

Meaning and Numbering (01:185:330)

Spring 2022, Prof. Pietroski

MW 3:50 PM - 5:10 PM, Scott 203

Canvas Site: <https://rutgers.instructure.com/courses/Number TBA>

Tentative Syllabus: topic will stay the same, specific readings may be slightly modified

Contact Information

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My office address: 528 Gateway Building (5th floor), 106 Somerset St.

Office Hours: TBA, but tentatively...Mondays 12:30-1:30, Wednesdays 11-12, or by appt.

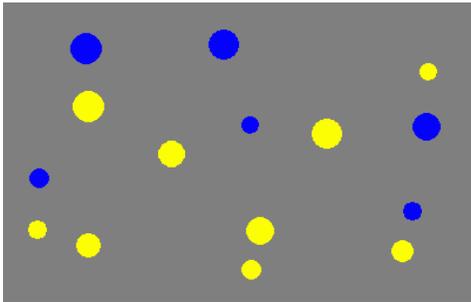
Any announcements about the class will be made via the course website.

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.

Course Description (longer version)



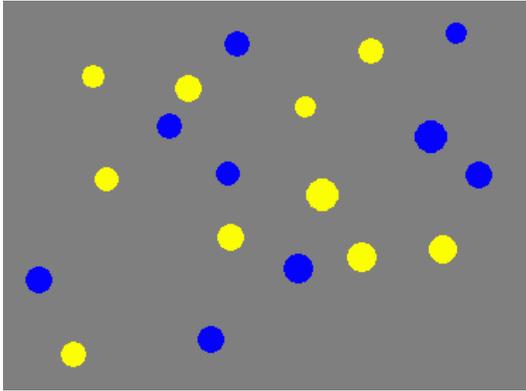
HOW MANY OF THE DOTS ARE YELLOW?

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)
- selected chapters from *The Origin of Human Concepts*, by Susan Carey (via website)
- The Number Sense*, by Stanislas Dehaene

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

Course Requirements and Grading

- (a) *three* responses to weekly topics, worth 30% of your grade.
 - You may rewrite *one* of your essays, in light of comments, and submit the rewrite (along with the original version) *before* the last class for a revised grade.
 - You must submit your first essay by Feb. 21 and your second essay by April 4.
- (b) a “describe an experiment” project, worth 10% of your final grade, due in the last week.
- (c) a *take-home* mid-term exam, distributed March 9th, worth 25% of your final grade.
- (d) a comprehensive final exam, emphasizing material from the second half of the course, worth 35% 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.
- (e) regular attendance and class participation can help your final grade as “extra credit” (one or two points).

Regarding (a), starting January 31st and ending on April 25th,

I will provide an essay topic each Monday (except for the Monday before Spring Break). 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.

Papers submitted late will be penalized one grade (e.g., ‘B’ to ‘C’) per day.

But you have a lot of flexibility about which weeks to do your writing.

Regarding (b), the task—which will be discussed in class—is to describe a proposed experiment that follows up on an issue raised by some of the experimental work we’ll be reading and discussing. 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 describe the same basic 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.

Class Schedule [Assigned reading for each week is indicated by author name; see the Canvas site]

Jan 19: Introduction	[Halberda, Baker]
Jan 24, 26: A very old “Poverty of Stimulus” argument	[Plato]
Jan 31, Feb 2: Chomsky, Constraints, and Competence	[Chomsky, Lasnik]
Feb 7, 9: Aux-inversion and a different “Poverty of Stimulus” argument	[Berwick <i>et.al.</i>]
Feb 14, 16: Knowledge of Meanings and some Psychological Experiments	[Crain <i>et.al.</i>]
Feb 21, 23: <i>The Number Sense</i> , easy observations and Weber’s Law	[Dehaene,
Feb 28, Mar 2: <i>The Number Sense</i> , rats and competences	<i>intro & ch. 1</i>]
March 7, 9: <i>The Number Sense</i> , babies	[Dehaene <i>ch. 2</i>]
Spring Break	
March 21, 24: <i>The Number Sense</i> , adults and the “number line”	[Dehaene <i>ch. 3</i>]
March 28, 30: <i>The Number Sense</i> , highlights from Part Two and Chapter 10	[Dehaene <i>ch. 10</i>]
April 4, 6: Core Knowledge and Development	[Carey <i>ch. 4</i>]
April 11, 13: Stages of Numerical Competence	[Carey <i>ch. 8</i>]
April 18, 20: Meanings, Logical Forms, and some experiments	[Lidz <i>et.al.</i>]
April 25, 27: Count Nouns, Mass Nouns...more experiments, and more work to do	[Odic <i>et.al.</i>]
May 2: wrap up, and review for exam	

Articles/Essays: available via the Canvas 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* and excerpts from *Syntactic Structures*
- Lasnik, and excerpt from *Syntactic Structures Revisited*
- 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*.
- Lidz, et. al. “Interface Transparency and the Psychosemantics of Most” *Natural Language Semantics* 19: 227-56 (2011).
- Odic, et. al. “Individuals and Non-Individuals in Cognition and Semantics: the Mass/Count Distinction and Quantity Representation.” *Glossa* 3:1-20 (2018).