Dear Nina

I will bring the correspondence to the attention of UGC, along with a request to reconsider the Cognitive Science BS proposal.

Andre Knoesen

From: nina.amenta@gmail.com [mailto:nina.amenta@gmail.com] On Behalf Of Nina Amenta
Sent: Wednesday, February 04, 2015 5:17 PM
To: David Copp; Academic Senate Chair
Cc: Carolyn Thomas; Matthew Traxler
Subject: ECS 40 and ECS 30

Dear David, Dear Andre,

I am writing to let you know that I am now fairly confident that Cognitive Science BS students will be able to enroll in ECS 30 and ECS 40 next year, and in years to come.

I could not have said that with any kind of confidence at the beginning of the Fall, but there have been several really positive developments since then. With exceptional help from the Letters and Science Executive Committee, Undergraduate Admissions, and the VP of Undergraduate Education's Office, it seems that we will be able to cut back on the growth of the LCSI major next year; this has been the main reason these classes grew so fast. We think we will be able to deal with the lack of large lecture halls by using overflow classrooms when necessary (an experiment with ECS 40 this quarter is going great; kudos to ATS!). And we are getting better data for predicting class sizes so that we can get big enough lecture halls.

Given all these positive developments, I am now much more confident that all students who need these courses will be able to get them. I do not think I can promise that no Cognitive Science student will ever be wait-listed, but we are optimistic that we can achieve this; and I do feel confident that we will at least be able to get back to a situation next year in which everyone on the wait list is accommodated by the add deadline.

I hope this is sufficient to allow the Cognitive Science Major to be approved. It is an excellent initiative and I do not want to see it held up. We are making it a priority to see that the required ECS classes will not be a bottleneck.

Best regards,

Nina Amenta
January 8, 2015

Andre Knoesen, Chair
Davis Division of the Academic Senate

Subject: Establishment of New Major in Cognitive Science – Bachelor of Science

Dear Professor Knoesen,

The faculty of the Philosophy, Psychology and Linguistics Departments, as well as the Center for Mind and Brain has proposed establishing a Bachelor of Science major in Cognitive Science. The Bachelor of Arts major in Cognitive Science was previously approved. In accordance with the provisions of PPM 200-25, the proposal has been reviewed by Dean George R. Mangun, Division of Social Sciences, who has expressed support for the proposed action.

After careful review the College of Letters and Science Executive Committee has recommended approval of the proposal to establish the major in Cognitive Science – Bachelor of Science. On behalf of the Executive Committee, I am hereby forwarding the proposal to you for review and action by the Davis Division.

Sincerely,

Steven Carlip, Chair
Executive Committee
College of Letters and Science

cc: B. Floyd, Director
    Undergraduate Education and Advising
    College of Letters & Science
Proposal for the Creation of an Interdisciplinary Undergraduate Major in Cognitive Science

Professor Steven Carlip
Chair, Faculty Executive Committee
College of Letters and Science

Dear Professor Carlip

I am writing with a revision of our proposal for an interdisciplinary undergraduate major in cognitive science, revised to meet worries raised by Undergraduate Council as I explain. This submission includes, in addition to this cover letter and attachments, draft catalog copy and a detailed explanation of the proposed curriculum for the BS, both of which have been revised to meet worries raised by Undergraduate Council: The proposed curriculum for the AB has not been changed but I include it with this submission as well, for completeness. I assume you have our previous submissions on file.

Our most recent submission, dated 2 May 2014, was approved by the L&S Educational Policy Committee and then by your committee. It was then submitted to Undergraduate Council of the Davis Division of the Academic Senate. Undergraduate Council responded on 16 June and then again on 14 October. The Council voted to support the proposal subject to two provisos, one concerning the mathematics requirements in the proposed curriculum leading to the BS and the other concerning the availability of courses in Statistics and Computer Science. The proposal we are submitting today has been revised to accept the Council’s recommendation concerning the math requirements, which we think were well taken. We are also submitting today, in this letter and attachments to it, a partial response to Council’s concern about the availability of courses in Statistics and Computer Science.

Let me add that, on the recommendation of Jeffrey Williams, chair of Undergraduate Council, we have replaced the term “stream” in the proposal with the term “emphasis.” We now use “emphasis” in referring to the two somewhat different routes to the BS in Cognitive Science that are envisioned in our proposal. This is only a terminological change.

A) The Math requirements

The proposed curriculum for the BS includes two streams or emphases. In both streams, we initially proposed requiring courses from the Math 16 calculus sequence. Undergraduate Council objected, very reasonably, that the Math 16 sequence is not really appropriate for this major and that it should be replaced with either the Math 17 or Math 21 sequence or a choice between the
two. We have opted to give students the option of taking either sequence. To be specific:

In the **Computational Emphasis** (emphasis 1 for the BS) we have eliminated reference to Math 16AB. Instead, we propose to require students to do either Math 17AB or Math 21AB. (They can choose between the Math 17 and Math 21 sequences, but must do one of the sequences.) By itself, this change would increase the minimum number of units required for the BS in the Emphasis by 2, to 112, which would violate a rule of L&S. To avoid violating this rule, we have reduced the required number of courses in group E from five courses to four. This saved 4 units so that the minimum number of units required for the BS in Emphasis 1 is now 108.

We think Emphasis 1 is coherent and well motivated with the four course requirement in group E instead of the five course requirement. We do not think this change in any way reduces the quality of the major. Overall, we agree with Undergraduate Council, that replacing the Math 16 sequence with a choice between the Math 17 and Math 21 sequences strengthens the program.

In the **Neuroscience Emphasis** (emphasis 2), we have eliminated reference to Math 16 ABC. Instead we propose to require students to do either Math 17ABC or Math 21ABC. (They can choose between the Math 17 and Math 21 sequences, but must do one of the sequences.) By itself, this change would increase the minimum number of units required for the BS in the Neuroscience Emphasis by 3, to 111, which would again violate a rule of L&S. To avoid violating this rule, we have decided to cut PSC 103B from the Group A requirement, saving 4 units. The minimum number of units required for the BS in Emphasis 2 is now 107.

We think the major is coherent and well motivated despite the elimination of the requirement to take PSC 103B. We do not think this change in any way reduces the quality of the major. Overall, we agree with Undergraduate Council, that replacing the Math 16 sequence with a choice between the Math 17 and Math 21 sequences strengthens the program in the Neuroscience Emphasis and improves the curriculum for the BS.

**B) The Availability of Statistics and Computer Science Courses**

I attach letters I have received from the chairs of Statistics and Computer Science addressing the concern of Undergraduate Council regarding the availability of courses for students taking the Cognitive Science major. Let me stress that the only real concern is with the Computer Science courses required for the **Computational Emphasis** in the proposed BS curriculum.

With respect to **Statistics**, Chair Hans-Georg Mueller assures me that “it is most unlikely that students in the proposed major ... will have problems to enroll in the key statistics introductory course STA 13 or to complete any of the Statistics courses that are listed as electives of this program.” In a second note, he writes to say that Statistics would be willing to allow a notification to be placed in Banner during first pass saying that registration in the key courses during first pass is restricted to “majors in Statistics and Cognitive Science.” It seems to me that this response deals adequately with Undergraduate Council’s concern about the availability of courses in Statistics for students in the new major.
With respect to Computer Science, the situation is less clear. Chair Nina Amenta reports that their College of Engineering ECSE major is impacted and that their College of L&S LCSI major needs to be declared impacted. Still, she says that this year is “the first time we had to actually turn students away in ECS 40 (and a few upper division classes as well).” In all other years, they “have been able to clear the waitlists.” I have asked Chair Amenta whether Computer Science would be willing to allow a notification to be placed in Banner during first pass saying that registration in the key courses during first pass is restricted to “ECSE, LCSI and Cognitive Science majors.” She seems open to the idea but says she needs to consult her faculty. When I hear more from her, I will pass on her message.

Despite not being able to fully respond to the worries about the availability of courses, I want to send you this package today so that the Educational Policy committee can consider the changes we have made to our proposal. The changes are minor but they are substantive so we understand that they need to be considered.

Yours sincerely,

David Copp
Distinguished Professor
Chair
Department of Philosophy

attached: letters from the chairs of Statistics and Computer Science
   Course of Study Leading to AB in Cognitive Science (unchanged)
   Course of Study Leading to BS in Cognitive Science (revised)
   Draft Catalog Copy (revised)
In the recent past, all students who wanted to take STA 13 have been able to enroll in a given quarter, even though a few of the various sections that are offered each quarter had waitlists. The only course where in some quarters students were unable to enroll was STA 108, however these students were able to enroll in the following quarter. So it is most unlikely that students in the proposed major in Cognitive Science will have problems to enroll in the key statistics introductory course STA 13 or to complete any of the Statistics courses that are listed as electives of this program.

Best regards,
Hans

Hans-Georg Mueller
Chair, Statistics
Proposed Cognitive Science Program -- Undergraduate Council & Statistics

Hans Mueller <hmueller@ucdavis.edu>                      Mon, Nov 10, 2014 at 10:40 PM
To: David Copp <dcopp@ucdavis.edu>
Cc: Bernard Molyneux <molyneux@ucdavis.edu>, "Mattey G.J." <gjmattey@ucdavis.edu>

Dear David,

after checking with our VC for undergraduate matters (Alex Aue) whether he is aware of any concerns, and his assurance that this is not the case, I agree to the proposed Banner line addition, under the proviso that this agreement may be revoked at a later time if it is found to create problems.

I would appreciate if you could let me know what needs to be done to effect this line addition.

On a related note, we are planning to create a new class "STA 11", a version of STA 13 that will be dedicated to train social sciences majors in statistics and data analysis (similarly to STA 100, a version that is geared towards bio majors, which has been very successful to the extent that we are now offering a follow-up class STA 101). While STA 100 has a somewhat higher level than STA 13, that of STA 11 likely will be somewhat lower, to assuage concerns from some parties in the social sciences that the current STA 13 may be too challenging for many of their students. We will not be offering STA 102 anymore.

Best wishes,
Hans

On Mon, Nov 10, 2014 at 10:45 AM, David Copp <dcopp@ucdavis.edu> wrote:

Dear Hans,

I've had a conversation with Jeffrey Williams of Undergraduate Council. He says that his committee wants to approve the Cognitive Science major but he stressed that they don't want to create a major that will be subject to bottlenecks right from the start. I showed him your letter to me of October 23, and he said it might be sufficient for the committee.

However, he also suggests the following, which would be an easy way to address the worry about the availability of classes, although you'd have to agree. The fix is to add to "Banner" a line that says something like "First Pass restricted to Statistics majors and Cognitive Science majors." Would you be willing to have this done?

Remember that the new major will be reasonably small at least at first. So we may be worrying about something that's not a real problem. If it becomes a problem, we could revisit the issue.

Many thanks,
David
Hi David,

Right now, we have students on the waitlist for all of these courses after second pass, pretty much every quarter. This is a function of our number of majors increasing at 10-15% per year for the last five years. After second pass, we start to look for bigger classrooms and increase the class sizes and add sections. In past quarters, we have been able to clear the waitlists by the drop deadline, but this year for the first time we had to actually turn students away in ECS 40 (and a few upper division classes as well). I don't know if this will satisfy the Undergrad Council. It certainly does not satisfy me.

We've identified transfer admits to the LCSI major as the main source of this enrollment increase (we have two majors, ECSE in the College of Engineering, and LCSI in the College of Letters and Sciences. ECSE has admissions essentially capped but LCSI has been admitting 75% of the transfer students who apply, swamping our courses, even though they are a tiny fraction of our applicants.) We are hoping to have the LCSI major declared impacted in time to cut back on LCSI transfer students next year, and also we are planning to hire a LSOE (Lecturer with Security of Employment) for next year, so hopefully that will help too. But ultimately we need another 6 or 7 FTE to get to a stable place with the number of majors we have now.

If you could mention getting LCSI declared impacted, it would be helpful! If you could mention more CS FTE, that would be helpful too!

Here's some graphs I happen to have.

---

**Program Enrollment**

![Program Enrollment Chart](https://mail.google.com/mail/u/0/?ui=2&ik=2bb4cd6682&view=pt&q=amenta%40cs.ucdavis.edu&qs=true&search=query&msg=14986addad208ed1&si…1/2)
I could get you info on pass two wait lists and class sizes, if you want.

Unfortunately the only thing I know of that could help us favor Cog-Sci majors would be giving them preference in pass one. If there is some other mechanism, let me know!

Thanks,

Nina

[Quoted text hidden]
MAJOR IN COGNITIVE SCIENCE

COURSE OF STUDY LEADING TO BS IN COGNITIVE SCIENCE
DESCRIPTION OF THE PROPOSED BS IN COGNITIVE SCIENCE

Document prepared by Bernard Molyneux, G.J. Mattey and Joshua Peterson.

November 10, 2014

Contact Information

Lead Proposer
Bernard Molyneux (molyneux@ucdavis.edu)

Steering Committee
David Copp (d copp@ucdavis.edu)
David Corina (dpcorina@ucdavis.edu)
Steve Luck (sj luck@ucdavis.edu)
Bernard Molyneux (molyneux@ucdavis.edu)

1 General

1. Name of Program:
   Cognitive Science

2. Campus:
   University of California, Davis

3. Degree/Certificate
   Bachelor of Science

4. CIP Classification:
   (to be completed by Office of the President)
5. Date to be started:
September 2014

6. If modification of existing program, identify that program and explain changes.
N/A

7. Purpose (academic or professional training) and distinctive features (how does this program differ from others, if any, offered in California?):
   The program would produce students capable of graduate study in the emerging inter-disciplinary field of cognitive science, and provide students heading into the workplace with a range of skills drawn from different academic backgrounds and relevant to a range of professions. The program would match the already existing cognitive science programs at many other universities across the country and internationally, including five other UC campuses. The unique environment provided by UC Davis is optimal for the cultivation of a cognitive science major given the resources it offers including the UC Davis Center for Mind and Brain, the Center for Neuroscience, the MIND Institute, the Institute for Social Sciences and the Humanities Institute.

8. Type(s) of students to be served:
   Due to the interdisciplinary nature of the major, the program targets students seeking a broad inter-disciplinary approach to the study of mind, seeking contributions from philosophy, psychology, linguistics, neuroscience, computer science, education, human development, communication, systems and control and, courses permitting, anthropology and sociology.

9. If program is not in current campus academic plan, give reason for proposing program now:
   In the absence of an established cognitive science major, UC Davis students have recently picked up the slack by designing and approving their own individual majors in cognitive science, with both BA and BS variants. There have, however, been questions raised at UC Davis about the viability of keeping the individual major as an option for UC Davis students. This has acted as a catalyst for a number of faculty to press ahead with developing a cognitive science major.

10. If program requires approval of a licensure board, what is the status of such approval?
    N/A

11. Please list special features of the program (credit for experience, internships, lab requirements, unit requirements, etc.)
The major would inherit the internships and honors thesis options of its constituting departments. This allows for a diverse array of both empirical and theoretical research options for students of the major.

12. List all new courses required: Dept, Course#, Title, Hrs/Week Lecture Lab.

Two new courses are required, and four other new courses are anticipated and are included in the list of electives. The former two are:

PHI 10 (Philosophy) Introduction to Cognitive Science, 4 hrs/week, Lecture/Discussion
CGS 100 Cognitive Science, 3 hours/wk, Lecture/Discussion

Since there is currently no cognitive science major under which either course could be proposed, the former has been proposed as PHI 10 ‘Introduction to Cognitive Science’. After the first year, assuming there then exists a cognitive science major, we plan to list it under a three letter code pertaining to the new major, e.g. as CGS 1. For the same reasons, we use the dummy code ‘CGS 100’ for the anticipated upper division cognitive science course. We hope to propose this course upon approval of the cognitive science major.

Two further courses are to be offered by the philosophy department in partial support of the new major:

PHI 133 (Philosophy) Logic for Artificial Intelligence, 4 hours/wk, Lecture/Discussion
PHI 136 (Philosophy) Formal Epistemology, 4 hours/wk, Lecture/Discussion

These courses concentrate on mathematical and set-theoretical approaches to processes involved (in 133) in common sense non-monotonic logical inference of the sort used in machine reasoning and (in 136) to updating and reasoning about knowledge and belief representation systems. PHI 136 has been submitted for approval to the course catalog. PHI 133 is to be submitted during the current academic year to be available, if approved, in the 2015-16 year.

The following two courses have been proposed independently of the new major but are included in the list of anticipated electives:

ECS 171 (Engineering: Computer Science) Machine Learning, 4hrs/week, Lecture/Discussion
NPB 163 (Neurobiology, Physiology, Behavior) Systems Neuroscience, 3 hrs/week, Lecture

13. List all other required courses: Dept, Course#, Title, Hrs/Week Lecture Lab

See section 2 below.
14. List UC campuses and other California institutions, public or private, which now offer or plan to offer this program or closely related programs:

- University of California, Berkeley, Cognitive Science (B.A.)
- University of California, Los Angeles, Cognitive Science (B.S.)
- University of California, Merced, Cognitive Science (Ph.D., B.A., B.S., Minor)
- University of California, Santa Cruz, Cognitive Science (B.S.)
- University of California, San Diego, Department of Cognitive Science (Ph.D., B.S., B.A.) California State
- California State University, Stanislaus, Department of Cognitive Studies (B.A., Minor)
- California State University, Fresno, Cognitive Science Program (B.S., Minor)

For additional programs, by country, see: http://en.wikipedia.org/wiki/List_of_institutions_granting_degrees_in_cognitive_science

15. List any related program offered by the proposing institution and explain relationship.

The cognitive science major draws from, and therefore relates to, each of the following majors at UC Davis:

- Psychology (AB, BS)
- Philosophy (AB)
- Linguistics (AB)
- Computer Science (BS)
- Neurobiology, Physiology, and Behavior (BS)
- as well as Anthropology, Communication, Economics, Education, Electrical, Biomedical and Mechanical Engineering, Human development, Sociology, and Statistics.

Cognitive science is characterized by the fact that it takes an internal (as opposed to behavioral) approach to the question of investigating human psychology, emphasizing the logical, computational and neural processes that go into the production of external behavior, and drawing heavily from the history of theorizing on logic, mental representation and language processing undertaken in philosophy and linguistics, and upon our knowledge
of computation and embodied robotics as investigated in computer science and engineering.

16. Summarize employment prospects for graduates of the proposed program. Give results of job market survey if such has been made.

UC Berkeley provides a four year profile (2003-2006). Out of 510 graduates (42% average respondents rate), 53% were employed, 14% were attending graduate school, 22% were seeking employment, and 11% engaging in other endeavors. Within the employment sector, 73% were for profit, 4% not-for-profit, 19% education, and 4% government. Employers range from Google, Inc. to Princeton University. Titles range from Engineer to Research Coordinator. In 2011, proportion of graduate school attendance rose to 27%. The average salary was $45,147. https://career.berkeley.edu/Major2006/CogSci.stm


17. Give estimated enrollment for the first 5 years and state basis for estimate.

The number of graduates per year ranged from 25 to 108 across UC campuses. We would expect, for the AB and BS combined, to have about 150-250 declared majors in an average year once the program is established.

18. Give estimates of the additional cost of the program by year for 5 years in each of the following categories: FTE Faculty, Library Acquisitions, Computing, Other Facilities, Equipment, Provide brief explanation of any of the costs where necessary.

We do not anticipate the need for additional faculty outside of the contributing departments in the near term. In the middle term, if the program grows as expected, we anticipate 1 faculty FTE in a core cognitive science area or as a joint appointment. We see no reason for additional library acquisitions, computing, facilities, or equipment in the near or middle term. We anticipate needing .25 staff FTE at the outset, with eventual growth to .5 FTE

19. How and by what agencies will the program be evaluated?

The program will be reviewed by each of the departments - philosophy, psychology and linguistics - centrally involved in the major and by the Curriculum Committee to be established for the major. Learning outcomes will be established and students in the program will be evaluated for their progress in achieving these outcomes.
2 Outline of Major

2.1 Overview

The BS is organized into two streams or emphases. The first emphasizes computational approaches to the study of mind relating to work in artificial intelligence. The second emphasizes neuroscientific and neuropsychological approaches. The BS is designed to prepare students in either stream for graduate work in a related field while nonetheless giving them a rich appreciation of work in other areas, and of the holistic, interdisciplinary approach to the mind that characterizes cognitive science.

The preparatory material for the two streams overlaps in preparing the student for a broad range of upper division courses in the cognitive sciences, but differs in the specialist preparation required. Students within each stream will find that they have the lower division preparatory matter required to take any upper division course within the major. Where further upper division preparation is required, that is also part of the major.

The upper division requirements are arranged into groups representing the appropriate sub-areas. CGS1 (PHI10 for first year) ‘Introduction to Cognitive Science’ is substituted as prerequisite in place of PSC 100 ‘Introduction to Cognitive Psychology’ throughout, by arrangement with the Psychology dept.

Care was taken to bring students within the vicinity of the 90 credit area requirement for science. Emphasis 1 requires 70-78 natural science and math credits. Emphasis 2 requires 76-86. It is assumed that new courses ECS 171 Machine Learning and NPB 163 Systems Neuroscience will count as math/natural science credits in the college.
3 Emphasis 1: Computational Emphasis

3.1 Preparatory Matter for Emphasis 1

3.1.1 Preparatory Matter: Universal

The universal preparatory subject matter is common to both streams of the BS and overlaps considerably with the preparatory material for the AB. The aim of this set of courses is, primarily, to give the student a broad introduction to the cognitive sciences that will prepare her to take courses in all the relevant fields. The list differs from the list in the AB in also including statistics and calculus preparation.

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAT 17AB Calculus for Biology and Medicine or MAT 21AB Calculus</td>
<td>8</td>
</tr>
<tr>
<td>STA 13 Elementary Statistics*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td>*PHI 10 (Cognitive Science 1 after first year of major) Intro Cognitive Science</td>
<td>4</td>
</tr>
<tr>
<td>LIN 1 Introduction to Linguistics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td>PHI 13+13G Minds, Brains and Computers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td>PSC 001 General Psychology</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td>PSC 041 Research Methods in Psychology</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
</tbody>
</table>

3.1.2 Specialist Preparatory Matter for Emphasis 1

Students in emphasis 1 must complete all the courses in this section. The material here is not particular to the sciences of the mind, but is essential preparation for upper division courses on artificial intelligence and machine learning.

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAT 22A+22AL Linear Algebra</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(3+1)</td>
</tr>
<tr>
<td>ECS 20 Discrete Mathematics for Computer Science</td>
<td>4</td>
</tr>
<tr>
<td>ECS 30 Introduction to Programming and Problem Solving</td>
<td>4</td>
</tr>
<tr>
<td>ECS 40 Introduction to Software Development and OOP</td>
<td>4</td>
</tr>
<tr>
<td>ECS 50 Computer Organization and Machine-Dependent Programming</td>
<td>4</td>
</tr>
<tr>
<td>ECS 60 Data Structures and Programming</td>
<td>4</td>
</tr>
<tr>
<td>PHI 12 Introduction to Symbolic Logic</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>60</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>40</td>
</tr>
</tbody>
</table>

*To be disjoined with STA 32 Basic Statistical Analysis Through Computers (3 units).
3.2 Depth Subject Matter for Emphasis 1

With reference to the course groupings listed in section 4, students pursuing the BS in Cognitive Science must complete the following requirements. (Numbers in italics to the right of the unit count are the number of credits qualifying as natural science or math.)

**Units**

1. All options from group A. ................................................................. 12 (4)
2. Three options from group B. ......................................................... 12 (4-12)
3. One option from group C. ............................................................... 4 (4)
4. One option from group D. ............................................................... 4 (0)
5. Four options from group E. ............................................................ 16 (16)

Total Depth Requirement ................................................................. **48 (28-36)**
Total Major Requirement ............................................................... **108 (68-76)**
4 Emphasis 1 Groups

Figure 2: Map of prerequisites for group A courses.

4.1 Emphasis 1 Group A: General
Students in emphasis 1 must complete all courses from group A.

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>*CGS 100 Cognitive Science</td>
<td>4</td>
</tr>
<tr>
<td>ECS 140 Programming Languages</td>
<td>4</td>
</tr>
<tr>
<td>PHI 112 Intermediate Symbolic Logic</td>
<td>4</td>
</tr>
</tbody>
</table>
Figure 3: Map of prerequisites for group B courses.

4.2 Emphasis 1 Group B: Computation
Students in emphasis 1 must complete at least three options from group B.

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECS 120 Intro Theory of Computation</td>
<td>4</td>
</tr>
<tr>
<td>ECS 170 Intro Artificial Intelligence</td>
<td>4</td>
</tr>
<tr>
<td>*ECS 171 Machine Learning</td>
<td>4</td>
</tr>
<tr>
<td>LIN 177 Computational Linguistics</td>
<td>4</td>
</tr>
<tr>
<td>*PHI 133 Logic for Artificial Intelligence</td>
<td>4</td>
</tr>
</tbody>
</table>
Stream 1 Group C Prerequisites

Requires no College Level Prerequisites
Universal Cognitive Science Preparatory
Stream 1 Group C Electives

Figure 4: Map of prerequisites for courses in group C.

4.3 Emphasis 1 Group C: Neuroscience
Students in emphasis 1 must complete one option from group C.

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIN 175 Biological Basis of Language</td>
<td>4</td>
</tr>
<tr>
<td>PSC 101 Intro. Psychobiology</td>
<td>4</td>
</tr>
<tr>
<td>PSC 135 Cognitive Neuroscience</td>
<td>4</td>
</tr>
</tbody>
</table>
4.4 **Emphasis 1 Group D: Philosophy and Linguistics**

Students in emphasis 1 must take one option from group D.

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIN 103A Linguistic Analysis I: Phonetics, Phonology, Morphology</td>
<td>4</td>
</tr>
<tr>
<td>LIN 103B Linguistic Analysis II: Morphology, Syntax, Semantics</td>
<td>4</td>
</tr>
<tr>
<td>LIN 150 Languages of the World</td>
<td>4</td>
</tr>
<tr>
<td>LIN 182 Multilingualism</td>
<td>4</td>
</tr>
<tr>
<td>PHI 103 Philosophy of Mind</td>
<td>4</td>
</tr>
<tr>
<td>PHI 104 The Evolution of Mind</td>
<td>4</td>
</tr>
<tr>
<td>PHI 136 Formal Epistemology</td>
<td>4</td>
</tr>
</tbody>
</table>
4 STREAM 1 GROUPS

Figure 6: Map of prerequisites for those group E courses yet to appear in a prerequisites map.

4.5 Emphasis 1 Group E: Further Computation and Psychology

Students take four courses from E. No course may be used both to satisfy a group C requirement and a group E requirement.

PSC 100 Introduction to Cognitive Psychology .......................................................... 4
PSC 101 Intro. Psychobiology ...................................................................................... 4
PSC 103A. Statistical Analysis of Psychological Data .................................................. 5
PSC 103B. Statistical Analysis of Psychological Data .................................................. 4
PSC 113 Developmental Psychobiology ..................................................................... 4
PSC 121 Physiological Psychology ............................................................................ 4
PSC 122 Advanced Animal Behavior ......................................................................... 4
PSC 124 Comparative Neuroanatomy ....................................................................... 4
PSC 127 Animal Cognition ....................................................................................... 4
PSC 129 Sensory Processes ....................................................................................... 4
PSC 130 Human Learning and Memory ................................................................... 4
PSC 131 Perception ................................................................................................... 4
PSC 135 Cognitive Neuroscience: The Biological Foundations of the Mind ............ 4
5  Emphasis 2: Neuroscience Emphasis

5.1  Preparatory Matter for Emphasis 2

5.1.1  Preparatory Matter: Universal

As with emphasis 1, the universal preparatory subject matter is common to both streams of the BS and overlaps considerably with the preparatory material for the AB. The aim of this set of courses is, primarily, to give the student a broad introduction to the cognitive sciences that will prepare her to take courses in all the relevant fields. The list differs from the list in the AB in also including statistics and calculus preparation.

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAT 17AB Calculus for Biology and Medicine or MAT 21AB Calculus</td>
<td>8</td>
</tr>
<tr>
<td>STA 13 Elementary Statistics</td>
<td>4</td>
</tr>
<tr>
<td>*PHI 10 (CGS 1 after first year of major) Intro Cognitive Science</td>
<td>4</td>
</tr>
<tr>
<td>LIN 1 Introduction to Linguistics</td>
<td>4</td>
</tr>
<tr>
<td>PHI 13+13G Minds, Brains and Computers</td>
<td>4</td>
</tr>
<tr>
<td>PSC 001 General Psychology</td>
<td>4</td>
</tr>
<tr>
<td>PSC 041 Research Methods in Psychology</td>
<td>4</td>
</tr>
</tbody>
</table>

5.1.2  Specialist Preparatory Matter for Emphasis 2

Students in emphasis 2 must complete the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHY 7 ABC (or 9 ABC) General Physics</td>
<td>12-15</td>
</tr>
<tr>
<td>MAT 17C or MAT 21C</td>
<td>4</td>
</tr>
<tr>
<td>BIS 2ABC Introduction to Biology</td>
<td>14</td>
</tr>
</tbody>
</table>

Total Preparation ................................................. 62-65
(of which) Natural Science/Mathematic ....................... 42-45
Stream 2 Preparatory Prerequisites

Figure 7: All emphasis 2 preparatory material, with all prerequisites shown. All prerequisites for preparatory material are themselves part of the emphasis 2 preparatory material.

5.2 Depth Subject Matter for Emphasis 2

With reference to the course groupings listed in section 6, students pursuing the BS in Cognitive Science must complete the following requirements. (Numbers in italics to the right of the unit count are the number of credits qualifying as natural science or math.)

Units

1. All options from group A. ................................................. 13 (13 )
2. One option from group B. ........................................................ 4-5 (0-5 )
3. 12-13 units from group C. .................................................. 12-13 (8-13 )
4. Two options from group D .................................................... 8 (0 )
5. Two options from group E. .................................................... 8 (8 )

Total Depth Requirement ..................................................... 45-47 (29-39 )
Total Major Requirement ..................................................... 107-112 (71-82 )
6 Emphasis 2 Groups

Figure 8: All group A courses with preparation required.

6.1 Emphasis 2 Group A: General
Students in emphasis 2 must complete all courses from group A.

Course                                Units
*CGS 100 Cognitive Science             4
NPB 100 Neurobiology                  4
PSC 103A Statistical Analysis of Psychological Data 5
Stream 2 Group B
Prerequisites

Figure 9: All group A courses with preparation required.

6.2 Emphasis 2 Group B: Computation
Students in emphasis 2 must complete one option from group B.

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIN 177 Computational Linguistics</td>
<td>4</td>
</tr>
<tr>
<td>NPB 167 Computational Neuroscience</td>
<td>5</td>
</tr>
</tbody>
</table>
Figure 10: All group C courses with preparation required.

6.3 Emphasis 2 Group C: Neuroscience
Students in emphasis 2 must complete 12-13 units from group C.

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPB 112 Neuroscience</td>
<td>3</td>
</tr>
<tr>
<td>NPB 152 Hormones and Behavior</td>
<td>3</td>
</tr>
<tr>
<td>NPB 161 Developmental Neurobiology</td>
<td>3</td>
</tr>
<tr>
<td>NPB 162 Neural Mechanisms of Behavior</td>
<td>3</td>
</tr>
<tr>
<td>*NPB 163 Systems Neuroscience</td>
<td>3</td>
</tr>
<tr>
<td>NPB 164 Mammalian Vision</td>
<td>4</td>
</tr>
<tr>
<td>NPB 165 Neurobiology of Speech Perception</td>
<td>3</td>
</tr>
<tr>
<td>LIN 175 Biological Basis of Language</td>
<td>4</td>
</tr>
<tr>
<td>PSC 101 Intro. Psychobiology</td>
<td>4</td>
</tr>
<tr>
<td>PSC 121 Physiological Psychology</td>
<td>4</td>
</tr>
<tr>
<td>PSC 135 Cognitive Neuroscience</td>
<td>4</td>
</tr>
</tbody>
</table>
Figure 11: All group D1 courses with preparation required.

6.4 Emphasis 2 Group D: Philosophy and Linguistics

Students in emphasis 2 take two courses from D.

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIN 103A Linguistic Analysis I: Phonetics, Phonology, Morphology</td>
<td>4</td>
</tr>
<tr>
<td>LIN 103B Linguistic Analysis II: Morphology, Syntax, Semantics</td>
<td>4</td>
</tr>
<tr>
<td>LIN 150 Languages of the World</td>
<td>4</td>
</tr>
<tr>
<td>LIN 182 Multilingualism</td>
<td>4</td>
</tr>
<tr>
<td>PHI 103 Philosophy of Mind</td>
<td>4</td>
</tr>
<tr>
<td>PHI 104 The Evolution of Mind</td>
<td>4</td>
</tr>
</tbody>
</table>
Figure 12: All group D2 courses yet to appear in a prerequisites map, with preparation required.

6.5 Emphasis 2 Group E: Psychology

Students choose two. Courses already used to satisfy other requirements may not be reused for the group E requirement.

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSC 100 Introduction to Cognitive Psychology</td>
<td>4</td>
</tr>
<tr>
<td>PSC 101 Intro. Psychobiology</td>
<td>4</td>
</tr>
<tr>
<td>PSC 113 Developmental Psychobiology</td>
<td>4</td>
</tr>
<tr>
<td>PSC 121 Physiological Psychology</td>
<td>4</td>
</tr>
<tr>
<td>PSC 122 Advanced Animal Behavior</td>
<td>4</td>
</tr>
<tr>
<td>PSC 124 Comparative Neuroanatomy</td>
<td>4</td>
</tr>
<tr>
<td>PSC 127 Animal Cognition</td>
<td>4</td>
</tr>
<tr>
<td>PSC 129 Sensory Processes</td>
<td>4</td>
</tr>
<tr>
<td>PSC 130 Human Learning and Memory</td>
<td>4</td>
</tr>
<tr>
<td>PSC 131 Perception</td>
<td>4</td>
</tr>
<tr>
<td>PSC 132 Language and Cognition</td>
<td>4</td>
</tr>
<tr>
<td>PSC 135 Cognitive Neuroscience</td>
<td>4</td>
</tr>
</tbody>
</table>
MAJOR IN COGNITIVE SCIENCE

DRAFT CATALOG COPY
Cognitive Science

(College of Letters and Science)

Program Office, 1240 Social Sciences and Humanities Building (530) 752-0703

The Major Programs

The cognitive science major is designed to provide a broad interdisciplinary approach to the study of mind that includes courses from different departments and attracts students with a variety of interests. It emphasizes a multi-faceted approach to the study of mind that integrates concepts and techniques from psychology, artificial intelligence, linguistics, neurology, philosophy and other relevant fields.

For students interested in the liberal arts the Cognitive Science major can be pursued as a Bachelor of Arts (A.B.) program. Alternatively, it can be pursued as a Bachelor of Science (B.S.) program for students with a stronger interest in the mathematical, neurological and computational foundations of the discipline. The main objective of both programs is to give the student a broad grounding in the integrated sciences of the mind and to connect approaches from different fields. Students must complete a number of core courses for the degree, as well as a number of specialty courses on such wide-ranging topics as logic for artificial intelligence, computational linguistics, cognitive neuroscience, animal cognition and the psychology of music.

Career Alternatives. A degree in cognitive science provides broad intellectual foundations useful for careers in a variety of areas, including teaching, business, social work/counseling and the information technology industry. An undergraduate education in cognitive science also prepares the student for graduate study in appropriate subfields of psychology, linguistics, philosophy and informatics. It is also suitable training for pre-medicine, pre-law, and pre-management students.

A.B. Major Requirements:

<table>
<thead>
<tr>
<th>Units</th>
<th>Preparatory Subject Matter</th>
<th>Depth Subject Matter</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td></td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>Preparatory Subject Matter</td>
<td>Depth Subject Matter</td>
</tr>
<tr>
<td></td>
<td>28</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prep 15</td>
<td>All courses from group A........12</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Group A: Core</td>
</tr>
<tr>
<td></td>
<td>*Philosophy 10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Philosophy 13+13G</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Psychology 001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Psychology 041</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Statistics 13</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Philosophy 12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

*Starting 2015-2016, PHI 10 will be replaced by Cognitive Science 1.
One 4-unit upper division course in cognitive science (to be initiated 2015-2016), Psychology 101, Philosophy 112
One course from group B........4
Group B: Computation
Linguistics 177, Philosophy 133
A further sixteen units from two of the groups B through F......16
Group C: Neuroscience
Psychology 121, 135
Group D: Linguistics
Linguistics 103A, 103B, 131, 141, 171, 173
Group E: Philosophy
Philosophy 103, 104, 136
Group F: Psychology
Psychology 100, 127, 130, 131, 132, 136, 140, 141
Twelve additional units from the groups B through G.........12
Group G: Other

Total Units for the Major............ 72

B.S. Major Requirements:
Students select to pursue either the computational emphasis (emphasis 1) or the neuroscience emphasis (emphasis 2).

Emphasis 1 (Computational) UNITS

Preparatory Subject Matter........... 60
Eng. Computer Science 20.........4
Eng. Computer Science 30........4
Eng. Computer Science 40........4
Eng. Computer Science 50........4
Eng. Computer Science 60........4
Linguistics 1 .................4
Mathematics 17AB or 21AB.........8
Mathematics 22A+22L..............4
*Philosophy 10 ..............4
Philosophy 12..................4
Philosophy 13+13G............4
Psychology 001 ................4
Psychology 041 .................4
Statistics 13 (or STA 102) ......4
*Starting 2015-2016, PHI 10 will be replaced by Cognitive Science 1.

Depth Subject Matter............. 48

All courses from group A.........12
Group A: Core
One four-unit upper division course in cognitive science (to be initiated 2015-2016), Engineering: Computer Science 140, Philosophy 112
Three courses from group B..................12
Group B: Computation
Eng. Computer Science 120, 170, 171, Linguistics 177, Philosophy 133
One course from group C........4
Group C: Neuroscience
Linguistics 175, Psychology 101, 135
One course from group D........4
Group D: Philosophy/Linguistics
Linguistics 103A, 103B, 150, 182, Philosophy 103, 104, 136
Four courses from group E in addition to any taken to satisfy group C requirements........16

Group E: Psychology
Psychology 100, 101, 103A, 103B, 113, 121, 122, 124, 127, 129, 130, 131, 135

Total Units for the Major....... 108

Emphasis 2 (Neuroscience)  

Preparatory Subject Matter ...... 62-65
Biological Science 2ABC ........14
Linguistics 1 ...................4
Mathematics 17ABC or 21ABC.....12
*Philosophy 10 ..................4
Philosophy 13+13G ...............4
Physics 7ABC (or 9ABC)........12-15
Psychology 001 ..................4
Psychology 041 ..................4
Statistics 13 (or STA 102).......4
*Starting 2015-2016, PHI 10 will be replaced by Cognitive Science 1.

Depth Subject Matter.......... 45-47

All courses from group A.......13
Group A: Core
One four-unit upper division course in cognitive science (to be initiated 2015-2016),
NPB 10, Psychology 103A
One course from group B. ....4-5
Group B: Computation
Linguistics 177, NPB 167
12-13 units from group C...12-13
Group C: Neuroscience
NPB 112, 152, 161, 162, 163, 164, 165, Linguistics 175,
Psychology 101, 121, 135
Two courses from group D.......8
Group D: Philosophy/Linguistics
Linguistics 103A, 103B, 150, 182, Philosophy 103, 104
Two courses from group E in addition to any taken to satisfy group C requirements........8
Group E: Psychology
Psychology 100, 101, 113, 121, 122, 124, 127, 129, 130, 131, 132, 135

Total Units for the Major..... 107-112

Major Advisers. David Copp
(Philosophy) David Corina
(Linguistics) Steve Luck (Psychology)
Bernard Molyneux (Philosophy)