BRAIN, BEHAVIOR AND COGNITION

1. Coursework

The minimum course requirements for the Ph.D. set by the Graduate School is 27 courses. The graduate program is designed both to encourage students to complete necessary coursework and to gain extensive research experience. Although there are some standard requirements (shown below), each student may take such courses as are needed in consideration of prior coursework and of the student's goals. Students begin doing research in their first year, devote more than half of their time to research in the second year, and nearly all of their effort in subsequent years. The doctoral program in BBC can be completed in four or five years; the actual time taken depends largely on the background of the individual student. The major requirements are:

Key courses in Brain, Behavior & Cognition

Key courses in Brain, Behavior & Cognition are listed below. In addition to the required courses, six elective courses are to be selected in consultation with the faculty adviser. At least two of these courses must be breadth courses – that is, courses offered by other areas of the Psychology Department or by other departments at Northwestern. Note that Northwestern operates on a quarter system.

Required Courses

- Psych 401-1 Psychology Proseminar (1)
- Psych 401-2 Psychology Proseminar (2)
- Psych 519 Ethics: Responsible Conduct of Research
- Psych 450 Fundamentals of Statistics (may be waived under some circumstances)
- Psych 451 Statistics in Experimental Design
- CSD 406 Functional Neuroanatomy or
- NUIN 440 Advanced Neuroanatomy

Electives (partial list)

- Psych 312-1,2 Neurobiology and Behavior
- Psych 314 Topics Courses (when relevant)
- Psych 321 Neuroscience and Behavior Lab
- Psych 324 Perception
- Psych 342 Biological Bases of Mental Illness
- Psych 360 Human Memory and Cognition
- Psych 361 Brain Damage and the Mind
- Psych 363 Images of Cognition

- Psych 364 Topics in Cognitive Neuroscience
- Psych 405 Psychometric Theory
- Psych 421 Psychopathology
- Psych 422 Child Psychopathology
- Psych 442 Experimental Approaches to Personality
- Psych 453 Linear Models: Correlation, & Regression
- Psych 460 Topics in Cognition
- Psych 470 Topics in BBC
- Psych 471 Cognitive Neuroscience
- CSD 303 Brain and Cognition
- CSD 310 Biological Foundations of Speech and Music

2. Master Thesis

The student is expected to submit at least one research report to a journal by the spring quarter of the second year of the program. The student submits this report for approval to a Master's Thesis committee, which conducts an oral examination of the student. This committee ordinarily consists of at least two members of the BBC faculty, plus at least one other faculty member from outside the BBC area.

3. Comprehensive Qualifying Examination

The comprehensive examination is taken after the student has completed the required course work and Master's Thesis work. As the student approaches the completion of required courses, a Program of Study is developed, in consultation with the adviser. This Program of Study is designed to help the student develop an in-depth appreciation of areas that increase breadth of knowledge via mastery of topics related to the student's graduate research. The Comprehensive Exam on this Program of Study must be completed by the end of the graduate student's third year in the Ph.D. program (August 30th) in order that the student is to be considered in good standing.

At the beginning of the fall quarter of the third year, the comprehensive examination committee should be formed. The make-up of this committee is based on the topics selected in the Program of Study and developed by the student in consultation with the student's primary advisor(s). Members of the committee are selected to provide suitable guidance in the specific topic areas. The committee can include three or more faculty members, but at least two must be from the BBC area. Working with the committee members, the student develops a bibliography adequately covering six topics within the program of study. Each bibliography includes 12-20 papers to read within each area with the number of papers depending on the material (note that reading lists of 12 papers are considered minimal and longer lists are strongly preferred for well-researched topic domains). After approval of the bibliography by the committee, the student undertakes to master the areas

selected. The reading period for the 72-120 paper reading list is typically expected to be 1-3 months.

The range of topic areas is determined collaboratively by the student, advisor and committee. The six areas can cover a wide range of topics in brain, behavior and cognition. A more detailed exploration of a complex area can be accomplished by two topic lists on closely-related areas. It is expected that the topics will generally cover specific issues within basic content areas in brain, behavior, and cognition such as, sensory analysis, perception, memory, and emotion. Methodological areas can also be used as a core content area. To allow for breadth of knowledge and foster possible novel connections across topics, the set of topic areas can include allied fields and faculty from other areas of the Psychology department as well as other departments across the University.

After completing the readings, a two-day written, "closed book," examination is used to assess the student's mastery of these areas. On each day, 3 exam questions will be answered that are based on topic areas. The exam questions are collected from the committee by the advisor and provided to the student at a specific time during the day to start the exam. Students are typically given 2 hours per question to complete the exam (i.e., 6 hours/day for each day). Once the answers are provided by the student, the answers are graded by committee members, and the advisor assembles the grades and feedback from the committee and passes that along to the student. Essays are graded an NIH-style 1 to 9 grading scale where 1 is the best possible score. By the standard NIH review scale, 1=Exceptional (Exceptionally strong with essentially no weaknesses), 2=Outstanding (Extremely strong with negligible weaknesses), 3=Excellent (Very strong with only some minor weaknesses), 4=Very Good (Strong but with numerous minor weaknesses), 5=Good (Strong but with at least one moderate weakness), 6=Satisfactory (Some strengths but also some moderate weaknesses), 7=Fair (Some strengths but with at least one major weakness), 8=Marginal (A few strengths and a few major weaknesses), 9=Poor (Very few strengths and numerous major weaknesses).

Scores better than or equal to 6 are considered passing within each topic. An average score greater than 6.0 is considered to be a failing grade and the student will not advance to candidacy. Any individual essay scored worse than 6.0 can be requested to be rewritten by the committee member. Rewritten questions will be evaluated by the committee member and the advisor and must be judged satisfactory to complete the exam.

When needed, alternate arrangements for the comprehensive exam can be made with the agreement of the student, advisor, and head of the BBC area. For example, the exam can be planned to be completed as an "open book" format, typically in conjunction with longer reading lists across the areas and higher expectations for detail and depth in the exam answers. Students have

sometimes found that in-depth reading in a specific area inspires them towards writing a review article that covers the area or connections to another area. This is encouraged, but generally does not replace the qualifying exam requirement. Writing a short exam essay in an area for which a review paper has already been written will likely be a straightforward task, and the review paper should be written to publication standards rather than on deadline for advancing to candidacy.

4. **PhD Dissertation Proposal**

   After completion of the Comprehensive Examination, the student selects a three-person dissertation committee. In some cases, a larger committee is formed. At least two members must be from the BBC group, and one member is generally an outside examiner from another area, department, or university. As a first step in execution of the doctoral studies, the student develops a written research proposal, in consultation with the adviser. The student is also encouraged to discuss the proposal individually with the committee members. Usually during the fourth year, the committee meets as a group for the dissertation proposal examination, following the requirements of the department and the graduate school. Following the oral examination of the student during this meeting, the student's dissertation proposal should be finalized. The Graduate School (TGS) requires that the dissertation proposal be successfully defended by the end of students' 4th year in the program (August 31st).

5. **PhD Dissertation**

   After completing the dissertation proposal the student can then follow the plan of the proposal and complete a set of research reports. These should be prepared in a form suitable for submission to an appropriate journal (or they can already be submitted or even published). Usually during the fifth year of the program, the doctoral dissertation is submitted for approval to the dissertation committee during a dissertation defense. This final oral examination on the completed dissertation by the committee completes the dissertation approval process.

For all milestones, students must complete a TGS form to officially register completion of the milestone. Students can do this by logging in to CAESAR and clicking on Main Menu, then TGS Forms. Print out a hard copy of the completed form (the Graduate Program Coordinator can print the qualifying exam form for you), and take it to the meeting for committee members to sign. The signed copy should be given to the Graduate Program Coordinator for submission to TGS.