2004. The proportion of minority students increased from 17% in 1997 to 23% in 2004. Thus, the field mirrors the proportions of minorities and surpasses the proportion of women in graduate study. Proportions of foreign students have also increased from 4 % in 1997 to 6 % in 2004 comparable to health fields (7%). Graduate work in Psychology does not enroll as high a proportion of foreign students as some other related Quantitative fields (e.g., in 2004, 37% for Mathematical Sciences, 19% for Social Sciences).

Appendix Table D1
Gender and Race/Ethnicity of Students Enrolled in Graduate Psychology

Graduate students in science, engineering, and health fields in all institutions, by field, citizenship, and race/ethnicity of U.S. citizens and permanent residents: 1997–2004**

Field, citizenship, sex, and race/ethnicity	1997	1998	1999	2000	2001	2002	2003	2004
Psychology	53,126	52,557	51,727	50,466	50,467	51,165	52,211	54,052
U.S. citizens and permanent residents	51,118	50,371	49,488	48,203	47,946	48,308	49,099	50,887
American Indian/Alaska Native	341	311	300	360	334	320	324	323
Asian/Pacific Islander	1,909	2,019	2,038	2,063	2,176	2,186	2,376	2,444
Black, non-Hispanic	3,644	3,813	3,749	4,214	4,347	4,491	4,692	4,994
Hispanic	3,075	3,228	3,567	4,145	4,309	4,655	4,680	4,777
White, non-Hispanic	38,724	37,622	36,267	33,801	33,578	33,473	33,587	33,636
Other or unknown	3,425	3,378	3,567	3,620	3,202	3,183	3,440	4,713
Temporary-visa holders	2,008	2,186	2,239	2,263	2,521	2,857	3,112	3,165
Psychology--male	15,507	15,095	14,456	13,594	13,149	13,437	13,395	13,960
U.S. citizens and permanent residents	14,757	14,297	13,666	12,842	12,372	12,345	12,240	12,715
American Indian/Alaska Native	118	87	88	103	83	83	95	89
Asian/Pacific Islander	510	551	536	532	548	553	576	561
Black, non-Hispanic	908	887	905	871	868	946	934	1,243
Hispanic	860	881	957	1,039	1,048	1,128	1,131	1,132
White, non-Hispanic	11,316	10,915	10,195	9,359	9,025	8,818	8,687	8,570
Other or unknown	1,045	976	985	938	800	817	817	1,120
Temporary-visa holders	750	798	790	752	777	1,092	1,155	1,245
Psychology--female	37,619	37,462	37,271	36,872	37,318	37,728	38,816	40,092
U.S. citizens and permanent residents	36,361	36,074	35,822	35,361	35,574	35,963	36,859	38,172
American Indian/Alaska Native	223	224	212	257	251	237	229	234
Asian/Pacific Islander	1,399	1,468	1,502	1,531	1,628	1,633	1,800	1,883
Black, non-Hispanic	2,736	2,926	2,844	3,343	3,479	3,545	3,758	3,751
Hispanic	2,215	2,347	2,610	3,106	3,261	3,527	3,549	3,645
White, non-Hispanic	27,408	26,707	26,072	24,442	24,553	24,655	24,900	25,066
Other or unknown	2,380	2,402	2,582	2,682	2,402	2,366	2,623	3,593
Temporary-visa holders	1,258	1,388	1,449	1,511	1,744	1,765	1,957	1,920

** Data taken from Tables 13, 14 & 15 of National Science Foundation, Division of Science Resources Statistics, *Graduate Students and Postdoctorates in Science and Engineering: Fall 2004*, NSF 06-325, Project Officer, Julia D. Oliver (Arlington, VA 2006).

Appendix Table D2

Gender and Race/Ethnicity of Students Enrolled in Science and Engineering

TABLE 3. Graduate S&E enrollment, by citizenship, enrollment status, sex, and race/ethnicity, and postdocs in S&E fields: 1993–2003

Characteristic	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	% change 2002–03
U.S. citizens and permanent residents												
S&E graduate students	330,057	329,026	323,962	317,075	308,668	302,879	301,254	290,711	294,711	309,280	327,332	5.8
Full time	204,405	206,809	204,113	200,674	195,974	191,945	190,076	185,673	188,225	200,232	213,349	6.6
First time	NA	NA	NA	NA	NA	NA	NA	46,316	48,232	54,652	59,770	9.4
Other	NA	NA	NA	NA	NA	NA	NA	139,357	139,993	145,580	153,579	5.5
Part time	125,652	122,217	119,849	116,401	112,694	110,934	111,178	105,038	106,486	109,048	113,983	4.5
Male	NA	195,794	189,915	182,519	174,934	169,490	165,823	157,023	158,015	165,004	175,027	6.1
Female	NA	133,232	134,047	134,556	133,734	133,389	135,431	133,688	136,696	144,276	152,305	5.6
White, non-Hispanic	256,772	255,660	245,857	238,032	228,007	220,667	216,750	205,569	206,027	213,162	222,118	4.2
Asian/Pacific Islander	24,048	26,471	25,902	25,929	26,012	26,726	27,570	25,058	26,584	29,352	32,450	10.6
Black, non-Hispanic	17,113	17,610	18,285	19,066	19,341	19,651	20,273	20,834	21,459	22,673	24,134	6.4
Hispanic	13,380	13,273	14,112	14,571	14,984	15,487	16,520	17,203	17,974	19,639	21,264	8.3
American Indian/Alaskan Native	1,309	1,382	1,516	1,538	1,599	1,607	1,553	1,602	1,683	1,735	1,872	7.9
Other or unknown race/ethnicity	17,435	14,630	18,290	17,939	18,725	18,741	18,588	20,445	20,984	22,719	25,494	12.2
Postdocs	11,635	12,469	12,823	12,930	12,835	12,966	12,725	12,627	12,088	13,523	13,590	0.5
Temporary visa holders												
S&E graduate students	105,666	102,116	98,504	98,106	98,962	101,977	109,928	122,825	134,531	145,612	146,871	0.9
Full time	89,500	86,170	83,058	83,365	84,695	86,998	93,817	105,682	115,796	125,266	125,859	0.5
First time	NA	NA	NA	NA	NA	NA	NA	32,016	34,179	32,170	29,574	-8.1
Other	NA	NA	NA	NA	NA	NA	NA	73,666	81,617	93,096	96,285	3.4
Part time	16,166	15,946	15,446	14,741	14,267	14,979	16,111	17,143	18,735	20,346	21,012	3.3
Male	NA	76,237	72,341	70,991	70,685	71,939	76,963	86,034	93,797	101,244	101,063	-0.2
Female	NA	25,879	26,163	27,115	28,277	30,038	32,965	36,791	40,734	44,368	45,808	3.2
Postdocs	13,030	13,318	13,337	13,639	14,429	14,910	16,255	17,597	18,106	18,381	20,095	9.3

NA = not available; information within citizenship groups on sex and on full-time, first-time enrollment was not collected before 1994 and 2000, respectively.

NOTE: For 2000, 2001, 2002, and 2003, the few graduate students who were reported as "Native Hawaiian/Other Pacific Islander" or "multiracial" were included in "Asian/Pacific Islander" or "other/unknown race/ethnicity," respectively.

SOURCE: National Science Foundation/Division of Science Resources Statistics, Survey of Graduate Students and Postdoctorates in Science and Engineering.

Appendix E

Materials Proposed for Creation for the Educational Community of Psychology about Quantitative Psychology

Targets of Information	Website links to sources of information on Quantitative Psychology	Unit Plans on Methods/ Statistics for use by teachers to teach quantitative methods	Informational materials on quantitative psychology including pamphlets and electronic media (DVD, PowerPoint)	Supplemental materials for use by teachers to teach about the field of quantitative psychology	Article in <i>Psychology Teachers Network</i> (PTN)	Article in <i>Eye on Psi Chi</i> magazine	Career profiles of quantitative psychologists	Career resources: preparing for a career in quantitative psychology	Proposals for programs on quantitative psychology for conferences and institutes	Articles for organization newsletters, magazines, or websites
High Schools	X	Currently under Revision by TOPSS HS member Allyson Wesley and College reviewer Richard Gonzalez	X	X	X		X	X		X
Community Colleges	X	a	X	X	X		X	X		
Under-graduate students and departments (psychology, mathematics)	X		X	X			X	X		

Targets of Information	Website links to sources of information on Quantitative Psychology	Unit Plans on Methods/ Statistics for use by teachers to teach quantitative methods	Informational materials on quantitative psychology including pamphlets and electronic media (DVD, PowerPoint)	Supplemental materials for use by teachers to teach about the field of quantitative psychology	Article in <i>Psychology Teachers Network</i> (PTN)	Article in <i>Eye on Psi Chi</i> magazine	Career profiles of quantitative psychologists	Career resources: preparing for a career in quantitative psychology	Proposals for programs on quantitative psychology for conferences and institutes	Articles for organization newsletters, magazines, or websites
College department chairs and faculty	X	a	X	X			X	X		
Advisors to Psi Beta Honorary society	X		X			X	X	X		
Advisors to Psi Chi Honorary society	X		X			X	X	X		
Professional Organizations	X		X				X	X	X	X

a. There are excellent websites of teaching materials for quantitative methods. These websites are recommended as sources for curriculum development.

Appendix F

Suggested areas to be covered in Introduction to Quantitative Psychology Textbook

Part I: Overall Introduction

1. Introduction to the field with descriptions of the areas of
 - a. Experimental Design and Methodology
 - b. Applied Statistics and Mathematics
 - c. Measurement and Assessment
 - d. Evaluation
2. History of Quantitative Psychology: How did the field start; its relation to the field of psychology from the beginning through the present day

Part II : Experimental Design and Methodology

3. Introduction to section
4. Elements of Research Design, Sampling etc.
5. Computational Skills Required to Conduct Research in Quantitative Psychology
6. Ethics
7. Writing Reports in Quantitative Psychology

Part III: Applied Statistics

8. Introduction to section
9. Descriptive and Inferential Statistical Methods
10. Structural Equation Modeling and related methods
11. Hierarchical Linear Modeling
12. Bayesian Statistics

Part IV: Psychometric Theories, Measurement and Assessment

13. Introduction to Section
14. Psychometric Models used in the Measurement of Psychological Constructs
15. Scales and Measures

Part V: Evaluation

Part VI: Examples of Research Conducted Using Elements Taught Above.