Philosophy-Neuroscience-Psychology

Philosophy-Neuroscience-Psychology (PNP) is an interdisciplinary program that provides an opportunity to examine the mind from multiple perspectives. Students who choose to major in PNP will learn to bring some of the newest findings in science to bear on some of the oldest questions in philosophy; equally important, they will see new questions emerge and learn to pursue those as well. Examples include: Is the mind–brain a single entity, or does having a mind involve something over and above the activity of a brain? What assumptions are made by cognitive psychologists when they divide mental activity into separate processes and use response times or other measures of task performance to describe those processes? What assumptions are made by neuroscientists when they use imaging techniques to determine where in the brain a cognitive process is carried out? What are we to make of Chomsky’s claim that language is an innate mental organ designed to generate an infinite number of sentences? PNP majors will seek answers to questions such as these in courses offered by PNP and PNP’s affiliated departments.

Contact: PNP Office
Phone: 314-935-4297
Email: pnp@wustl.edu
Website: http://pnp.artsci.wustl.edu

Faculty

Director
Ron Mallon (http://philosophy.artsci.wustl.edu/people/ron-mallon)
Professor
PhD, Rutgers University
(Philosophy; Philosophy-Neuroscience-Psychology)

Core Faculty
Carl F. Craver (http://philosophy.artsci.wustl.edu/people/Carl_Craver)
Professor
PhD, University of Pittsburgh
(Philosophy; Philosophy-Neuroscience-Psychology)
John Doris (http://philosophy.artsci.wustl.edu/people/John_Doris)
Professor
PhD, University of Michigan
(Philosophy; Philosophy-Neuroscience-Psychology)

Brett D. Hyde (http://philosophy.artsci.wustl.edu/people/Brett_Hyde)
Associate Professor
PhD, Rutgers University
(Philosophy; Linguistics; Philosophy-Neuroscience-Psychology)
Casey O’Callaghan (http://pnp.artsci.wustl.edu/people/casey-ocallaghan)
Professor
PhD, Princeton University
(Philosophy; Philosophy-Neuroscience-Psychology)
Mark Rollins (http://philosophy.artsci.wustl.edu/people/mark-rollins)
Professor; Chair, Performing Arts Dept.; Dean, University College
PhD, Columbia University
(Philosophy; Philosophy-Neuroscience-Psychology)
Elizabeth Schechter (http://philosophy.artsci.wustl.edu/people/elizabeth-schechter)
Assistant Professor
PhD, University of Maryland
(Philosophy; Philosophy-Neuroscience-Psychology)

Participating Faculty
Richard A. Abrams (http://psychweb.wustl.edu/people/richard-abrams)
Professor
PhD, University of Michigan
(Psychological & Brain Sciences)
David A. Balota (http://psychweb.wustl.edu/people/david-balota)
Professor
PhD, University of South Carolina
(Psychological & Brain Sciences)
Deanna M. Barch (http://psychweb.wustl.edu/people/deanna-barch)
Professor
PhD, University of Illinois
(Psychological & Brain Sciences)
Joe Barcroft (http://rll.wustl.edu/people/joe-barcroft)
Professor
PhD, University of Illinois at Urbana-Champaign
(Romance Languages and Literatures)
Cindy Brantmeier (http://rll.wustl.edu/people/cindy-brantmeier)
Professor
PhD, Indiana University
(Romance Languages and Literatures; Education)
Todd S. Braver (http://psychweb.wustl.edu/people/todd-braver)
Professor
PhD, Carnegie Mellon University
(Psychological & Brain Sciences)
John Bruer (http://philosophy.artsci.wustl.edu/people/John_Bruer)
Adjunct Professor
PhD, Rockefeller University
(Philosophy)

Dennis DesChene (http://philosophy.artsci.wustl.edu/people/Dennis_DesChene)
Professor
PhD, Stanford University
(Philosophy; Interdisciplinary Project in the Humanities)

Janet M. Duchek (http://psychweb.wustl.edu/people/janet-duchek)
Associate Professor
PhD, Washington University
(Psychological & Brain Sciences)

Leonard Green (http://psychweb.wustl.edu/green)
Professor
PhD, State University of New York–Stony Brook
(Psychological & Brain Sciences; Economics)

John Heil (http://philosophy.artsci.wustl.edu/people/John_Heil)
Professor
PhD, Vanderbilt University
(Philosophy)

Erik Herzog (http://wubio.wustl.edu/herzog)
Professor
PhD, Syracuse University, Institute for Sensory Research
(Biology)

Lori Markson (http://psychweb.wustl.edu/markson)
Associate Professor
PhD, University of Arizona
(Psychological & Brain Sciences)

Kathleen McDermott (http://psychweb.wustl.edu/mcdermott)
Professor
PhD, Rice University
(Psychological & Brain Sciences)

Camillo Padoa-Schioppa (http://neurosci.wustl.edu/People/camillo-padoa-schioppa)
Associate Professor
PhD, Massachusetts Institute of Technology
(Anatomy and Neurobiology; Biological Engineering)

Jonathan Peelle (http://jonathanpeelle.net)
Assistant Professor
PhD, Brandeis University
(Otolaryngology)

Anya Plutynski (http://philosophy.artsci.wustl.edu/people/anya-plutynski)
Associate Professor
PhD, University of Pennsylvania
(Philosophy)

Marcus E. Raichle (http://www.nil.wustl.edu/labs/raichle)
Professor
MD, University of Washington
(Radiology)

Andrew Rehfeld (http://polisci.wustl.edu/andrew_rehfeld)
Professor
PhD, University of Chicago
(Political Science)

Larry Snyder (http://neurosci.wustl.edu/People/Faculty/lawrence-snyder)
Professor
PhD, University of Rochester
(Anatomy and Neurobiology)

Mitchell S. Sommers (http://psychweb.wustl.edu/sommers)
Professor
PhD, University of Michigan
(Psychological & Brain Sciences)

Roy Sorensen (http://philosophy.artsci.wustl.edu/people/roy-sorensen)
Professor
PhD, Michigan State
(Philosophy)

Paul S.G. Stein (http://wubio.wustl.edu/stein)
Professor
PhD, Stanford University
(Biology)

Brian Talbot (http://philosophy.artsci.wustl.edu/people/brian-talbot)
Study Abroad Advisor; Lecturer
PhD, University of Southern California
JD, University of California, Berkeley
(Philosophy)

James Wertsch (http://anthropology.artsci.wustl.edu/wertsch_james)
Marshall S. Snow Professor in Arts & Sciences
PhD, University of Chicago
(Anthropology; American Culture Studies; Education; International and Area Studies)

Desirée A. White (http://psychweb.wustl.edu/white)
Professor
PhD, Washington University
(Psychological & Brain Sciences)

Jeffrey M. Zacks (http://psychweb.wustl.edu/zacks)
Professor
PhD, Stanford University
(Psychological & Brain Sciences)
Endowed Professors

John Baugh (http://anthropology.artsci.wustl.edu/baugh_john)
Margaret Bush Wilson Professor in Arts & Sciences
PhD, University of Pennsylvania
(African and African-American Studies; American Culture Studies; Anthropology; Education; English; Psychological & Brain Sciences)

Pascal R. Boyer (http://anthropology.artsci.wustl.edu/boyer_pascal)
Henry Luce Professor of Collective and Individual Memory
PhD, University of Paris–Nanterre
(Anthropology; Religious Studies)

Maurizio Corbetta (https://wuphysicians.wustl.edu/for-patients/find-a-physician/maurizio-corbetta)
Norman J. Stupp Professor of Neurology
MD, University of Verona, Italy

Steven E. Petersen (http://dbbs.wustl.edu/faculty/Pages/faculty_bio.aspx?SID=1480)
James S. McDonnell Professor of Cognitive Neuroscience
PhD, California Institute of Technology
(Neurology; Neurological Surgery; Psychological & Brain Sciences)

Henry L. Roediger III (http://psychweb.wustl.edu/roediger)
James S. McDonnell Distinguished University Professor
PhD, Yale University
(Psychological & Brain Sciences; American Culture Studies)

Rebecca Treiman (http://psychweb.wustl.edu/treiman)
Burke and Elizabeth High Baker Professor of Child Developmental Psychology
PhD, University of Pennsylvania
(Psychological & Brain Sciences)

Majors

The Major in Philosophy-Neuroscience-Psychology

I. Core Undergraduate Requirements for PNP

Required for all students, regardless of track:

Entry Sequence

Choose one of the following:

- PNP Sequence
  - PNP 200 Introduction Cognitive Science and
  - PNP 201 Inquiry in the Cognitive Sciences or
  - Psych 301 Experimental Psychology

or

- Mind, Brain, Behavior Sequence (MBB)

Core Philosophy Requirements

Prerequisites:

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<th>Units</th>
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<td>Phil 100G</td>
<td>Logic and Critical Analysis</td>
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<td>or Phil 102</td>
<td>Introduction to Scientific Reasoning</td>
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<tr>
<td>or Phil 120F</td>
<td>Problems in Philosophy</td>
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<tr>
<td>or Phil 125C</td>
<td>Great Philosophers</td>
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Upper division: Two courses at the 300 or 400 level.
Majors must take either

- PNP 315 Philosophy of Mind, or
- PNP 306 Philosophy of Language

and another from the list below:

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<tr>
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<td>Symbolic Logic</td>
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<td>PNP 306</td>
<td>Philosophy of Language</td>
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<td>Mind and Morals</td>
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<td>PNP 321</td>
<td>Philosophy of Science</td>
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<td>Music 3221</td>
<td>Music Cognition</td>
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<td>Phil 339F</td>
<td>Philosophy of the Arts</td>
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<td>Phil 349C</td>
<td>Descartes to Hume</td>
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<td>PNP 3581</td>
<td>Conceptual Foundations of Modern Science</td>
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<td>Phil 361</td>
<td>Philosophy of Emotions</td>
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<td>Phil 366</td>
<td>Art and the Mind-Brain</td>
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<td>Phil 390</td>
<td>Philosophical Writing (upon approval of subject matter, consult PNP office for each semester)</td>
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<td>Phil 403</td>
<td>Mathematical Logic 1</td>
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<td>Phil 404</td>
<td>Mathematical Logic II</td>
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<td>Philosophical Logic</td>
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<td>Philosophy of Logic</td>
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<td>Phil 4061</td>
<td>Topics in the Philosophy of Language</td>
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<td>PNP 4065</td>
<td>Advanced Philosophy of Language</td>
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<td>Phil 410</td>
<td>Theories of Perception</td>
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<td>Advanced Epistemology</td>
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<td>PNP 4142</td>
<td>Advanced Metaphysics</td>
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Core Psychological & Brain Sciences Requirements

**Prerequisite:** Psych 100B Introduction to Psychology

**Upper division:** Two courses at the 300 or 400 level. Unless a student has completed FYP 120A with a grade of B- or higher, they must take

PNP 360 Cognitive Psychology, or PNP 408 Psychology of Language

and another from the list below:

<table>
<thead>
<tr>
<th>Code</th>
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<td>Psych 300</td>
<td>Introduction to Psychological Statistics</td>
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<td>Psych 301</td>
<td>Experimental Psychology</td>
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<td>PNP 3151</td>
<td>Introduction to Social Psychology</td>
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<tr>
<td>PNP 3211</td>
<td>Developmental Psychology</td>
<td>3</td>
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<tr>
<td>PNP 323</td>
<td>Play and Development</td>
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<td>Psych 326</td>
<td>Introduction to the Psychology of Aging</td>
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<td>PNP 330</td>
<td>Sensation and Perception</td>
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<tr>
<td>PNP 3401</td>
<td>Biological Psychology</td>
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<td>PNP 3451</td>
<td>Genes, Environment, and Human Behavior</td>
<td>3</td>
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<tr>
<td>PNP 3531</td>
<td>Psychology of Personality</td>
<td>3</td>
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<tr>
<td>PNP 3541</td>
<td>Abnormal Psychology</td>
<td>3</td>
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<tr>
<td>Psych 357</td>
<td>Introduction to Clinical Psychology</td>
<td>3</td>
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<tr>
<td>Psych 358</td>
<td>Language Acquisition</td>
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<td>PNP 360</td>
<td>Cognitive Psychology</td>
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<td>PNP 361</td>
<td>Psychology of Learning</td>
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<tr>
<td>PNP 362</td>
<td>The Biological Basis of Human Behavior</td>
<td>3</td>
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<tr>
<td>PNP 3661</td>
<td>Psychology of Creativity</td>
<td>3</td>
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<tr>
<td>Psych 374</td>
<td>Drugs, Brain and Behavior</td>
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<td>PNP 380</td>
<td>Human Learning and Memory</td>
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<tr>
<td>PNP 408</td>
<td>Psychology of Language</td>
<td>3</td>
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<tr>
<td>Psych 403</td>
<td>Developmental Neuropsychology</td>
<td>3</td>
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<tr>
<td>Psych 4182</td>
<td>Perception, Thought and Action</td>
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<tr>
<td>Psych 4301</td>
<td>Contemporary Topics in Cognitive Development</td>
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<tr>
<td>PNP 4302</td>
<td>Cognitive Psychology Applied to Education</td>
<td>3</td>
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<tr>
<td>Psych 4351</td>
<td>Reading and Reading Development</td>
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<td>Psych 4352</td>
<td>Reading and Reading Development-</td>
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<tr>
<td>Psych 4625</td>
<td>Autobiographical Memory</td>
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<tr>
<td>Psych 4651</td>
<td>History and Modern Systems of Psychology</td>
<td>3</td>
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<tr>
<td>Psych 4746</td>
<td>Biological Pathways to Psychology</td>
<td>3</td>
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</table>

II. Track-specific Requirements

Courses required for the Cognitive Neuroscience (CN) track

**Prerequisites:** Biol 2960 or Psych 3401* and permission of instructor; Biol 3058 recommended.

**Upper division:** Two neuroscience courses at the 300 or 400 level. Students must take:

<table>
<thead>
<tr>
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<td>Biol 3411</td>
<td>Principles of the Nervous System</td>
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<tr>
<td>PNP 360</td>
<td>Cognitive Neuroscience</td>
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</table>

(*Psych 3401 Biological Psychology can count toward the depth requirement, if taken as a prerequisite.)

Courses required for the Language, Cognition and Culture (LCC) track

**Prerequisites:**

<table>
<thead>
<tr>
<th>Code</th>
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<tr>
<td>Anthro 170D</td>
<td>Introduction to Linguistics</td>
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<tr>
<td>Anthro 150A</td>
<td>Introduction to Human Evolution</td>
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**Upper division:** Two courses at the 300 or 400 level, chosen from those below:

<table>
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<tr>
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<td>Philosophy of Language</td>
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<td>PNP 309</td>
<td>Syntactic Analysis</td>
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<tr>
<td>PNP 311</td>
<td>Introduction to Semantics</td>
<td>3</td>
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<tr>
<td>Ling 312</td>
<td>Phonetics</td>
<td>3</td>
</tr>
<tr>
<td>PNP 313</td>
<td>Phonological Analysis</td>
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</tbody>
</table>
III. Depth Requirement

Students on the CN track must complete at least 9 units, including at least 3 units at the 400 level or above, in one area of either philosophy, psychology or neuroscience.

Students on the LCC track must complete at least 9 units, including at least 3 units at the 400 level or above, in one area of either philosophy, psychology, anthropology or linguistics.

Note that for either track, for students matriculating in 2015 and beyond who have another major in one of the designated areas, courses from the other major may not count toward satisfying the depth requirement; i.e., there is no "double counting" between the majors.

Three units of FYP 3001 may be counted toward the depth requirement, in an area appropriate to the research undertaken (e.g., a psychology research project would count toward the psychology depth requirement). All 9 depth requirement units must be taken in a single area.

Philosophy

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<td>PNP 4141</td>
<td>Advanced Epistemology</td>
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<td>PNP 418</td>
<td>Current Controversies in Cognitive Science</td>
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<td>Philosophy of Psychology</td>
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<td>PNP 4210</td>
<td>Topics in Advanced Philosophy of Science: Scientific Explanation</td>
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<td>Phil 4212</td>
<td>Philosophy of Neuroscience</td>
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<td>Phil 423</td>
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<td>PNP 426</td>
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<td>PNP 4332</td>
<td>Cognition and Computation</td>
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<td>PNP 495</td>
<td>PNP Seminar</td>
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<td>PNP 496</td>
<td>PNP Seminar: Rethinking Psychological Kinds</td>
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Psychology

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<tr>
<td>Psych 300</td>
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<td>Experimental Psychology</td>
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<td>PNP 3151</td>
<td>Introduction to Social Psychology</td>
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<td>PNP 3211</td>
<td>Developmental Psychology</td>
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<td>PNP 323</td>
<td>Play and Development</td>
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<td>Psych 326</td>
<td>Introduction to the Psychology of Aging</td>
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<td>Genes, Environment, and Human Behavior</td>
<td>3</td>
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<td>PNP 3531</td>
<td>Psychology of Personality</td>
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<td>PNP 3541</td>
<td>Abnormal Psychology</td>
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<td>Psych</td>
<td>Introduction to Clinical Psychology</td>
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<td>Psych</td>
<td>Language Acquisition</td>
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<td>PNP 360</td>
<td>Cognitive Psychology</td>
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<td>PNP 361</td>
<td>Psychology of Learning</td>
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<td>PNP 362</td>
<td>The Biological Basis of Human Behavior</td>
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<td>PNP 3661</td>
<td>Psychology of Creativity</td>
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<td>Psych</td>
<td>Positive Psychology: The Science of Happiness</td>
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<td>Psych</td>
<td>Drugs, Brain and Behavior</td>
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<td>PNP 380</td>
<td>Human Learning and Memory</td>
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<td>Psych</td>
<td>Developmental Neuropsychology</td>
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<td>PNP 408</td>
<td>Psychology of Language</td>
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<tr>
<td>PNP 4302</td>
<td>Cognitive Psychology Applied to Education</td>
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<tr>
<td>Psych</td>
<td>Perception, Thought and Action</td>
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<td>Psych</td>
<td>Psychological Perspectives on the Self</td>
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<td>Psych</td>
<td>Trauma and Memory</td>
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<tr>
<td>Psych</td>
<td>Advanced Cognitive Neuroscience (Writing Intensive)</td>
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<td>PNP 4450</td>
<td>Functional Neuroimaging Methods</td>
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<td>Psych</td>
<td>The Development of Social Cognition (Writing Intensive)</td>
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<td>Psych</td>
<td>Development of Social Cognition</td>
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<td>Psych</td>
<td>Psychology of Memory and Cognition</td>
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<td>Psych</td>
<td>Autobiographical Memory</td>
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<td>Psych</td>
<td>History and Modern Systems of Psychology</td>
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<td>Psych</td>
<td>Biological Pathways to Psychopathology: From Genes and the Environment to Brain and Behavior</td>
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<tr>
<td>Psych</td>
<td>Inside the Disordered Brain: Biological Bases of the Major Mental Disorders</td>
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<td>PNP 495</td>
<td>PNP Seminar</td>
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<td>PNP 496</td>
<td>PNP Seminar: Rethinking</td>
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### Neuroscience
- Biol 3058: Physiological Control Systems - 2 units
- Psych 3401: Biological Psychology - 3 units
- Biol 3421: Introduction to Neuroethology - 3 units
- Biol 3422: Genes, Brains and Behavior - 3 units
- PNP 350: Physics of the Brain - 3 units
- PNP 355: Physics of Vision - 3 units
- Biol 360: Biophysics Laboratory - 3 units
- PNP 402: The Physiology and Biophysics of Consciousness - 2 units
- Biol 4030: Biological Clocks - 3 units
- Biol 4031: Biological Clocks (WI) - 3 units
- PNP 404: Laboratory of Neuropysiology - 4 units
- Psych 4046: Developmental Neuropsychology - 3 units
- Phil 4212: Philosophy of Neuroscience - 3 units
- Psych 4413: Advanced Cognitive Neuroscience (Writing Intensive) (WI) - 3 units
- PNP 4450: Functional Neuroimaging Methods - 3 units
- PNP 4488: The Cognitive Neuroscience of Film - 3 units
- Psych 4746: Biological Pathways to Psychopathology: From Genes and the Environment to Brain and Behavior - 3 units
- BME 4902: Cellular Neurophysiology - 3 units
- PNP 495: PNP Seminar - 3 units
- PNP 496: PNP Seminar: Rethinking Psychological Kinds - 3 units

### Anthropology
- Anthro 3386: Language, Culture and Society - 3 units
- PNP 362: The Biological Basis of Human Behavior - 3 units
- PNP 3662: Primate Biology - 3 units
- PNP 406: Primate Ecology and Social Structure - 3 units
- PNP 4122: Language and Gender - 3 units
- PNP 4190: Primate Behavior - 3 units
- PNP 4192: Primate Cognition - 3 units
- PNP 495: PNP Seminar - 3 units
- PNP 496: PNP Seminar: Rethinking Psychological Kinds - 3 units

### Linguistics
- PNP 301: Symbolic Logic - 3 units
- PNP 306: Philosophy of Language - 3 units
- PNP 309: Syntactic Analysis - 3 units
Minors

The Minor in Philosophy-Neuroscience-Psychology

Units required: 15

Required courses: Minors are required to complete at least 15 units, of which 9 must be at the 300 level or above.

The minor is composed of a 6-unit introductory sequence (PNP 200 and PNP 201, or FYP 120A and MBB 122), followed by:

- 3 units in Philosophy:
  - PNP 315 Philosophy of Mind/Phil 315
  - PNP 306 Philosophy of Language/Phil 306G

- 3 units of Neuroscience:
  - PNP 3411 Principles of the Nervous System/Biol 3411
  - Psych 3604 Cognitive Neuroscience

- 3 units in Psychology:
  - PNP 360 Cognitive Psychology/Psych 360
  - PNP 408 Psychology of Language

Additional Information

Psych 100B is the prerequisite for all psychological & brain science courses at the 300 level and above. Note that no more than 6 units counted toward a minor in PNP may be transferred or earned abroad, and no more than 3 units may be counted toward another major or minor.

Courses

Visit online course listings to view semester offerings for L64 PNP (https://courses.wustl.edu/CourseInfo.aspx?sch=L&dept=L64&crslvl=1:4).

### L64 PNP 200 Introduction Cognitive Science

We seek to understand the mind-brain by integrating findings from several of the cognitive sciences, including philosophy, psychology, neuroscience, linguistics, anthropology and artificial intelligence. This course considers multiple perspectives on such topics as mental imagery, concepts, rationality, consciousness, emotion, language, thought, memory, attention and machine intelligence. Prerequisite: completion of at least one of the following courses: Psych 100B, Phil 120F, Phil 125C, Biol 296A, MBB 120A or Ling 170D.

Credit 3 units. A&S IQ: SSC Arch: SSC Art: SSC BU: HUM EN: S
L64 PNP 201 Inquiry in the Cognitive Sciences
Understanding the mind-brain involves orchestrating a variety of conceptual tools and modes of inquiry from the cognitive sciences. This course offers a hands-on introduction to a variety of research tactics used in the behavioral and biological sciences and emphasizes the advantages of combining them. For example, neuroimaging can enhance the interpretation of experiments by cognitive psychologists and modeling can be used to simulate and understand the effects of brain lesions. Prerequisite: completion of at least one of the following courses: Psych 100B, Phil 120F, Phil 125C, Biol 296A, MBB 120 or Ling 170D.
Credit 3 units. A&S IQ: NSM, AN Arch: NSM Art: NSM

L64 PNP 3001 Research in the Mind, Brain, and Behavior
An introduction to research for students in the Mind, Brain and Behavior program (formerly known as Hewlett Program). Students work under the supervision of a mentor. Prerequisite: admission to the Mind, Brain and Behavior program, completion of MBB/PNP 122, and permission of the mentor.
Credit 3 units. A&S IQ: NSM Arch: NSM Art: NSM

L64 PNP 301 Symbolic Logic
In the first half of the course we study some features of truth-functional and first-order classical logics, including studying the model theory and metatheory for first-order logic in much greater detail than in Phil 100. In the second half of the course we go on to study three different styles of proof-system: tableaux, axiomatic, and natural deduction. This course continues on where Phil 100: An Introduction to Logic and Critical Analysis leaves off. It is recommended for students who have already taken that introductory course, or for students who already have a strong background in mathematics. Priority given to majors in philosophy and PNP.
Credit 3 units. A&S IQ: NSM, AN Arch: NSM Art: NSM BU: HUM

L64 PNP 306 Philosophy of Language
A survey of major philosophical problems concerning meaning, reference, and truth as they have been addressed within the analytic tradition. Readings that represent diverse positions on these focal issues will be selected from the work of leading philosophers in the field, for example: Frege, Russell, Wittgenstein, Davidson, Quine, Kripke, and Putnam. Students are encouraged to engage critically the ideas and arguments presented, and to develop and defend their own views on the core topics. Prerequisites: one course in Philosophy at the 100 or 200 level, or permission of the instructor. Priority given to majors in philosophy and PNP.
Credit 3 units. A&S IQ: HUM Arch: HUM Art: HUM BU: HUM EN: H

L64 PNP 309 Syntactic Analysis
The ability to produce and understand an infinite number of sentences is perhaps the most fascinating aspect of the human language faculty. Syntax is the study of how the brain organizes sentences from smaller phrases and words. This course explores syntactic analysis from several perspectives within generative linguistics, focusing primarily on the Government and Binding framework but also introducing Minimalist and Optimality Theoretic approaches. Topics include phrase-structure, transformations, case theory, thematic roles and anaphora. Assignments help students learn to construct and compare analyses of syntactic problems in English and other languages. Prerequisite: Ling 170D or permission of instructor.
Same as L44 Ling 309
Credit 3 units. A&S IQ: SSC BU: HUM EN: S

L64 PNP 3111 Introduction to Semantics
Semantics is the branch of linguistics which studies how speakers assign meaning to words, sentences, and larger units of discourse. We combine perspectives from both linguistics and philosophy to explore a variety of topics including polysemy, compositionality, quantification, anaphora, definite descriptions, attitude reports, presupposition and implicature. Prerequisite: Ling 170D or Phil 301G or permission of instructor.
Same as L44 Ling 311
Credit 3 units. A&S IQ: SSC Arch: SSC Art: SSC BU: HUM EN: S

L64 PNP 313 Phonological Analysis
There are several important abilities involved in the use of human language, one of these being the ability to organize speech sounds. The system that the brain uses to accomplish this task is the subject matter of phonology. This course explores phonology from several perspectives within generative linguistics, including both traditional rule-based and current Optimality Theoretic approaches. Topics discussed include phonological features, lexical phonology, prosodic morphology, tone, and metrical stress. Assignments help students learn to analyze phonological problems in a variety of languages and to evaluate the consequences of using different analytic approaches. Prerequisite: Ling 170D or permission of instructor.
Same as L44 Ling 313
Credit 3 units. A&S IQ: SSC BU: BA EN: S

L64 PNP 315 Philosophy of Mind
An introduction to philosophical analyses of the nature of mind, especially those developed by contemporary philosophers. The focus will be on questions such as the following: What is a mind? How does it relate to a person's brain? How does it relate to a person's body and the external world? Can a mind exist in a very different kind of body (e.g., a computer or a robot)? Does thinking require a language-like code? If so, can non-linguistic species think? What is it to have a mental image or to experience pain? Prerequisites: one course in Philosophy at the 100 or 200 level, or permission of the instructor. Priority given to majors in philosophy and PNP.
Same as L30 Phil 315
Credit 3 units. A&S IQ: HUM Arch: HUM Art: HUM BU: HUM EN: H

L64 PNP 3151 Introduction to Social Psychology
Introduction to the scientific study of individual behavior in a social context. Topics: person perception, stereotyping and prejudice, attitudes, memory, and political psychology, among other issues. Prerequisite: Psych 100B.
Same as L33 Psych 315
Credit 3 units. A&S IQ: SSC Arch: SSC Art: SSC BU: BA EN: S

L64 PNP 316 Mind and Morals
This course explores a number of issues at the intersection of ethics and cognitive science. Possible topics include: Are we rational? Do we know our own thoughts and motivations? Can one believe that one ought to do something without being
motivated to do it? Do emotions impair or enhance our ability to reason? How do moral beliefs develop through childhood? Are traits such as intelligence and character unchangeable, and what implications follow if they are (or are not)? Does retaining my identity over time require having the same mind, and, if so, am I the same person now as I was as a child? Are non-human animals worthy of moral consideration? If brain activity is determined by causal laws, can we have free will? Prerequisite: one course in Philosophy at the 100 or 200 level, or permission of the instructor. Priority given to majors in philosophy and PNP. Same as L30 Phil 316
Credit 3 units. A&S IQ: HUM Art: HUM BU: ETH EN: H

L64 PNP 3171 Introduction to Computational Linguistics
Use of computers to analyze, understand, and generate human language. Emphasis on appreciating practical applications such as text analysis, search and creation of dictionaries and corpora, information retrieval, machine translation, and speech interfaces. Survey of rule-based and statistical techniques. Students acquire programming skills appropriate for solving small- to medium-scale problems in linguistics and text processing, using a language such as Python. Students have regular programming assignments and complete a semester project. No previous knowledge of programming required. Prerequisite: L44 Ling 170D. Same as L44 Ling 317
Credit 3 units. A&S IQ: SSC Arch: SSC Art: SSC BU: BA EN: S

L64 PNP 320 Historical and Comparative Linguistics
Historical linguistics focuses on how languages change over time. Comparative linguistics focuses on their similarities and differences. In this course we trace some of the differences and changes in sound (phonetics and phonology), word formation (morphology), sentence structure (syntax), and meaning (semantics). Topics include linguistic universals, the structural and genetic classification of languages, the techniques of reconstructing proto-languages, and the causes of language change. Examples from Indo-European languages (for example, Greek, English, and Spanish) and from Native American languages (for example, Quechua and Mayan) are emphasized. Prerequisite: Ling 170D. Same as L44 Ling 320
Credit 3 units. A&S IQ: LCD, SSC Arch: SSC Art: HUM BU: HUM EN: S

L64 PNP 321 Philosophy of Science
Pivotal concepts common to empirical sciences are examined and clarified. These include: explanation, confirmation, prediction, systematization, empirical significance, and the relationship of all these concepts to the structure of scientific theory. Examples may be drawn from both contemporary and historical science, including the social, biological, and physical sciences. Students with a background in science are particularly encouraged to consider this course. Priority given to majors in philosophy and PNP. Same as L30 Phil 321G
Credit 3 units. A&S IQ: HUM Art: HUM BU: HUM EN: H

L64 PNP 3211 Developmental Psychology
This course concentrates on the cognitive and social development of the person from conception to adolescence. Topics covered include: infant perception, attachment, cognitive development from Piagetian and information processing perspectives, aggression and biological bases of behavior. Prerequisite: Psych 100B.

L64 PNP 3221 Music Cognition
An introduction to modern research on music perception and cognition. The course covers four main topics: the perception of key, the psychoacoustics of dissonance, the relationship between attention and musical meter, and the process by which melodies establish, fulfill, and deny expectations. Students read and discuss research from both cognitive science and music theory, in addition to completing several projects. Same as L27 Music 3221
Credit 3 units. A&S IQ: NSM Arch: NSM Art: NSM BU: BA EN: S

L64 PNP 323 Play and Development
An examination of current research and theory in play, in development and education, from infancy through the early school years. Topics include play and the development of language, social skills, creativity, and cognitive abilities. We will also examine the uses of play in educational contexts, focusing on preschool and the early primary grades. Prerequisite: Psych 321 (Developmental Psychology) or Educ 304 (Educational Psychology). Same as L12 Educ 337
Credit 3 units. A&S IQ: SSC BU: BA EN: S

L64 PNP 330 Sensation and Perception
What's involved in seeing and hearing? This course covers perceptions from the physical stimuli (light and sound) that impinge upon the sensory receptors through the higher-level percepts that the stimuli generate. Demonstrations and illusions are used as we learn about the anatomy and physiology of the sensory systems, and study the brain mechanisms that are involved in vision and audition. Prerequisite: Psych 100B. Same as L33 Psych 330
Credit 3 units. A&S IQ: NSM Arch: NSM Art: NSM BU: BA, SCI

L64 PNP 3401 Biological Psychology
An introduction to biological mechanisms underlying behavior. Topics include the physiology of nerve cells, anatomy of the nervous system, control of sensory and motor activity, arousal and sleep, motivation and higher mental processes. Prerequisite: Psych 100B.
Same as L33 Psych 3401
Credit 3 units. A&S IQ: NSM Arch: NSM Art: NSM BU: BA, SCI

L64 PNP 3411 Principles of the Nervous System
The basic anatomical, physiological, and chemical organization of the nervous system; how nerve cells communicate with each other, the ionic basis of nerve signals, the function and properties of chemical agents in the nervous system, the development of neural circuitry, and how neurons interact to produce behavior. Prerequisite: Biol 2960, Biol 2970 recommended, Biol 3058 recommended or Psych 3401 and permission of instructor.
Same as L41 Biol 3411
Credit 3 units. A&S IQ: NSM Art: NSM BU: SCI

L64 PNP 3451 Genes, Environment, and Human Behavior
This class will examine how genetic influences impact various dimensions of human behavior, ranging from traits (e.g., personality) to psychiatric disorders. Topics to be covered include methods used to study genetic influence, how genetic
L64 PNP 350 Physics of the Brain
Concepts and techniques of physics are applied to study the functioning of neurons and neuronal circuits in the brain. Neurons and neural systems are modeled at two levels: (i) at the physical level, in terms of the electrical and chemical signals that are generated and transmitted and (ii) at the information-processing level, in terms of the computational tasks performed. Specific topics include: neuronal electrophysiology, neural codes, neural plasticity, sensory processing, neural network architectures and learning algorithms, and neural networks as dynamical and statistical systems. Course grade is based primarily on an individualized term project. Prerequisite: Physics 117A-118A, Physics 197-198, or permission of the instructor. Same as L31 Physics 350. Credit 3 units. A&S IQ: SSC Arch: SSC Art: SSC BU: SCI EN: S

L64 PNP 3531 Psychology of Personality
Review of basic theoretical orientations to the understanding of personality and complex human behavior. Overview of related techniques, procedures, and findings of personality assessment and personality research. Discussion of critical issues in evaluation of personality theories. Prerequisite: Psych 100B. Same as L33 Psych 353. Credit 3 units. A&S IQ: NSM Art: NSM BU: SCI EN: SU, TU

L64 PNP 3541 Abnormal Psychology
This is an introductory course in psychopathology or the scientific study of mental health disorders. The course includes definitions, theories and classification of abnormal behavior. Content focuses on symptoms, classification, prevalence, etiology, and treatment of mental health disorders, including mood, anxiety, eating, schizophrenia spectrum, substance use and personality disorders. Prerequisite: Psych 100B. Same as L33 Psych 354. Credit 3 units. A&S IQ: SSC Arch: SSC Art: SSC BU: BA EN: S

L64 PNP 355 Physics of Vision
How do the eyes capture an image and convert it to neural messages that ultimately result in visual experience? This lecture and demonstration course covers the physics of how we see. The course is addressed to physics, pre-medical, and life-sciences students with an interest in biophysics. Topics include physical properties of light, evolution of the eyes, image formation in the eye, image sampling with an array of photoreceptors, transducing light into electrical signals, color coding, retinal organization, computing with nerve cells, compressing the 3-D world into optic nerve signals, inferring the 3-D world from optic nerve signals, biomechanics of eye movement, engineered vision in machines. The functional impact of biophysical mechanisms for visual experience are illustrated with psychophysical demonstrations. Corequisite: Physics 117A, Physics 197 or permission of instructor.

L64 PNP 3551 Conceptual Foundations of Modern Science
The aim of this course is to present some of the basic concepts underlying modern science. Insofar as many of those concepts first appeared or became predominant in the seventeenth and early eighteenth centuries, the course concentrates on primary works from that period. Among the concepts to be studied are: 1. Nature and natures: the ontology of matter and force; causal closure. 2. Methods: observing and intervening, systematic and organized. 3. Explanations: appeal to laws and mechanisms; teleology. Prerequisite: one course in Philosophy at the 100 or 200 level, or permission of the instructor. Priority given to majors in philosophy and PNP. Same as L30 Phil 358. Credit 3 units. A&S IQ: HUM BU: HUM EN: H

L64 PNP 360 Cognitive Psychology
Introduction to the study of thought processing from an information-processing approach. Emphasis on theoretical models grounded in empirical support. Topics include pattern recognition, attention, memory, reasoning, language processes, decision-making and problem-solving. Prerequisite: Psych 100B. Same as L33 Psych 360. Credit 3 units. A&S IQ: NSM Art: NSM BU: BA

L64 PNP 361 Psychology of Learning
Basic learning processes in animals, such as conditioning, reinforcement, punishment, and constraints on learning. Comparisons and interactions between classical and operant conditioning. Consideration given to learning theorists and theories, along with applications from the laboratory to the "real world." Prerequisite: Psych 100B. Same as L33 Psych 361. Credit 3 units. A&S IQ: NSM Art: NSM BU: SCI

L64 PNP 362 The Biological Basis of Human Behavior
Infidelity, marriage customs, inner city violence, infanticide, intelligence...Are the behavioral patterns we see genetically fixed and racially variable? What is the evolutionary and biological basis of human behavior? This course offers a critical evaluation of these from an anthropological perspective. Same as L48 Anthro 362. Credit 3 units. A&S IQ: LCD, NSM, SD Arch: NSM Art: NSM BU: BA

L64 PNP 366 Art and the Mind-Brain
In recent years, there has been a growing interest in the bearing of cognitive science on the perception and understanding of art. This interest has roots in tradition: Historically, art, aesthetics, and vision science have often been linked. But the growth of knowledge in cognitive science has opened up new opportunities for understanding art and addressing philosophical questions. The converse is also true. The production, perception and understanding of art are human capacities that can shed light on the workings of the mind and brain. This course considers questions such as: What is art? How do pictures represent? Does art express emotion? Why does art have a history? Prerequisite: one course in Philosophy at the 100 or 200 level, or permission of the instructor. Priority given to majors in philosophy and PNP. Same as L30 Phil 366.
L64 PNP 3661 Psychology of Creativity
This course is an introduction to the psychological study of art and creativity. Our topics include the artist, the audience, the artistic product, the creative process, and social, cultural, and institutional influences on the creative process. We will explore these issues by considering a range of creative fields, including painting, literature, music and theater performance. Throughout the semester, we will take a developmental perspective on psychology and art. How do children learn to create, perceive and understand different art forms? What role can the arts play in education? To ground our study of the psychology of art, we will explore what “art” is, which members of society are labeled “artists,” and how these categories are socially and culturally defined. Prerequisites: Educ 304 Educational Psychology or Psych 325 Adolescent Psychology or Psych 321 Developmental Psychology.
Same as L12 Educ 366
Credit 3 units. A&S IQ: SSC BU: BA

L64 PNP 3662 Primate Biology
This course takes a multifaceted introductory approach to the primates, the closest relatives of human beings, by investigating anatomy, growth and development, reproduction, behavioral adaptations, ecology, geographic distribution, taxonomy and evolution. Emphasis is placed not only on the apes and monkeys, but also on the lesser-known lemurs, lorises, bushbabies, tarsiers and many others. The importance of primate biology to the discipline of anthropology is discussed. Intended for students who have already taken Anthro 150A, and recommended for students who wish to take the more advanced 400-level courses on primates. Prerequisite: Anthro 150A or permission of instructor. Same as L48 Anthro 3661
Credit 3 units. A&S IQ: NSM Art: NSM BU: SCI

L64 PNP 3701 Introduction to Hispanic Linguistics
An introduction to the scientific study of the Spanish language, this course focuses on each of the major linguistic subsystems, including the sound system (phonetics and phonology), word formation (morphology), formation of phrases and sentences (syntax), and the use of the language to convey meaning (semantics and pragmatics). At each level of analysis, selected comparisons are made between Spanish and English and between Spanish and other languages. The course also examines different historical, regional and social varieties of Spanish and situations of Spanish in contact with other languages. Same as L38 Span 370
Credit 3 units. A&S IQ: LCD BU: HUM EN: H

L64 PNP 380 Human Learning and Memory
A survey of issues related to the encoding, storage and retrieval of information in humans. Topics include memory improvement strategies, people with extraordinary memories, memory illusions and distortions, among other topics. Limited to 25 students. Prerequisite: Psych 100B. Same as L33 Psych 380
Credit 3 units. A&S IQ: NSM Art: NSM BU: BA

L64 PNP 390 PNP Reading Class
Each time this course is offered a book is selected that does an exemplary job of bringing together insights and results from multiple disciplines in targeting an important topic. We read and discuss the book and possibly a small amount of supplementary reading. A short presentation and paper are required. Prerequisite: PNP major standing.
Credit 2 units. A&S IQ: HUM BU: HUM EN: S

L64 PNP 396 Linguistics Seminar: Pragmatics in Second Language Learning
Readings on a selected topic in theoretical linguistics with an emphasis on discussion, presentation and writing. Prerequisite: varies with topic. Same as L44 Ling 396
Credit 3 units. A&S IQ: SSC EN: S

L64 PNP 402 The Physiology and Biophysics of Consciousness
This course will explore the questions surrounding the search to understand the biophysical substrate of consciousness. Some areas to be explored: 1. Can consciousness be addressed like any other biological property in the sense that it has evolved by natural selection and that some elements of it are present in simple model systems, such as the fruit fly? Can insight be gained studying simple model systems? 2. Where in the brain is consciousness? What is the pattern of neurological events that occurs during consciousness? Is brain activity generating consciousness localized or distributed? Does it involve interacting brain regions? Does brain activity generating consciousness migrate to different brain regions? 3. How does the dynamic core hypothesis of Edelman relate to these questions? What can functional brain imaging add to these questions? Are Gamma waves involved in higher mental activity, and do they promote synchronized firing of neurons from different brain areas? How does this relate to the binding problem? 4. How does the brain’s ability to function as a computer relate to consciousness? In many respects the brain functions as a computer using electrical signals called Action Potentials. Action potentials in neuronal networks function in an analogous was as DC electrical impulses function in computer circuits. What is the output of computation in an electrical device? What are the theoretical limitations regarding what computation can achieve and ask whether electrical activity in the brain also has a fundamentally different purpose in addition to computation. 5. Is our knowledge of the physical world too primitive and incomplete to understand consciousness? The brain is an electronic device and consciousness clearly depends on its electrical activity. Yet, electrical forces are poorly understood, both in the context of classical physics and quantum physics. Will understanding consciousness help us understand consciousness? In many respects the brain and consciousness have to wait for a unified theory that more accurately describes electrical forces? Taught in the medical school: McDonnell Science Building 983. Prerequisites: Bio3411 or equivalent. College-level physics, some knowledge of computers.
Credit 2 units. A&S IQ: NSM

L64 PNP 404 Laboratory of Neurophysiology
Neurophysiology is the study of living neurons. Students record electrical activity of cells to learn principles of the nervous system including sensory transduction and coding, intercellular communication and motor control. The course meets for 9 hours each week. Students may leave the lab for up to 2 hours. Prerequisites: Biol 3411 or Psych 4411 and permission of
Possible topics include such concepts as substance, category, cause, identity, reality and possibility, and such positions as metaphysical realism, idealism, materialism, relativism and irrealism. Prerequisites: one course in Philosophy at the 300 level, graduate standing, or permission of the instructor.
Same as L30 Phil 4142
Credit 3 units. A&S IQ: HUM Art: HUM EN: H

L64 PNP 418 Current Controversies in Cognitive Science
An advanced survey of current debates in cognitive science with an emphasis on the philosophical issues raised by these debates. Topics may include: evolutionary psychology; innateness and neural plasticity; perception and action; consciousness; connectionism; robotics; embodied cognition; moral reason; emergence and artificial life; concepts and content; animal cognition. Prerequisites: one course in Philosophy at the 300 level, graduate standing, or permission of the instructor.
Credit 3 units. A&S IQ: HUM EN: H

L64 PNP 419 Philosophy of Psychology
An investigation of the philosophical presuppositions and implications of various traditions in psychology, including behaviorism, Gestalt and cognitivism, with a special emphasis on the development of the information processing approach of contemporary cognitivism. The conception of psychological phenomena, data and explanation central to each of these traditions are examined, and typical topics include the debates between propositional and imagistic models of representation, different accounts of concepts and categorization, and the relation of psychology to ethics. Prerequisite: one previous course in Philosophy at the 300 level, graduate standing, or permission of the instructor.
Same as L30 Phil 419
Credit 3 units. A&S IQ: HUM Art: HUM

L64 PNP 4190 Primate Behavior
Discussion and analysis of recent research on the social behavior of nonhuman primates. Data from both field and laboratory study. Prerequisite: Anthro 406, or permission of instructor.
Same as L48 Anthro 419
Credit 3 units. A&S IQ: NSM Art: NSM

L64 PNP 4192 Primate Cognition
This course investigates historical and current views regarding the cognitive capacities of nonhuman primates, and the extent to which these abilities are shared with humans. Topics for this class include: social cognition, problem-solving, tool use, culture, communication, theory of mind, deception, self-recognition, imitation, and numerical cognition. The classes involve discussion and critical evaluation of theory and methods in this challenging and exciting area of primate cognitive research.
Same as L48 Anthro 4191
Credit 3 units. A&S IQ: NSM Art: NSM

L64 PNP 4210 Topics in Advanced Philosophy of Science: Scientific Explanation
This course will vary in topics related to Philosophy of Science from semester to semester. Prerequisites: one course in Philosophy at the 300-level, graduate standing, or permission of the instructor.

L64 PNP 426 Theories of Concepts
Concepts are the building blocks of thought. They are implicated in just about every cognitive task. Beyond that, there is little consensus. What information do concepts encode? How are they acquired? How are they combined to form thoughts? How are they related to perception and imagery? Each of these questions has been answered in numerous ways. In this course, we will explore competing theories of concepts that have been proposed by philosophers, psychologists, and other cognitive scientists. No prior acquaintance with these issues is required. Prerequisites: one previous course in Philosophy at the 300 level, graduate standing, or permission of the instructor. Same as L30 Phil 426
Credit 3 units. A&S IQ: HUM Art: HUM

L64 PNP 4302 Cognitive Psychology Applied to Education
This course is intended to cover topics in the cognitive psychology of human memory, conceptual learning and comprehension with special focus on areas, theory and research that have potential application to education. Thus, the course provides selective coverage of theoretical and empirical work in cognitive psychology that provides potential to inform and improve educational practice. The applicability of these themes is explicitly developed and evaluated through the primary research literature using educationally oriented experimental paradigms. The course is of interest and benefit to education majors and to psychology majors interested in cognitive psychology and its applications. Prerequisites: junior/senior status, 9 units in psychology and Psych 100B or junior/senior status, 9 units in education and Psych 100B.
Same as L33 Psych 4302
Credit 3 units. A&S IQ: SSC

L64 PNP 4315 Culture, Language and the Education of Black Students
This course examines the communicative patterns of what is called variously African-American language, Pan-African linguistic systems and Ebonics within the context of public school policy and practice. In addition to a review of the structural and pragmatic aspects of black speech, the course highlights relationships between controversies within the linguistic community, contrasting views of speech within black lay communities, public discourse, and educational policy. Students also conduct a field-based research project in accord with their particular interests.
Same as L12 Educ 4315
Credit 3 units. A&S IQ: LCD, SSC Art: SSC

L64 PNP 4322 Cognition and Computation
This course introduces students to some of the key frameworks for thinking about the mind in computational terms. We look at some basic topics in the theory of computation, in addition to considering philosophical issues raised by computational models of cognitive processes. This course is required for graduate students in the PNP PhD program. Prerequisites: at least two 400-level PNP courses cross-listed in Philosophy.
Credit 3 units. A&S IQ: SSC

L64 PNP 4450 Functional Neuroimaging Methods
This course is intended for students wishing to become sophisticated producers or consumers of functional neuroimaging data. Emphasis will be on extracting the most information from neuroimaging techniques toward the goal of answering psychologically motivated questions. A number of issues relating to neuroimaging methodology will be covered, including technical principles, acquisition options, potential sources of artifact, experimental design, software tools, and analytical techniques. Class approach will be hands-on, with students gaining experience in actually acquiring and working with neuroimaging data. Prerequisites: Permission of instructor required.
Same as L33 Psych 4450
Credit 3 units. A&S IQ: SSC Art: SSC

L64 PNP 4488 The Cognitive Neuroscience of Film
To understand complex events in real life depends on perception, action and memory. To understand movies, people probably depend on similar psychological and neural mechanisms. This seminar uses results from psychology and neuroscience to try to better understand the experience of a movie viewer, and uses theory and practice to explore psychological hypotheses about perception. Prerequisite: Psych 360 or Psych 3604, or Psych 4604, or graduate standing in psychology.
Same as L33 Psych 488
Credit 3 units. A&S IQ: NSM

L64 PNP 4466 Second Language Acquisition
There are many ways in which a second language can be learned: from infancy as the child of bilingual parents, or later through formal instruction, immersion in a new culture, or in a particular work or social situation. This class is an inquiry into the processes by which acquisition occurs. Topics include the nature of language learning within the scope of other types of human learning; the relationship between first- and second-language acquisition; the role of linguistic, cognitive and sociocultural factors; insights gained from analyzing learners' errors; key concepts such as interlanguage and communicative competence; bilingualism; the optimal age for second-language acquisition; and a critical appraisal of different theories of second-language acquisition. Both theoretical and instructional implications of second-language acquisition research are considered. This course can be used toward certification in TESOL and is a required course for the Graduate Certificate in Language Instruction. Prerequisite: Ling 170D or equivalent is recommended, especially for undergraduates, but is not required.
Same as L44 Ling 466
Credit 3 units. A&S IQ: HUM

L64 PNP 4477 Grammar and Vocabulary Acquisition
This course examines theoretical and instructional implications of research on grammar and vocabulary acquisition. Topics include making form-meaning connections during language learning; developmental stages; the role of input and input processing; explicit and implicit methods of grammar instruction; pertinent factors in vocabulary acquisition, such as a learning context and processing resource allocation; and comparisons of incidental and direct vocabulary instruction techniques. Major theories of language acquisition (e.g., nativism, emergentism) are critically examined in light of the research presented, and research findings are applied to instructional practices.
L64 PNP 4691 Second Language Reading and Writing: Theory, Research and Practice
This course, taught in English, extends issues in second language literacy beyond pedagogy by examining the wide range of theoretical and research issues, both historical and current. Literacy acquisition among second language learners involves a number of variables including both cognitive and social factors. Topics discussed in class include literacy and social power, universal cognitive operations, individual learner differences, text types and literary forms, and the extent to which reading and writing are interrelated. Students discuss how to bridge research and practice, and they create reading and writing activities driven by theory and empirical investigations. This course is a required course for the undergraduate minor in applied linguistics and an elective for the Graduate Certificate in Language Instruction.
Same as L38 Span 4691
Credit 3 units.
A&S IQ: LCD BU: BA EN: H

L64 PNP 494 Behavioral Psychology Readings Group
This weekly journal-style readings class provides the opportunity to read and discuss seminal as well as current papers on the conceptual aspects of behavioral psychology and relevant research. Points of contact among behaviorism, cognitivism and neuroscience, and the natural lines of fracture, are examined. Prerequisite: permission of instructor.
Same as L33 Psych 494
Credit 1 unit.
A&S IQ: SSC EN: S

L64 PNP 495 PNP Seminar
Subject varies per semester. Not always offered as writing-intensive, refer to individual semester listing. Prerequisites: a 300-level philosophy course (Phil/PNP 315 is recommended) and PNP major standing or approval of instructor.
Credit 3 units.
A&S IQ: SSC Arch: SSC Art: SSC EN: S

L64 PNP 495W PNP Seminar: Writing Intensive
Subject varies per semester. Fulfills Writing Intensive (WI) requirement. Prerequisites: a 300-level philosophy course (Phil/PNP 315 is recommended); and PNP major standing or approval of instructor.
Credit 3 units.
A&S IQ: SSC, WI EN: S

L64 PNP 496 PNP Seminar: Rethinking Psychological Kinds
Subject varies each semester. Prerequisite: a 300-level Philosophy course (Phil/PNP 315 is recommended); and PNP Major standing or approval of instructor.
Credit 3 units.
A&S IQ: SSC Arch: SSC Art: SSC EN: S

L64 PNP 499 Study for Honors
Prerequisites: Visit the PNP Honors webpage (http://pnp.artsci.wustl.edu/undergraduate/honors/prerequisites).
Credit 3 units.
EN: S