Undergraduate Preparation for Graduate Study in Psychological Clinical Science

Preamble

The Academy of Psychological Clinical Science (APCS) issues this white paper that describes an undergraduate curriculum designed to optimally prepare students for a career in psychological clinical science. APCS is an organization of highly research-oriented PhD programs and internships in clinical psychology. APCS, therefore, is concerned with increasing the supply of well-trained scientists who also have clinical training in recognition of the special contribution such scientists can make to understanding and ameliorating psychological problems.

What follows is *not intended as a prescriptive list of courses and experiences that are essential*. Rather, it is an attempt to invite students interested in clinical science to think about what kind of education they are seeking. It is especially concerned to counter the common assumption that preparing for a clinical science career requires taking predominantly "clinical" undergraduate courses. To the contrary, we would advise prospective clinical scientists to prioritize the "science" side of their undergraduate preparation, favoring rigorously scientific courses not only in psychology, but also in related or foundational disciplines such as biology, mathematics, and the social/economic sciences.

As just noted, no student could—or would want to—take all of the courses below and thus must make choices among them. Indeed, all of these recommendations are in the form of a reference template to be considered by a student in making decisions in the context of the student's interests, the available curriculum at a given institution, and other factors.

Psychological Clinical Science

The term psychological clinical science refers broadly to the adoption of a scientific approach to every aspect of clinical problems. Assessments and interventions should be evaluated with rigorous experimental designs and appropriate statistical techniques. Attempts to understand the nature of clinical problems and clinical processes should draw on basic psychological and related sciences in the same way that pathology in medicine draws on understanding of normal physiology and biochemistry. Moreover, one needs to learn about social, organizational, and economic processes that play an important role in problem maintenance and change and in the delivery of psychological and medical services. Thus, theories in clinical science should be grounded in an understanding of basic biological and social science, and applications to clinical problems should be evaluated with the best scientific methods available at any given time. Clinical or abnormal psychology is not separate from the rest of psychology but rather requires a full understanding of basic psychological science.

PhD graduate programs in psychological clinical science emphasize a strongly scientific approach to application training (e.g., see Baker, McFall, & Shoham, 2008). In addition, such programs emphasize the academic rigor and development of research skills necessary for students to become creators of knowledge—i.e., to pursue careers in clinically-relevant research. Because of the combination of application and research training, clinical science programs often are more demanding than are programs that provide primarily one or the other component. However, this combination of skills—clinician psychologists who have the skill to implement assessment and treatment and to conduct research of high quality—is much in demand. Indeed, NIMH has noted a distinct shortage of research clinicians, and funds for clinical research tend to be more available than in less applied areas

In evaluating applicants for admission, graduate programs in psychological clinical science emphasize the strength of the student's scientific background. The purpose of this white paper is to describe aspects of an undergraduate major that optimally prepares students for admission to clinical science programs. Two features of most variations on the clinical science undergraduate major are a balanced selection of rigorous courses and a well mentored research experience with independent study opportunities, in order to obtain the best scientific background possible. Thus, within psychology students should select a broad range of courses in the various basic areas of psychology rather than selecting only courses with a clinical focus. Similarly, in selecting science courses outside of psychology, students

should select the more rigorous courses rather than courses designed to make them popular to a larger audience. Another consideration in the selection of courses is that they often provide prerequisites for more advanced courses. Given the uncertainty of the evolution of one's interests, there is much value in keeping options open by taking a wide range of entry-level courses across the sciences.

In addition to coursework, hands-on research experience is essential. This experience can range from passive exposure (e.g., working in a professor's laboratory and participating in tasks defined by others) to the more valuable enterprise of participating in the development, implementation, analysis, and writing up of a research project. The latter description ideally applies to the senior honor's thesis or equivalent capstone research project, but for some students it may be possible to arrange even more extensive active participation in research. Such experience is invaluable preparation for graduate school and also helps to develop interest in specific areas of research. Similarly, in many cases registration for independent study may provide opportunities for learning in areas beyond basic courses—potentially opening up broad new areas of research interests.

Psychology Courses and Research Experience

As noted, a clinical science undergraduate major should include a broad range of courses in psychology. Although there can be variations on this theme, some obvious potential courses are cognitive psychology, perception, social psychology, developmental psychology (both social and cognitive development), behavioral neuroscience, abnormal psychology, and personality. Any comprehensive psychology major will also include courses in elementary statistics, experimental psychology, a laboratory course in which students conduct their own experiments and analyze the data, and a capstone experience in which the student designs and conducts a research project. Prior to the honor's thesis, participation as a research assistant in faculty laboratories provides both valuable training for the honor's thesis and exposure to areas of psychology that might be of interest. There may be additional courses of value depending on one's interest—for example, additional courses in statistics, cognitive psychology, neuroscience, developmental biology, interpersonal processes, psychoimmunology, neuropsychology, behavior genetics, epidemiology, etc.

The Importance of Biology

Due to many developments in the field, biology and psychology have become so intertwined that exposure to biology—especially neuroscience and genetics—should be an essential part of undergraduate training in psychology. These developments include increasing recognition of the fundamental and pervasive role of intertwined genetic and environment influences and of the impact of social environmental influences on brain structure/function and on gene expression. Moreover, developments in the field of behavioral neuroscience have resulted in numerous multilevel, integrated theories of psychological processes (e.g., the important role played by dopaminergic neural pathways in substance abuse). Consequently, many psychology students embarking on a career in clinical research should strive to become literate in aspects of biology relevant to psychology. For the large number of clinical scientists whose research interests do not take them into areas that articulate strongly with neuroscience or other aspects of biology, achieving a modest level of biological literacy still should be a goal. Such literacy hopefully will permit them to understand relevant developments in biology, collaborate with experts in biology, and eventually be able to translate basic-science findings into clinical applications. This proposal parallels the tradition of learning statistics. The modest statistics learned by almost all clinical researchers does not make them statisticians, but it does greatly facilitate consulting statisticians about research design and data analysis, and the undergraduate introductory course prepares them for graduate school.

This emphasis on biology does not imply greater importance than psychosocial factors. Rather, the latter are so central to psychology that it is assumed that they will be well covered in a psychology major and in graduate programs in clinical psychology—an assumption that would not necessarily be true for biology.

The Importance of Methodology, Statistics and Mathematics

A strong background in mathematics is an important prerequisite for many clinical science careers, given the increasing importance of statistical modeling of various sorts in analyzing complex data sets. As psychological research becomes more complex, statistical models of many interacting factors are now becoming commonplace. Even theories of the etiology of various psychological and medical disorders, where genetic contributions usually are manifestly important, do not embrace unifactor or single cause models. Such theories take into account a wide variety of factors, including social (e.g., familial) and economic variables. For example, in predicting physical abuse against a partner, many variables have been shown to increase the odds that a man will be physically aggressive to his wife. Some of those variables include the man's anger, dominance, and jealousy; during childhood observing parents hit one another and being hit repeatedly; and the couples' marital discord. In addition, use of physical aggression against family members is more likely in young individuals with less education and lower incomes. In order to evaluate the relative contribution of such variables, complex statistical models are required. Further, using genetic and statistical techniques, twin studies have now been able to show how genetic factors contribute to partner abuse. Consequently, students need to know that to be able to account for the complexity of behavior at the genetic, individual, and social levels one needs to have knowledge of methodology, statistics and model evaluation that did not exist 20 years ago. Thus, undergraduate students need to develop expertise in the use of rigorous quantitative approaches to theory building and testing theoretical models—i.e., the more math, the better.

Science and Math Courses Outside Psychology

As indicated above, the demands of graduate training preclude a considerable amount of coursework that would be desirable for clinical science students to consider. Accordingly, coursework outside the major at the undergraduate level becomes critical in supplying this essential and broad background. The comments above on the centrality of biology for many areas of psychology suggest that all—or at least almost all—clinical science psychology majors should take basic courses in biology and genetics. An additional desirable course for anyone with even a modest interest in this biological interface is a year-long course in inorganic chemistry (organic chemistry is an additional valuable course).

Also as noted above, math and statistics are increasingly important in clinical science research. In addition to the elementary statistics courses required for a psychology major, two courses in calculus provide a prerequisite for advanced courses in natural or biological sciences, and also provide a foundation for the statistics that will be taught in psychology at the graduate level. Matrix algebra provides a valuable background for multivariate statistics. Thus, students should consider pursuing additional study in calculus (2 semesters) and a course that includes matrix algebra (e.g., linear algebra, multivariate calculus, differential equations) to provide a broad background for multivariate statistics and both natural and biological sciences. Also, having more than one statistics course is valuable.

Experience with a computer programming language is also valuable for most students. While students may or may not need to write extensive programs for data analysis and manipulation per se, a knowledge of programming techniques is invaluable in many areas of working with commercial statistics packages and also for programming experiments using currently available programs. Such experience could be obtained in one or two courses or, at least at an introductory level, through research practica and hands-on training within ongoing research programs.

After the above courses, the selection of additional science courses depends to a significant extent on the student's specialized interests. For example, if the interests are strongly biological, additional courses in neuroscience, neuroanatomy, neurophysiology, and neuropharmacology are useful, while students interested in the science of behavior change could benefit from advanced courses in social psychology. Alternatively, courses in physics provide a very helpful background for anyone interested in pursuing brain imaging, either fMRI or electrocortical recording, and provide a foundation for the increased study that is necessary for one to assume technical responsibility for such techniques, such as pulse programming for fMRI studies.[1]

The types of expertise and the range of professional roles that graduates of psychological clinical science programs will hold are remarkably broad. Therefore, to prepare for their future careers, students may wish to take courses in a variety of different fields, such as public health, public policy, epidemiology, and business. For example, if one has public policy interests related to psychology, one could elect courses regarding health care delivery, health economics, and prevention of social and mental health problems. In a second example, research on obesity may have implications for national public policies that address the health issues related to obesity. Similarly, applying basic research on response to traumatic events in the lab to the development of effective treatments has produced interventions that now are widely applied in the entire Veteran Affairs system and other community agencies.

The Need for a Liberal Arts Education

Since psychological clinical science strives to reduce human suffering and enhance human potential, it is important for students to obtain a well-rounded education that will enable them to appreciate the human experience from multiple and creative perspectives. Similarly, since humans do not think, behave, and feel in a vacuum, it will be valuable for future psychological clinical scientists to understand the importance of the sociocultural contexts in which people live. Toward these ends, it is important for students to take courses in the humanities and social sciences. Which particular courses students should take will depend on the interests they plan to pursue in psychological clinical science. Courses in the traditional liberal arts areas of history, philosophy, and literature might well be supplemented with courses in sociology, cultural anthropology, and area studies.

Making Choices Among Courses

As emphasized in the introduction, no student will take all of the courses above and thus must make choices among them, taking into account his/her interests, the available curriculum at a given institution, and other factors.

There is a tension between two perspectives. On the one hand, obtaining a background in as wide a range of courses as possible serves the functions of providing basic literacy in many areas, exposure to topics that might trigger a life-long interest, and having prerequisites that facilitate taking more advanced courses in graduate school. On the other hand, making a decision about the likely range of interests permits some degree of specialization. The latter choice is perhaps most easily made for courses outside of psychology, where students might opt for more advanced courses in only one domain such as biology-chemistry, mathematics, sociocultural perspectives, public health, etc., while at the same time preserving a relatively broad exposure to areas within psychology.

One strategy might be to omit a couple of the psychology courses listed above, while still taking many of the recommended courses in mathematics/statistics, biology/chemistry, and computer science. Hopefully, at least some of these courses outside of psychology would meet university breadth or general education requirements and thus would not constitute added credit hours. They would, in any case, constitute a valuable science component of a broad liberal arts education. With the remaining course credits, a student could concentrate on additional courses in a broadly defined domain of interest and liberal arts courses.

To summarize, a good selection of courses for a clinical science major might include the following:

- Twelve or so courses in psychology, including statistics and a capstone research project
- Non-thesis research experience
- Biology courses, such as physiology and genetics
- Inorganic chemistry
- Exposure to a computer programming language
- Two to three courses of additional math

The above courses represent just over half the courses required for an undergraduate degree. As suggested above, the nonpsychology courses represent a significant contribution to the science component

of a liberal arts education that may well fulfill college breadth or general education requirements. Thus, there should be ample credit hours left to pursue some of the specialization courses suggested above, as well as a non-science liberal arts curriculum. Nevertheless, a student may well choose to pursue only a portion of these courses outside of psychology and still develop an excellent clinical science major curriculum—especially in the context of clearly focused specific interests.

Comment

As noted above, these suggestions describe a hypothetical ideal clinical science undergraduate major. Preparation for graduate school is not an all or none matter, however, but rather a continuum. It will be rare for an undergraduate to follow all of the recommendations above. Most undergraduates with an interest in a career in psychological clinical research might use the recommendations as a point of reference in selecting courses. If so, they will still be better prepared for graduate psychological clinical science programs than are most undergraduates: at present most students admitted to clinical science graduate programs have very few of the nonpsychology science and math courses suggested here. The basic point here is that clinical scientists can play many roles, and in each kind of role science training in clinical psychology—and beyond—is critical.

Footnote

[1] It is well known that grade distributions in natural and biological sciences and mathematics courses tend to be lower than in psychology courses. Some students may be concerned that taking these courses outside psychology may lower their GPA and, thus, place them at a disadvantage in graduate admissions. That is unlikely to be the case. Admissions committees are aware of this phenomenon and will take it into account. Further, the educational background recommended here will strengthen the application, not weaken it.

Suggested Readings

Baker, T.B., McFall, R.M., & Shoham, V. (2008). Current Status and Future Prospects of Clinical Psychology: Toward a Scientifically Principled Approach to Mental and Behavioral Health Care. *Psychological Science in the Public Interest, 9*, 67-103.

Caspi, A., Sugden, K., Moffitt, T. E., Taylor, A., Craig, I. W., Harrington, H., et al. (2003). Influence of life stress on depression: moderation by a polymorphism in the 5-HTT gene. *Science, 301*, 386-389. (18 July 2003 issue)

Rutter, M, & Silberg, J. (2005). Gene-environment interplay in relation to emotional and behavioral disturbance. *Annual Review of Psychology, 53*, 463-490.

Park, D.C. & Gutchess, A.H. (2006). The cognitive neuroscience of aging and culture. *Current Directions in Psychological Science, 15(3)*, 105-108

Suggested Courses

Psychology Core Curriculum (perhaps omitting 6 s.h.):

- Elementary Psychology
- Cognitive psychology
- Perception
- Social Psychology
- Cognitive Development
- Social Development
- Behavioral Neuroscience
- Abnormal Psychology
- Personality
- Experimental Psychology
- Experimental Psychology Laboratory
- Research Participation (6 s.h.)
- Honor's Thesis (6 s.h.)

Additional, highly desirable courses that would broaden a psychology major, providing prerequisites for later specialized interests:

- Calculus 1 and 2
- Inorganic Chemistry 1 and 2
- Biology/physiology
- Genetics
- Introduction to Computer Programming (possibly 2 semesters)

The following are suggested sets of courses that would facilitate a more specialized, stronger undergraduate preparation. That is, a student might choose one of the following areas of specialization and take a number of the suggested courses.

Suggested courses for additional concentration in biological aspects of psychology:

- Organic Chemistry 1 and 2
- Biochemistry

Suggested courses for additional concentration in mathematical modeling and statistical aspects of psychology:

- Calculus 1 and 2
- Matrix algebra

Suggested courses for additional concentration in interpersonal and social-interactional aspects of psychology:

- Ethnocultural Issues in Mental Health
- Mental Health Policies & Economics: Current Trends & Future Implications
- Community Processes that Contribute to Psychiatric Disorders
- Conceptual & Methodological Issues in Mental Health Interventions & Prevention
- Family & Peer Contributors to Mental Health Risk