COGNITIVE SCIENCE (Div II)

Chair: Professor Nate Kornell

- Joseph L. Cruz, Chair and Professor of Philosophy

- Kris N. Kirby, Professor of Psychology

- Nate Kornell, Professor of Psychology, Chair of Cognitive Science Program; affiliated with: Psychology, Cognitive Science; on leave Fall 2023

- Heather Williams, William Dwight Whitney Professor of Biology; affiliated with: Biology, Neuroscience

Cognitive science is concerned with how humans, non-human animals, and computers acquire, represent, manipulate, and use information. As an interdisciplinary field it combines research and theory from computer science (e.g., artificial intelligence), cognitive psychology, philosophy, linguistics, and neuroscience, and to some extent evolutionary biology, math, and anthropology. Complex issues of cognition are not easily addressed using traditional intra-disciplinary tools. Cognitive researchers in any discipline typically employ a collection of analytic and modeling tools from across traditional disciplinary boundaries. Thus, the methods and research agenda of cognitive science are broader than those of any of the fields that have traditionally contributed to cognitive science. The Cognitive Science Program is designed to provide students with the broad interdisciplinary foundation needed to approach issues of cognition.

THE CONCENTRATION

The concentration in Cognitive Science consists of six courses, including an introductory course, four electives, and a senior seminar.

Minds, Brains, and Intelligent Behavior (COGS 222) is the entry point into the concentration, and provides an interdisciplinary perspective on issues of cognition. Ideally, it should be taken before the end of the sophomore year. Emphasizing the highly interdisciplinary nature of the field, the four electives must be distributed over at least three course prefixes. In the fall of the senior year, concentrators will participate in a senior seminar (COGS 493) or a senior tutorial, depending on enrollments.

Required Courses

COGS/PHIL/PSYC 222 Minds, Brains, and Intelligent Behavior: An Introduction to Cognitive Science

COGS 493 Senior Seminar or Senior Tutorial (In years where 493 is not offered, students should contact the Program Chair for details).

Elective Courses

Four electives are required, chosen from at least three prefixes, at most two of which can be at the 100 level.

BIOL 204(S) LEC Animal Behavior

Taught by: Manuel Morales
Catalog details

COGS 224 / PHIL 221(F) LEC Introduction to Formal Linguistics

Taught by: Christian_De Leon
Catalog details

COGS 323 / PSYC 323 TUT Visual Consciousness

Taught by: TBA
Catalog details

COGS 328 / PSYC 328 SEM Cognitive Approaches to Visual Perception

Taught by: TBA
Catalog details

COGS 390 / PHIL 390 SEM Discourse Dynamics

Taught by: Christian_De Leon
Catalog details

CSCI 134(F, S) LEC Introduction to Computer Science

Taught by: Mark_Hopkins, Bill Jannen, Iris_Howley, Shikha_Singh
Catalog details

CSCI 361 / MATH 361(S) CON Theory of Computation

Taught by: Aaron Williams
Catalog details

CSCI 373 LEC Artificial Intelligence

Taught by: Mark_Hopkins
Catalog details

CSCI 374(F) LEC Machine Learning

Taught by: Rohit_Bhattacharya
Catalog details

[CSCI 375 LEC Natural Language Processing](#)

Taught by: [Katie Keith](#)
[Catalog details](#)

[CSCI 378 / STS 378(S) LEC Human Artificial Intelligence Interaction](#)

Taught by: [Iris_Howley](#)
[Catalog details](#)

[CSCI 379(S) LEC Causal Inference](#)

Taught by: [Rohit_Bhattacharya](#)
[Catalog details](#)

[CSCI 381(S) LEC Deep Learning](#)

Taught by: [Mark_Hopkins](#)
[Catalog details](#)

[NSCI 201 / BIOL 212 / PSYC 212(F) LEC Neuroscience](#)

Taught by: [Matt Carter](#), [Shivon Robinson](#)
[Catalog details](#)

[PHIL 207 SEM Contemporary Philosophy of Mind](#)

Taught by: [Joseph Cruz](#)
[Catalog details](#)

[PHIL 216 / ENVI 216 SEM Philosophy of Animals](#)

Taught by: [Joseph Cruz](#)
[Catalog details](#)

[PSYC 221(F) LEC Cognitive Psychology](#)

Taught by: [Nate_Kornell](#)
[Catalog details](#)

[PSYC 316 / NSCI 316(S) SEM Neuroscience of Decision-Making](#)

Taught by: [Yunshu_Fan](#)
[Catalog details](#)

[PSYC 326 SEM Choice and Decision Making](#)

Taught by: [Kris Kirby](#)
[Catalog details](#)

[PSYC 327(S) SEM Cognition and Education](#)

Taught by: [Nate_Kornell](#)
[Catalog details](#)

[REL 288 / PHIL 288 SEM Embodiment and Consciousness: A Cross-Cultural Exploration](#)

Taught by: [Georges Dreyfus](#)
[Catalog details](#)

Recommended Courses

The following courses are recommended for students seeking a richer background in cognitive science. These will not count as electives for the cognitive science concentration.

[BIOL 209 / NSCI 209(F) TUT Animal Communication](#)

Taught by: [Heather_Williams](#)
[Catalog details](#)

[BIOL 305(F) LEC Evolution](#)

Taught by: [Luana Maroja](#)
[Catalog details](#)

[COGS 224 / PHIL 221(F) LEC Introduction to Formal Linguistics](#)

Taught by: [Christian_De Leon](#)
[Catalog details](#)

[COGS 390 / PHIL 390 SEM Discourse Dynamics](#)

Taught by: [Christian_De Leon](#)
[Catalog details](#)

[ECON 502(F) LEC Statistics/Econometrics](#)

Taught by: [Anand Swamy](#)
[Catalog details](#)

[MATH 250(F, S) LEC Linear Algebra](#)

Taught by: [Cesar Silva](#), [Palak_Arora](#)
[Catalog details](#)

[PHIL 209 / STS 209 SEM Philosophy of Science](#)

Taught by: [Bojana_Mladenovic](#)
[Catalog details](#)

[PSYC 201(F, S) LEC Experimentation and Statistics](#)

Taught by: [Steven_Fein](#), [Noah Sandstrom](#), [Kris Kirby](#), [Catherine Stroud](#)
[Catalog details](#)

Formal admission to candidacy for honors will occur at the end of the fall semester of the senior year and will be based on promising performance in COGS 493. This program will consist of COGS W31-494(S), and will be supervised by members of the advisory committee from at least two departments. Presentation of a thesis, however, should not be interpreted as a guarantee of a degree with honors.

STUDY ABROAD

Students who wish to discuss plans for study abroad are invited to meet with any member of the Cognitive Science advisory committee.

FAQ

Students MUST contact departments/programs BEFORE assuming study away credit will be granted toward the major or concentration.

Can your department or program typically pre-approve courses for major/concentration credit?

Yes, in many cases, though students should be sure to contact the department.

What criteria will typically be used/required to determine whether a student may receive major/concentration credit for a course taken while on study away?

Complete syllabus and course description, including readings/assignments.

Does your department/program place restrictions on the number of major/concentration credits that a student might earn through study away?

No.

Does your department/program place restrictions on the types of courses that can be awarded credit towards your major?

No. As long as the study abroad courses conform to the interdisciplinary distribution requirements of the concentration.

Are there specific major requirements that cannot be fulfilled while on study away?

No.

Are there specific major requirements in your department/program that students should be particularly aware of when weighing study away options? (Some examples might include a required course that is always taught in one semester, laboratory requirements.)

No.

Give examples in which students thought or assumed that courses taken away would count toward the major or concentration and then learned they wouldn't:

None to date.

COGS 129 (F)(S) Language and the Mind

Cross-listings: PHIL 129

Secondary Cross-listing

Many animals communicate, but only humans can use language. What is language? Is the ability to learn it specialized, or just a matter of having enough cognitive processing power? Do successes of large language models and AI chat bots confirm or challenge traditional linguistic theory? Does language in any way determine, shape, or enable thought? How sophisticated could a mind without language be? Does knowledge of language require consciousness? In this course we will investigate (a) what makes language stand out from other kinds of communication system and (b) what makes human minds uniquely capable of acquiring language. Drawing on debates about the evolution of language, Chomskyian universal grammar, the computational theory of mind, and more, we will explore the philosophical consequences of our existance as linguistic creatures.

Requirements/Evaluation: Short reading responses (approx. 2 pages) every other week, two exams

Prerequisites: None

Enrollment Limit: 20

Enrollment Preferences: Priority given to first and second years

Expected Class Size: 15

Grading: yes pass/fail option, yes fifth course option

Distributions: (D2)

This course is cross-listed and the prefixes carry the following divisional credit:

COGS 129(D2) PHIL 129(D2)

Attributes: Linguistics

Fall 2023

LEC Section: 01 TF 2:35 pm - 3:50 pm Christian De Leon

Spring 2024

LEC Section: 01 MR 2:35 pm - 3:50 pm Christian De Leon

COGS 222 (S) Minds, Brains, and Intelligent Behavior: An Introduction to Cognitive Science

Cross-listings: PSYC 222 / PHIL 222

Primary Cross-listing

This course will emphasize interdisciplinary approaches to the study of intelligent systems, both natural and artificial. Cognitive science synthesizes research from cognitive psychology, computer science, linguistics, neuroscience, and contemporary philosophy. Special attention will be given to the philosophical foundations of cognitive science, representation and computation in symbolic and connectionist architectures, concept acquisition, problem solving, perception, language, semantics, reasoning, and artificial intelligence.

Requirements/Evaluation: midterm and final exams, and weekly exercises

Prerequisites: PSYC 101 or any PHIL course or CSCI 134 or permission of instructor; background in more than one of these is recommended.

Enrollment Limit: 20

Enrollment Preferences: sophomore and first-year students, with additional preference given to students who satisfy more of the prerequisites. Do not contact the instructor to plead for special enrollment consideration.

Expected Class Size: 20

Grading: no pass/fail option, no fifth course option

Distributions: (D2)

This course is cross-listed and the prefixes carry the following divisional credit:

PSYC 222(D3) PHIL 222(D2) COGS 222(D2)

Attributes: Linguistics PHIL Contemp Metaphysics + Epistemology Courses PSYC 200-level Courses

Spring 2024

LEC Section: 01 TR 9:55 am - 11:10 am Joseph L. Cruz

COGS 224 (F) Introduction to Formal Linguistics (QFR)

Cross-listings: PHIL 221

Primary Cross-listing

The sentence "Every cookie is chocolate chip and three of them are oatmeal raisin" is a perfectly grammatical sentence of English, but it's self-contradictory. What does it take to realize this fact? One must grasp the meanings of the various parts of the sentence. In particular, one must grasp that "three of them" picks out a subset of the group picked out by "every cookie", and that there's no such thing as a cookie that is both chocolate chip *and* oatmeal raisin. There two ways to understand "Many students took every class". According to one, there is a single group of students that had their hands extremely full this semester. According to the other, every class was well-populated, potentially by different groups. The reason for this is that there are two underlying structures that the original sentence can realize. This course serves as an introduction to formal methods in the scientific study of language. Our goal will be to characterize phenomena like those above with logical and mathematical precision. The focus will be on model-theoretic semantics, the sub-field of linguistics that studies meanings. Along the way we will discuss principles of syntax, the sub-field that studies sentence structures, and pragmatics, the sub-field that studies inferences of non-literal content. This is a formal course, but no

prior logical or mathematical background will be expected. Starting from scratch, students will learn the building blocks of current-day linguistic research. This introduction will be of use to students interested in language from a variety of perspectives, including philosophy, cognitive science, and computer science.

Requirements/Evaluation: Weekly problem sets, plus a final project (paper/presentation/other type, to be discussed with instructor)

Prerequisites: No prerequisites

Enrollment Limit: 20

Enrollment Preferences: Preference given to seniors and philosophy/cognitive science majors.

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Distributions: (D2) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

COGS 224(D2) PHIL 221(D2)

Quantitative/Formal Reasoning Notes: This course teaches the fundamentals of the formal analysis of language. Students will learn to provide translation schemes from English to a logical language (typed lambda calculus).

Attributes: COGS Interdepartmental Electives COGS Related Courses Linguistics PHIL Contemp Metaphysics + Epistemology Courses

Fall 2023

LEC Section: 01 MR 2:35 pm - 3:50 pm Christian De Leon

COGS 323 (F) Visual Consciousness (WS)

Cross-listings: PSYC 323

Primary Cross-listing

Consciousness is considered as the 'last great mystery of science.' In this course we are going to delve into one of the most well-studied areas of this mystery, that is visual consciousness. Do you really perceive everything you look at? Are you aware of everything you see? Is our visual experience a grand illusion? We will start our investigation of such questions by reading about various approaches in understanding human consciousness. Then, we are going to apply these approaches to perception, and discuss theoretical and empirical controversies in visual consciousness. Finally, we are going to focus on evaluating empirical studies that attempt to resolve such controversies. The goal of this course is to build a bridge between theory and experimentation by learning how to interpret the results of scientific studies to shed light on theoretical and philosophical debates in the literature.

Requirements/Evaluation: 5 - 7 page essays every other week, and 2-page response papers to their partner's essays in alternate weeks

Prerequisites: COGS 222 (same as PHIL 222 or PSYC 222); or permission of instructor

Enrollment Limit: 10

Enrollment Preferences: Cognitive Science concentrators and Psychology majors

Expected Class Size: 10

Grading: no pass/fail option, no fifth course option

Distributions: (D2) (WS)

This course is cross-listed and the prefixes carry the following divisional credit:

COGS 323(D2) PSYC 323(D3)

Writing Skills Notes: In a tutorial format, students will receive detailed feedback on their writing each week from the professor, as well as from their partner. Students will receive timely comments on their writing skills, with suggestions for improvement. The written essays will be discussed during tutorial meetings.

Attributes: COGS Interdepartmental Electives PSYC Area 2 - Cognitive Psychology

Not offered current academic year

COGS 328 (S) Cognitive Approaches to Visual Perception

Cross-listings: PSYC 328

When you open your eyes, you immediately perceive your environment in great detail. Seeing is so quick and effortless that people mistakenly think that vision works like a camera. However, the reason it feels effortless is due to the tremendous amount of complex processes and computations that take place in your brain whenever you open your eyes. In this course, we will explore such processes from a computational perspective and examine the concept of "visual illusion". We will focus on research methodologies used in vision science and look into how we can use such methodologies to explain visual illusions. We will learn about how our visual system processes certain visual features in our environment, such as motion, color, depth and shape. Learning about these processes will make us appreciate how everything we see around us can be a visual illusion.

Requirements/Evaluation: Class participation, weekly take-home quizzes, weekly short commentaries on readings, class presentation, individual 10-page final paper

Prerequisites: PSYC 221, COGS/PHIL/PSYC 222, or permission of instructor

Enrollment Limit: 19

Enrollment Preferences: Cognitive Science concentrators

Expected Class Size: 19

Grading: yes pass/fail option, yes fifth course option

Distributions: (D2)

This course is cross-listed and the prefixes carry the following divisional credit:

COGS 328(D2) PSYC 328(D3)

Attributes: COGS Interdepartmental Electives PSYC Area 2 - Cognitive Psychology

COGS 390 (S) Discourse Dynamics (WS)

Cross-listings: PHIL 390

It'd be perfectly natural to say "I might've left the stove on", then check the stove, then say "I didn't leave the stove on". But perform those exact same steps in a different order--check the stove, say "I didn't leave the stove on", then say "I might've left the stove on"--and something's gone quite wrong. Conversation is dynamic--the back and forth exchange of information is a process that grows and adapts to the surrounding context. The order in which you say things matters, and it matters for what you communicate what actions you take and what events happen around you. In this course, we will investigate dynamic communicative phenomena and discuss competing theoretical explanations about how they're interpreted. Of particular interest will be the extent to which discourse dynamics are built into the meanings of linguistic expressions vs. the extent to which they're consequences of our rational cognition. Is a sentence's relation to previously uttered sentences similar to its relation to extra-linguistic events? How much inference goes into interpreting what's said? In pursuing the answers to these questions, we will discuss both classic and contemporary theories from philosophy and linguistics.

Requirements/Evaluation: Four short papers (3-4 pages), take-home midterm paper (5-7) pages, take-home final paper (6-8 pages)

Prerequisites: At least one philosophy or cognitive science course (any level), or permission of instructor.

Enrollment Limit: 19

Enrollment Preferences: Preference given to seniors and philosophy/cognitive science majors, then to students who have taken 200-Level Intro to Formal Linguistics

Expected Class Size: 19

Grading: yes pass/fail option, yes fifth course option

Distributions: (D2) (WS)

This course is cross-listed and the prefixes carry the following divisional credit:

COGS 390(D2) PHIL 390(D2)

Writing Skills Notes: There will be four short papers (3-4 pages each) that will receive written comments on substance, argument structure, and writing style. These will be designed to include sections that, upon revision in light of comments, can be incorporated into the longer midterm and final papers (5-7 pages and 6-8 pages respectively). Students will be required to meet with the instructor before the midterm and final papers to discuss outlines and revisions of short papers.

Attributes: COGS Interdepartmental Electives COGS Related Courses Linguistics PHIL Contemp Metaphysics + Epistemology Courses

COGS 493 (F) Advanced Topics in Mind and Cognition

In the last decade the science of the mind has continued to draw on its 20th century history as well as expand its methodological repertoire. In this seminar we will investigate some of the current trends in mind and cognition. We will attend both to the specific empirical details as well as the conceptual foundations of cognitive science. In particular, we will focus on the concept of mental representation, which is the core and defining theoretical posit in the field of cognitive sciences. We will discuss both the philosophical foundations of this concept, as well as how it is utilized in the current empirical literature in this field.

Requirements/Evaluation: in-class participation, seminar presentations, final paper & project

Prerequisites: Senior Cognitive Science concentrator

Enrollment Limit: 12

Enrollment Preferences: Open only to Senior Cognitive Science concentrators

Expected Class Size: 5

Grading: no pass/fail option,   no fifth course option

Distributions: (D2)

Fall 2023

SEM Section: 01   MWF 11:00 am - 12:15 pm   Joseph L. Cruz

COGS 494 (S) Senior Thesis: Cognitive Science

The senior concentrator, having completed the senior seminar and with approval from the advisory committee, may devote winter study and the spring semester to a senior thesis based on the fall research project.

Requirements/Evaluation: Determined by thesis advisor

Prerequisites: permission of program chair

Enrollment Limit: none

Enrollment Preferences: Senior Cognitive Science concentrators

Expected Class Size: NA

Grading: no pass/fail option,   no fifth course option

Distributions: (D2)

Spring 2024

HON Section: 01   TBA   Nate Kornell

COGS 497 (F) Independent Study: Cognitive Science

Cognitive Science independent study.

Class Format: This course is coordinated in agreement with a sponsoring Cognitive Science faculty member.

Requirements/Evaluation: Determined by individual instructors

Prerequisites: permission of program chair

Enrollment Limit: none

Enrollment Preferences: Cognitive Science concentrators

Expected Class Size: NA

Grading: yes pass/fail option,   yes fifth course option

Distributions: (D2)

Fall 2023

IND Section: 01   TBA   Nate Kornell

COGS 498 (S) Independent Study: Cognitive Science

Cognitive Science independent study.

Class Format: This course is coordinated in agreement with a sponsoring Cognitive Science faculty member.

Requirements/Evaluation: Determined by individual instructors

Prerequisites: permission of program chair

Enrollment Limit: none

Enrollment Preferences: Cognitive Science concentrators

Expected Class Size: NA

Grading: yes pass/fail option,   yes fifth course option

Distributions: (D2)

Spring 2024

IND Section: 01   TBA   Nate Kornell

Winter Study ---

COGS 31 (W) Senior Thesis: Cognitive Science

May be taken by students registered for Cognitive Science 494.

Class Format: independent study

Grading: pass/fail only

Winter 2024

HON Section: 01   TBA   Nate Kornell

COGS 99 (W) Ind Study: Cognitive Science

Open to upperclass students. Students interested in doing an independent project (99) during Winter Study must make prior arrangements with a faculty sponsor. The student and professor then complete the independent study proposal form available online. The deadline is typically in late September. Proposals are reviewed by the pertinent department and the Winter Study Committee. Students will be notified if their proposal is approved prior to the Winter Study registration period.

Class Format: independent study

Grading: pass/fail only

Winter 2024

IND Section: 01   TBA   Nate Kornell