

**DEPARTMENT OF PSYCHOLOGY AND NEUROSCIENCE
GRADUATE TRAINING PROGRAM IN BEHAVIORAL GENETICS**

General Description

Behavioral genetics is an area of specialization devoted to the study of genetic and environmental influences on behavior. In behavioral genetics, principles and techniques from biochemical genetics, developmental genetics, evolutionary genetics, molecular genetics, pharmacogenetics, and quantitative genetics are applied to the analysis of behavior. Students in the graduate training program are expected to achieve competence in genetics relevant to their special research interests. Departmental faculty are currently applying the concepts and tools of behavioral genetics to such diverse areas as aging, alcohol abuse and addiction, cognitive development, drug abuse and addiction, learning disabilities, neurological diseases, nicotine tolerance and withdrawal, personality/temperament, and psychopathology.

Within the Behavioral Genetics (BG) graduate training program, students can arrange a course of studies that incorporates elements of the other training programs in the Department of Psychology and other academic units within the University (e.g., the Department of Ecology and Evolutionary Biology or the Department of Molecular, Cellular, and Developmental Biology). A graduate Interdisciplinary Certificate in Behavioral Genetics is available in the C.U. Boulder Graduate School and is administered through the Institute for Behavioral Genetics.

I. Course Requirements for Ph.D. students in the Behavioral Genetics Area

Department of Psychology and Neuroscience Ph.D. students in the behavioral genetics area are required to enroll in the following courses. As many courses are not taught every year, it is the student's responsibility to take relevant courses when offered. Course substitutions may be requested by submitting a petition for approval by the BG training committee.

Required Courses:

1. Physiological Genetics (PSYC 5200, IPHY 5200, 3 credits; Stitzel).

This requirement may be waived for students who have had an equivalent course in molecular genetics or substituted by another graduate molecular genetics course. Examples of other graduate molecular genetics courses are:

MCDB 5220, Molecular Genetics, 3 credits
MCDB 5230, Gene Expression, 3 credits
MCDB 5471, Mechanisms of Gene Regulation in Eukaryotes, 3 credits
MCDB 5520, Bioinformatics and Genomics, 3 credits

2. Behavioral Genetics (PSYC 5102, 3 credits; Rhee, Carey).

3. Statistics (PSYC 5741 (Graduate Statistics), 4 credits; PSYC 5741, 4 credits (Quantitative Methods in Neuroscience); PSYC 5751, 4 credits; IPHY 5800, 5 credits;

PSYC 5541, 4 credits; or other approved course). This must be a graduate-level course in statistics (of at least one semester), approved by the student's advisory committee.

4. Scientific ethics (PSYC 5112, 3 credits; Smolen).

Students must complete three courses (at least 9 credit hours) from the following:

1. Quantitative Genetics (PSYC 5122, 3 credits; professor TBA).
2. Molecular Genetics and Behavior/ Human Genomics (IPHY 5232; PSYC 5232, MCDB 5232, 3 credits; Johnson). Note: Tom may change the course number to create a new course rather than teach this as 5232.
3. Biometrical Methods in Behavioral Genetics (PSYC 5242, 3 credits; Stallings).
4. Bioinformatics and Genomics (IPHY 6010, PSYC 6010, 3 credits; Ehringer).
5. Advanced Statistical Genetics (IPHY 5300, PSYC 5300, 3 credits; McQueen).
6. Up to two courses in Behavioral Neuroscience

Examples of Behavioral Neurosciences courses are:

NRSC 5100, Introduction to Neuroscience I, 2-5 credits
 NRSC 5110, Introduction to Neuroscience II, 3 credits
 NRSC 5032, Neurobiology of Learning and Memory, 3 credits
 NRSC 5052, Behavioral Neuroscience, 3 credits
 NRSC 5072, Clinical Neuroscience, 3 credits
 NRSC 5132, Neuropharmacology, 3 credits
 NRSC 5092, Behavioral Neuroendocrinology, 3 credits

Students must complete two courses (at least 4 credit hours) from the following seminar courses:

1. Genetics of Psychopathology (PSYC 7102, 2 credits; Rhee, Carey). **Note: required of NIMH trainees.**
2. Molecular Genetics of Addiction* (e.g., IPHY 6010, 3 credits; Stitzel).
3. Genetics and Substance Use Disorders* (PSYC 7102, 2 credits; Stallings).
4. Neurobiology of Addiction* (NRSC 5545, 3 credits, Bachtell).

Note: *NIDA trainees are required to take at least one of the courses.

5. Benchmark Papers in Behavioral Genetics (PSYC 7102, 2 credits; Hewitt).
6. Mouse Models for Behavioral Genetics (Johnson).

7. Developmental Psychopathology (PSYC 5453, 3 credits, Willcutt). **Note: required of NICHD trainees.**

8. Population Genetics (PSYC 7102, 2 credits; Keller).

9. Other approved seminar courses on topics relevant to behavioral genetics

II. Other Ph.D. Requirements

In addition to this sequence of core courses within the BG training program, the following requirements also must be met prior to admission to candidacy for the Ph.D. degree unless a specific exception has been obtained in writing from both the Director of the BG program and the departmental Director of Graduate Studies.

Competency in General Genetics	Grade above C in Physiological Genetics (PSYC 5200, IPHY 5200) and Behavioral Genetics (PSYC 5102)
Yearly Review	Near the end of the each year of graduate study, the progress of each BG student is reviewed by an advisory committee. This review and evaluation may include an examination, which samples course and research work.
Elective Requirements	In addition to the required BG courses, students must take three additional courses. These can be any graduate level course, and can be within or outside of the BG program. The specific courses are determined through consultation between the student and the student's advisory committee
First-Year Project	At the beginning of the fall semester, students starting their second year will present their first-year project at the IBG orientation poster session.
Second-Year Project	At the beginning of the fall semester, students starting their third year will present their second-year project at the IBG orientation poster session.
Master of Arts Degree or Equivalent.	Receipt of M.A. degree based on research relevant to behavioral genetics or equivalent (see IV below). The two papers must be submitted to the masters committee by the end of the second year (i.e., August following the second year). The masters papers should be defended at the same time as the comprehensive examination defense during the fall semester of the third year. Students must petition the faculty for permission to complete the masters after the second year.

Teaching and Research Experience

The student is required to obtain at least one semester of teaching experience. This requirement usually can be met by successful performance as a teaching assistant.

Students will be required to engage in research under the supervision of a faculty member of their choosing each semester of their graduate career. It is expected that the first year of this research will be in the form of a research apprenticeship.

A file of each student's achievements will be kept in the BG Area Office in the Department of Psychology (and at the Institute for Behavioral Genetics). It is the student's responsibility to keep this file up to date by submitting every spring a brief description of the research and teaching experience gained during the previous year. This file also should include copies of all papers, published and unpublished, for which the student desires credit during evaluation procedures.

Advisor

On being admitted, the student will be assigned a BG Area major advisor to supervise the training program leading to advanced degrees. If a change of interests or circumstances necessitates a change of advisor, students should obtain written consent from the faculty member with whom they wish to work and the approval of the Director of the Behavioral Genetics training program. During the first semester of residence, the student and advisor will select a three-person committee to advise and guide the student. This committee will usually be the same as that which administers the examination designated below and will constitute the thesis committee for the student's Master's degree.

III. Graduate School Rules

The rules of the Graduate School can be found on the web at: <http://www.colorado.edu/GraduateSchool/policies>. Students are responsible for compliance with these rules.

IV. Program Leading to the Master's Degree

The Master's degree is a prerequisite for the Ph.D. There are two alternative plans for obtaining the Master's degree. Plan I is satisfied by presenting 30 semester hours of graduate work including 4-6 thesis hours and a Master's thesis approved by the student's advisory committee. At least 24 hours of the graduate work must be at the level of 5000 or above. Plan II is satisfied by completing 30 hours of graduate work and presenting two research papers or an F31 application as described below. At least 24 semester hours must be 5000 level courses or above. A student who wishes to satisfy the Master's requirement under Plan II must (1) obtain advisory committee approval, (2) obtain the approval of the Director of Graduate Studies, and (3) submit two senior-authored research papers on some aspect of behavioral genetics of a quality suitable for publication, as judged by the student's advisory committee, or complete an F31 application on some aspect of behavioral genetics that is approved by the advisory committee.

Examinations and Evaluations:

At the end of the each year of residency, students must meet with the advisory committee for evaluations of their academic record and research program. This evaluation may include a written examination. The advisory committee will then recommend to the BG area and the Department one of the following courses of action: continuation, continuation with conditions, or termination. Prior to the end of the third semester in residence, students who wish to satisfy the Master's requirement under Plan I must submit a written proposal for the Master's thesis research. This should include (a) a review of the relevant literature, (b) a statement of the research question, (c) a description of the methodology to be used, (d) suggestions as to possible outcomes and interpretations. If the proposal is prepared in time, its merits may be judged at the second semester evaluation meeting. At the end of the fourth

semester, the student will be scheduled for a comprehensive final examination. The examination, which may be either oral or written or both, must cover the thesis as well as other work done in the university in formal courses and seminars in the major field. It is the student's responsibility to ensure that all Graduate School requirements for the Master's degree have been met prior to this time. The comprehensive examination for the Master's degree may be combined with the Ph.D. comprehensive examination at the request of the student and the approval of the student's advisory committee. If so, the examination shall be written and oral and shall be administered by a five-person committee (see next section). Students must be registered for credits the semester (including summer sessions) in which the master's defense or comprehensives are taken to be recognized by the graduate school.

V. Program Leading to the Doctor of Philosophy Degree

Advisory Committee: Before taking the comprehensive examination, students should request the faculty member with whom they wish to undertake Ph.D. research to act as chairperson of the advisory committee. The chairperson will select four additional faculty members to serve on the committee so that the several fields in which the student is interested are represented. Members of this committee must be graduate faculty members, as specified by the CU Graduate School. This committee must be approved by the Director of the Behavioral Genetics training program and the Director of Graduate Studies of the Department of Psychology. The student should obtain the signatures of the members of the committee indicating their willingness to serve. Copies of this form are to be given to the chairperson of the advisory committee and to the Director of Graduate Studies, and one copy is to be placed on file in the BG Area office. Any change in the advisory committee is to be similarly reported. It is the student's responsibility to keep the advisory committee informed of progress in their research and training and of any significant change in the direction or status of this training program.

Comprehensive Examination: Before admission to candidacy for the Ph.D. degree, the student must pass a comprehensive examination in the field of concentration and related fields. This written examination will test the student's mastery of a broad field of knowledge, not merely the formal course work completed. In the BG training program, this examination is ordinarily part of the Master's final examination. Students entering the program with a Master's degree in some aspect of behavioral genetics should arrange to take the comprehensive examination during their first year. Before attempting the examination, the student must (1) have earned at least four semesters of residence; and (2) have made formal application for admission to candidacy on forms supplied by the Graduate School at least 2 weeks before the comprehensive examination is attempted. The comprehensive examination will take place during the fall semester of the student's third year in the program. Students must petition for permission to take the comprehensive examination after the fall semester of the third year.

Dissertation Proposal: Following completion of the comprehensive examination, the student must submit a written doctoral research proposal, including a review of the pertinent literature, to all members of the doctoral committee. Approximately 2 weeks later, the committee will meet with the student and evaluate the proposal.

Residence Requirements: At least 30 semester hours of courses at the 5000 level or above are required; at least 20 of the required hours must be in graduate courses taken at this University. To receive credit for the doctoral thesis, the student must complete 30 semester hours of Psychology 8991 – Doctoral Thesis Research; 5 of these hours must be completed in the semester(s) after admission to candidacy.

Final Examination: This examination is the dissertation defense. The dissertation must be available to the members of the examining board at least 2 weeks prior to the date set for the examination. The final examination cannot be attempted until the student has been in residence for at least two semesters as a doctoral candidate (i.e., after passing the comprehensive examination).

Student's Responsibility: None of the stipulations of the BG training program is to be seen as in conflict with normal Graduate School requirements. It is the student's responsibility to see that these requirements, including total credit hours, advanced registration for examinations, etc., are met. Students should arrange for the scheduling of examinations with their major advisor and the Director of Graduate Studies. The student should pay careful attention to the rules governing the various examinations, thesis preparation, residence requirements, etc., as they are set forth in the Graduate School Bulletin. The Graduate School mandates completion of the Ph.D. in six years. Students failing to meet this deadline must receive an approved extension from the Graduate School in order to continue in the program. A written request for extension should specify the extenuating circumstances necessitating the extension.

VI. Summary of Examination Schedule

A typical schedule of examinations for students undertaking study for the doctorate in psychology with a specialization in behavioral genetics is as follows:

Year 1

First semester: See Course Requirements for Physiological Genetics (PSYC 5200, IPHY 5200) and Behavioral Genetics (PSYC 5102) in “**I. Course Requirements**” section.

Second semester: First-year evaluation of all course work and ongoing research projects. This evaluation is usually conducted by the student's three-person M.A. committee.

Year 2

The two alternative plans for obtaining the Master's degree are:

Plan I - a Master's thesis approved by the student's advisory committee

Plan II – two senior-authored research papers on some aspect of behavioral genetics of a quality suitable for publication, as judged by the student's advisory committee, or an F31 application approved by the student's advisory committee

Year 3

First semester: All students in the BG area will take their comprehensive examination for the Ph.D. degree during the first semester of their third year. The comprehensive examination will be conducted by a committee (five people or more) that includes at least two graduate faculty members from the BG area.

Year 3/4

Ph.D. dissertation proposal should be submitted within 2 semesters of receiving Ph.D. candidacy. This requirement can be fulfilled by either writing an NIH-type grant proposal on the dissertation topic **or** a more traditional dissertation proposal which includes: an introduction and literature review, statement of the research hypothesis, outline of the proposed methods and experiments, and a time table for execution of the research. The type of proposal should be agreed upon in consultation with the student's advisor and committee.

Year 4/5

Final examination by the doctoral committee. This is the traditional dissertation defense, and it is open to members of the academic community. The committee must consist of 5 members: at least two from the BG area, one from Psychology outside the BG area, one from outside the Psychology Department and the final member coming from any area.

VII. Journal Club Requirement

Students must participate in the weekly journal club and colloquia series at the Institute for Behavioral Genetics. Each student must present at journal club at least three times across three different semesters during the course of their training, but yearly presentations are encouraged. At least one presentation should be focused on the student's own research.