

***Meaning and Numbering (01:185:3??)***  
<https://rutgers.instructure.com/courses/????>

Fall 2018, Prof. Pietroski

Time TBA, Place TBA

**Contact Information**

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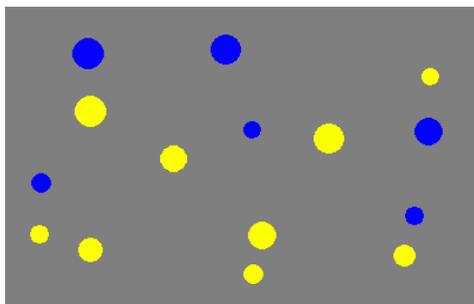
*Any announcements about the class will be made via the course website.*

**Course Description (short version)**

*Prerequisite:* Introduction to Cognitive Science (01:185:201)

This course will illustrate some central issues in cognitive science—and strategies for addressing questions about the contributions of innate endowment and individual experience (a.k.a., Nature and Nurture) to mature cognition—via discussion and comparison of two important case studies: the human capacity to understand linguistic expressions, and the apparently more widespread capacity to make numerical comparisons. The goals are for students to achieve (300-level) mastery of some literature and current research that exemplifies the relevant fields, in a way that stresses understanding the large questions which animate the detailed work, while also preparing students for more advanced courses and participation in research projects within cognitive science. This allows for many syllabi. The course described below could be offered immediately.

**Course Description (longer version)**

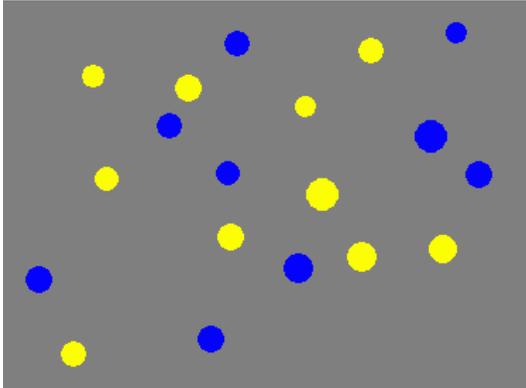


**HOW MANY OF THE DOTS ARE YELLOW?**

You understand the question. You know how to get the answer. Upon reflection, that's amazing.

Think about what it takes to *understand* the question. You need to know what the words *mean*, and how those words can be *combined* to form an *interrogative* sentence, which differs from any corresponding *declarative* sentence like 'Many of the dots are yellow' or 'Nine dots are yellow'. You also need to know that while there are many possible answers to a 'How many' question—'nine', 'forty nine', 'millions', etc.—you can't answer such a question with 'Yes' or 'No'. By contrast, 'Are most of the dots yellow' seems intimately related to 'Most of the dots are yellow'. And notice: this declarative sentence seems *obviously correct*, even if you *don't count* any dots. But how can we "just tell" that most of the dots are yellow, simply by looking, if counting is required to know that there are nine yellows and six blues? How can we know "roughly" how many yellow dots there are, and that there are *fewer* blue dots, without counting?

Can *children* tell that there are *more* yellow dots, in the picture above, even if they can't count? What about other animals? And why do pictures like the one below seem importantly different?



HOW MANY OF THE DOTS ARE YELLOW?

ARE MOST OF THE DOTS YELLOW?

Here, the answer to the “Are most...” question is not so obvious. You can feel that you’ll have to *resort* to counting, as with the “How many...” question. Why? And why does counting, which isn’t especially difficult, feel like work you’d rather not do? Answers raise further questions.

In the course, we’ll focus on a cluster of issues related to understanding and counting—meanings and numbers, and more broadly, language and math—with the aim of addressing large issues in cognitive science via more specific questions concerning linguistic and numerical knowledge.

There is a long tradition, going back at least to Plato, of philosophers thinking about

- (i) how various kinds of *knowledge* are related to kinds of *experience*,
- (ii) how various aspects of *human* cognition—including those that underpin linguistic and mathematical knowledge—*emerge developmentally*, as children grow and learn, and
- (iii) how the capacities required for such cognition might have *emerged historically*.

Starting in the 1950s, Chomsky and many others connected this ancient project with new insights regarding the spoken/signed languages that human children can naturally acquire. While it’s obvious that both experience and human nature are relevant to acquiring English, it’s very hard to specify the relevant aspects of English (as opposed to, say, Japanese) experience or human (as opposed to, say, orangutan) nature. But one can make progress by trying to specify what speakers know about sentences—including unexpected but comprehensible interrogatives like ‘Was the hiker who lost found a cabin’—and asking how much of this knowledge is plausibly due to learning from experience, and then conducting experiments to test specific hypotheses.

With regard to the “number sense” that lets many animals make numerical estimates and comparisons, we can ask related questions about the relative contributions of innate endowment and idiosyncratic experience, how much variation there is across and within species, and how this evolutionarily ancient capacity interacts with human capacities to understand words. In the final part of the course, we’ll look at some recent research that builds on older work, in order to ask how linguistic and numerical knowledge develop and interact as children grow and learn.

## Required Reading (many options out there for used copies or e-versions of the books)

—a series of articles/essays that will be made available via the course website (see below)

—*The Number Sense*, by Stanislas Dehaene

—selected chapters from *The Origin of Human Concepts*, by Susan Carey

Recommended: all of *The Origin of Human Concepts* (e-versions can be really inexpensive)

## Course Requirements and Grading

(a) responses to weekly topics, worth 40% of your grade.

You must do *four* of these: *one* in each of the three units of the course;

*and* a “describe an experiment” project, to be presented during the last two weeks

(b) a take-home mid-term exam, worth 20% of your final grade.

(c) a comprehensive final exam, emphasizing material from the second half of the course, worth 30% of your final grade. The exam will be open-note, and it will be straightforward for those who have done the readings and attended classes.

(d) a revised version of your mid-term exam *or* one of your responses to a weekly topic, worth 10% of your final grade, to be submitted before the last class.

(e) attendance and class participation, while not obligatory, can help your final grade as “extra credit” (one or two points).

Regarding the weekly topics: after the first two class meetings, and until week 12,

I will provide an essay topic each week. These will be based on the current assigned readings.

(You can also view them as indications of what I might ask about on the exams.)

Each of these will call for a largely expository 2-page essay (double spaced).

These essays will be due a week later, at the start of class. ***No late essays will be accepted.***

The final assignment, which will be discussed in class (shortly after mid-term), will be to describe a proposed experiment that follows up on an issue raised by some of the experimental work we’ll be reading and discussing. There will be class presentations of these proposals in the last two weeks, perhaps in teams, depending on enrollment and what projects people want to pursue. Each student will submit (and be graded on) their own written version of a proposed experiment. But collaboration at the thinking stage is strongly encouraged; and each member of a team can, of course, describe the same experimental design.

## Other Links and Information

Rutgers has a detailed policy on Academic Integrity and Code of Student Conduct:

<http://academicintegrity.rutgers.edu/academic-integrity-at-rutgers>

Please familiarize yourself with this policy. If you have any questions about what counts as plagiarism (cheating, etc.), talk with before submitting work for grading.

We'll talk explicitly in class about some of the things that are OK, and some that are not-OK, in the context of discussing experimental design and jointly authored work.

Cognitive Science Club:

<http://ruccs.rutgers.edu/ruccs/index.php/opportunities/cogsci-club>

### *Student-Wellness Services*

Just In Case Web App: <http://codu.co/cee05e>

Access helpful mental health information and resources for yourself or a friend in a mental health crisis on your smartphone or tablet and easily contact CAPS or RUPD.

Counseling, ADAP & Psychiatric Services (CAPS) (848) 932-7884

17 Senior Street, New Brunswick, NJ 08901

<http://www.rhscaps.rutgers.edu>

CAPS is a University mental health support service that includes counseling, alcohol and other drug assistance, and psychiatric services staffed by a team of professional within Rutgers Health services to support students efforts to succeed at Rutgers.

Violence Prevention & Victim Assistance (VPVA) (848) 932-1181

3 Bartlett Street, New Brunswick, NJ 08901

<http://www.vpva.rutgers.edu>

The Office for Violence Prevention and Victim Assistance provides confidential crisis intervention, counseling and advocacy for victims of sexual and relationship violence and stalking to students, staff and faculty.

Disability Services (848) 445-6800

<https://ods.rutgers.edu>

Rutgers welcomes students with disabilities into all of the educational programs. In order to receive consideration for reasonable accommodations, a student with a disability must contact the office, participate in an intake interview, and provide documentation:

<https://ods.rutgers.edu/students/documentation-guidelines>

Scarlet Listeners (732) 247-5555

<http://www.scarletlisteners.com>

Free and confidential peer counseling and referral hotline, providing a comforting and supportive safe space.

## ***Tentative Class Schedule (by week, assuming 2 classes per week)***

1a: Introduction	[after class, look at the short excerpts from Halberda <i>et.al.</i> and Baker]
1b: A very old “Poverty of Stimulus” argument	[Plato]
2a: Plato, Pythagorus, and Proofs	
2b: Chomsky, Children, and Constraints	[Chomsky]
3a: Aux-inversion and a different “Poverty of Stimulus” argument	
3b: a little more Poverty	[Berwick <i>et.al.</i> ]
4a: Knowledge of Meanings and Psychological Experiments, Round One	
4b: Knowledge of Meanings and Psychological Experiments, Round Two	[Crain <i>et.al.</i> ]
5a: Patterns across the Patterns and another “Poverty of Stimulus” argument	
5b: <i>Catch up and review the first unit of the course</i>	[Hornstein]
6a: The Number Sense, easy observations	[first half of Dehaene]
6b: The Number Sense, review of some experiments	
7a: The Number Sense, humans and other animals	[second half of Dehaene]
7b: The Number Sense, humans and words	
8a: Core Knowledge and Development	[selected chapters from Carey, <i>exact pages TBA</i> ]
8b: Stages of Numerical Competence	
9a: Counting vs. Counting Things	[additional excerpts from Carey]
9b: Counting vs. Estimating, <i>catch up and review the second unit of the course</i>	<i>exact pages TBA</i>
10a: Meanings and Logical Forms	[Pietroski]
10b: Logical Forms and Numbers	
11a: Meanings, Logical Forms, and an initial experiment	[Lidz <i>et.al.</i> ]
11b: Logical Forms, Numbers, and another experiment	
12a: Much, many, more, and most	[Rothstein]
12b: Count Nouns, Mass Nouns...more experiments, and more work to do	[Odic <i>et.al.</i> ]
Weeks 13 and 14: catch up; presentations of student proposals; as time permits, a few Speculations about Natural History; review for exam	[Berwick & Chomsky]

### **Articles/Essays: available via the course website**

First page of Halberda *et. al.*, “Individual differences in non-verbal number acuity correlate with maths achievement,” *Nature* (Letters) 2 October 2008, pp. 665-69.

Excerpt from the first chapter of Baker, *The Atoms of Language*

Plato, “Meno”

Chomsky, chapter one of *Knowledge of Language*

Berwick *et. al.*, introduction and first two sections of “Poverty of Stimulus Revisited,”  
*Cognitive Science* 35: 1207-42 (2011).

Crain *et. al.* “Language acquisition in the absence of experience,” *Behavioral and Brain Sciences*; “The Language Faculty” in *The Handbook of Philosophy of Cognitive Science*; excerpts from chapters in *The Emergence of Meaning*.

Hornstein, “Empiricism and Rationalism as Research Strategies,”  
in *The Cambridge Companion to Chomsky*

Pietroski, first half of “Logical Form” in the *Stanford Encyclopedia of Philosophy*

Lidz, *et. al.* “Interface Transparency and the Psychosemantics of Most”  
*Natural Language Semantics* 19: 227-56 (2011).

Rothstein, excerpts from *Semantics for Counting and Measuring*

Odic, *et. al.*...a paper accepted for publication (in *Glossa*) but not yet in press

Berwick and Chomsky, excerpts from *Why Us?*

### **Supplementary reading: available via the course website**

excerpts from Lasnik, *Syntactic Structures Revisited*

excerpts from a review essay by Lasersohn and an article by Chierchia on the mass/count distinction

excerpts from a pair of articles by Benacerraf on counting and knowledge of numbers