

PSYC3363.01 FALL 2018
BOSTON COLLEGE, DEPARTMENT OF PSYCHOLOGY
LANGUAGE ACQUISITION & DEVELOPMENT

Overview: Children have an instinct for language. Every typically-developing child learns language – something neither our most powerful machines or smartest non-human animals can do. Even adults do not learn language as quickly or successfully as children. If not exposed to a language, children will invent one. In this course, we try to understand how children learn language, why animals, machines, and adults have so much difficulty learning language, and what the answers to these questions say about what it means to be human. After completing this course, you will be able to:

- Explain the major scientific and philosophical quandaries about language
- Summarize models and theories of language development
- Understand how empirical data support or reject hypotheses about mechanisms supporting development.
- Contrast language acquisition in humans versus nonhuman primates.

Much of the learning will take place in the lab. By the end of the course, you should have acquired the following technical skills:

- Be proficient in basic statistical analyses in R.
- Be comfortable using version control with Git.
- Understand how to design, conduct, and analyze a statistical learning experiment

Course Format: This is a “flipped” classroom. There are no lectures. The first hour of every meeting will be devoted to discussion. The second hour will be devoted to lab work. You should come prepared to ask questions about the readings and videos during the first hour and prepared to work on the lab assignments during the second hour.

For the lab assignments, you will need a laptop. ***If you do not have a laptop, please email the instructor immediately so that a loaner can be arranged.***

Course text: All readings and videos are free and available through the course website. If you feel that a textbook would be helpful, many of my colleagues use *The Development of Language* by Jean Berko Gleason & Nan Bernstein. A much cheaper (and more fun) alternative is *The Language Instinct* by Steven Pinker. While older than any of you, it still remains one of the best overviews of language available.

Grades: Exams (25%), discussion questions (25%), problem sets (25%), and lab reports (25%).

Exams. There will be three non-cumulative exams. The first will cover the first two units (“Introduction” and “What is language?”). The second will cover the third and fourth units (“The Language Instinct” and “Development”). The final exam will cover the remainder of the course.

Discussion Questions. For each class (except the 1st) you will submit a question about the readings and videos through Canvas. The questions will be graded out of two: where one point is earned for turning it in, an additional point is earned for good questions

(An example of a question: What is language? An example of a good question: Monkey alarm calls communicate information from one monkey to another, but we don’t count that as language. On the other hand, we often talk about the language of math or the language of music, neither of which seem all that language-y to me. So what is the definition of language? The second question is more specific, making it easier to address. It also highlights the facts that the questioner is considering, helping the answerer know what kind of additional information might be relevant, and allowing the answerer to correct misconceptions [if any]),

and a third (extra!) point is earned if really like the question and/or use that question in class.

Problem Sets. The first 2/3 of the labs are organized around problem sets, with one due each week. Some of these must be done in small groups. You may wish to do the others in groups as well.

Written lab reports. You will be conducting (at least) two experiments. The first one will be conducted as a class, though you must write your own report. You will work on the second one in small groups.

Additional Resources for Programming and Statistics

Many of you will have limited experience with programming or statistics. That is expected. A major goal of this course is to get you started on these really, really useful abilities. You will have plenty of opportunity for direct coaching from the instructor and TAs. If you feel like you would benefit from some additional assistance, here are a few suggestions:

- [The Quick-R website \(https://www.statmethods.net/\)](https://www.statmethods.net/) provides many useful tutorials on statistics and R. While easy to read and understand, it is actually very comprehensive (I often use it myself!).
- Field, A., Miles, J., & Field, Z. (2012). *Discovering statistics using R*. London: Sage.
- DataCamp.com – which we will be using extensively in this class – has many different
- programming modules. You may find it useful to try some of the others.

Policy information:

- **Make-up exams.** Make-up exams will only be allowed for university-mandated and officially verified reasons. If an absence can be anticipated, you must take the make-up exam prior to the scheduled date. To schedule a make-up exam, you will need to inform me at least a week in advance of your absence. If you miss an exam because of an excused event that was unforeseeable (e.g., illness or a death in your family), you must notify me as soon as possible and no later than the start of the exam itself. You will need to furnish documentary support upon your return and take the exam as soon as you return to the university. Make up exams will not be allowed for other absences.
- **Regrade.** If you are unhappy with the grading of your exam or data exercise, you can request a regrade of the entire document but not of a particular section. Additional points may be added or deducted during this regrade.
- **Academic dishonesty.** Cheating on academic work will not be tolerated in any form, and will be subject to strong penalties in this class and the university system. When in doubt, listen to your conscience ...and the instructor. I am happy to answer your questions. See also the [university policy \(https://www.bc.edu/offices/stserv/academic/integrity.html\)](https://www.bc.edu/offices/stserv/academic/integrity.html).
- **Disabilities or special needs.** If you have a disability that requires special consideration (e.g., modification of seating or testing), please see me after class or during office hours so that accommodations can be arranged.
- **Absences and Extensions.** The goal of having deadlines is to help you stay on track and to keep the administration of the course manageable. If you believe you can make a good case that your education would be better served by a different deadline and that this outweighs the inconvenience to me, then make your case. When making your case, please propose a new deadline. The farther you plan ahead, the easier it is for me (just sayin'), so keep this in mind when requesting deadline changes for foreseeable situations.
- **Proper use of technology.** Research shows that there is no such thing as a good multi-tasker, only people who incorrectly believe they are good multi-taskers. If I perceive that technological distraction is become a problem, I will ban laptops on discussion days. Please keep that in mind as you decide whether and how to use technology in the classroom.
- **Course evaluation.** Your feedback about this course is very important to me. I am constantly revising this course to make it better. Your feedback will help me make it better not just for future students, but for you. In addition to the campus-wide online evaluation at the end of the semester, I'll be posting feedback forms on Canvas during the semester. You are not required to complete them, but please do.

Discussion Sessions

August 27 - Introduction I: Why is language possible at all, and why can't everyone do it?

This is a flipped classroom. All materials will be online and should be gone through before class. However, this is the first day of the semester, so if you can't go through these beforehand, that is OK. However, you should do so as soon as possible, since you will have more materials for Day #2!

For the same reason, there is nothing to turn in today. But there will be most other days.

Videos:

1. [Descriptive & Prescriptive Grammar](#)
2. [Steven Pinker on the "language instinct"](#)
3. The first and last lecture of the course

Optional:

1. [Where are all the talking robots?](#) Joshua Hartshorne, *Scientific American*

August 29 - Introduction II: The shape of language development

We'll start by learning the basic contours of language development. How are infants different from 1-year-olds, from 2-year-olds, etc? Start with Pinker (1994) *The Language Instinct*. [pp. 262-290](#), which provides a good overview. Then check out the [video](#), The birth of a word (from 0:10-7:12) by Deb Roy, which covers development of the first word in one child's vocabulary.

So far, we've glossed over the fact that language acquisition may look quite different depending on the environment you grow up in. Read Hart & Risley (1995) *Meaningful Differences in the Everyday Experience of Young Children*. [Appendix B](#).

But while we're talking about person-to-person differences, it is worth pointing out that many things are the same, even across very different types of languages. Check out, for instance, this [video](#) of babbling in sign language (“Phonological Acquisition in American Sign Language: From Coing and Babbling to Articulating Words”)

Recommended

For most units, I'll have a few recommended materials. These aren't required, but they are recommended, particularly if you have limited background in language research.

1. [Developmental Milestones: "Baby Talk from First Sounds to First Words"](#)
2. ["How to Think Like a Baby"](#)

Readings:

1. Pinker (1994) *The Language Instinct*. pp. 262-290.
2. Hart & Risley (1995) *Meaningful Differences in the Everyday Experience of Young Children*. Appendix B [[HartRisley.pdf](#)]

Videos:

1. ["Deb Roy – The Birth of a Word"](#)
2. ["Phonological Acquisition in American Sign Language: From Cooing and Babbling to Articulating Words"](#)

August 31 - Introduction III: Bilingualism

Required

First, read [this overview](#) of bilingualism research by Ellen Bialystok, one of the main researchers in this literature. Compare Bialystok's review with Maria Polinsky's take in [this video](#) ("Cognitive Advantages of Bilingualism – Maria Polinsky"). Also watch [this short overview](#) ("Bilingualism Will Supercharge Your Baby's Brain"), which covers some of the same ground as the first two but also addresses some interesting findings in social cognition. In order to get a better sense as to how all this research is done, check out [this very short video](#) ("Bilingual and Monolingual Baby Brains Differ in Response to Language") describing a recent study.

By definition, people who speak more than one language have to decide when to use which one. Sometimes, they change their mind in the middle of a sentence. However, this "code-switching" is something that even monolinguals do, when they switch between dialects or levels of formality. Watch [this short video](#) ("Linguistic Code Switching?"), which gives a formal overview of "code switching". While that video is a nice presentation of what code switching is, to get an intuition as to people's motivations when they code-switch, watch [this video](#) ("[Code-Switching](#)"), which focuses on switching between languages, and [this one](#) ("Key & Peele on 'Code-Switching' & the 2016 Presidential Candidates"), which talks about switching between dialects. Are you wondering what a young child who speaks several languages sounds like? Glad you asked. ([Watch](#): "Code Switching between Indonesian, French and English")

Optional:

We often focus on what it is like to be brought up bilingual. However, this is often the result of choices made by parents. Here is a mother [talking about her efforts](#) (“My Bilingual Baby – Our Daily Routine”) to raise her child trilingual (bonus features include one very cute baby).

Readings:

1. Bialystok, Ellen. "Bilingualism." *Wiley interdisciplinary reviews: cognitive science* 1.4 (2010): [559-572](#).

Videos:

1. [“Cognitive Advantages of Bilingualism – Maria Polinsky”](#)
2. [“Bilingualism Will Supercharge Your Baby’s Brain”](#)
3. [”Bilingual and Monolingual Baby Brains Differ in Response to Language”](#)
4. [“Linguistic Code Switching?”](#)
5. [“Code-Switching”](#)
6. [“Key & Peele on 'Code-Switching' & the 2016 Presidential Candidates”](#)
7. [“Code Switching between Indonesian, French and English”](#)
8. Optional: [“My Bilingual Baby – Our Daily Routine”](#)

September 05 - What is Language: Phonology

This is the first in a four-session overview of language. For those of you with no background in language, don't worry -- we'll be returning to a lot of these issues over and over again. For those of you who have taken some linguistics already, some of this will be familiar, but probably some of it will new, since I approach the study of language a little differently from the linguistics faculty at BC. It might be interesting to keep track of the differences and discuss them.

Please start by going through the following sections from Week 2 of the Coursera course ["Human Language"](#)

1. Distinguishing consonants
2. Production of speech sounds
3. Consonants of world languages
4. Sounds in systems
5. All of the "language informants" videos

Note that you do not need to pay to watch these videos. You can watch for free. You only have to pay if you want to get a certificate of completion, which you don't.

One of the things I like about this online course is that they have lots of good examples from languages around the world (the "language informants" videos). So please do pay attention to those.

Once you've done that, I want you to look at two chapters in the World Atlas of Language Structures (WALS). WALS is a fantastic online resource that is widely used by language researchers. It tries to summarize what is known about how languages vary around the world. Read the chapters on [consonant inventories](#). Spend at least 10-20 minutes poking around the maps (to get these, click on the buttons "go to map"). Look at the distribution of these linguistic features around the world. Look up a few of the languages in Wikipedia to learn more about them.

Some languages make use of phonological phenomena that do not exist in European languages, such as tones and clicks. Listen to [this famous song](#) ["The Click Song- Miriam Makeba"] from a click language, and see what the Ling Space has to say about [tones](#) ("Sing like you mean it! – the Linguistics of Tonal Languages")

Closely related to phonology is prosody. Watch this [very short overview](#) ("Duane Watson on Prosody and Language Comprehension").

Optional:

If you are still confused about phonology, Steve Pinker gives an overview from 32:05 - 43:33 in [this video](#) ("Steven Pinker: Linguistics as a Window to Understanding the Brain").

Also, two [fun videos](#) on the difficulty of teaching machines to do what babies do. (See Videos labelled Optional)

Readings:

1. World Atlas of Language Structures (WALS) - [Consonant Inventories](#),

Videos:

1. ["The Click Song- Miriam Makeba"](#)
2. ["Sing like you mean it- The Linguistics of Tonal Languages"](#)
3. ["Duane Watson on Prosody and Language Comprehension"](#)
4. ["Steven Pinker: Linguistics as a Window to Understanding the Brain"](#)
5. Optional: ["CAPTION FAIL: Lady Gaga Putt-Putt Rally"](#)
6. Optional: ["Burnistoun S1E1 – Voice Recognition Elevator!"](#)

September 07 - What is Language: Syntax, Part 1

Syntax is complicated. Sorry. But it's also really interesting. So please bear with me. The readings and videos for this session may take significantly more time than the previous ones, so plan ahead. Start with this overview of language by psycholinguist icon Steven Pinker. (If you've had a linguistics course or two already, you probably don't need to watch this, but you might enjoy it anyway.) [Watch](#) ("Steven Pinker: Linguistics as a Window to Understanding the Brain") from roughly 15:24 - 24:20.

Next, we will get into some of the details of syntax. Start with this video on [word order, grammar, and phrase structure rules](#). Then, watch the "Miracles of Human Language" video on [morphology](#).

Videos:

1. ["Steven Pinker: Linguistics as a Window to Understanding the Brain"](#)
2. ["Word Order, Grammar, and Phrase Structure Rules"](#)
3. ["Miracles of Human Language – Morphology"](#)

September 12 - What is Language: Syntax, Part 2

Having gotten the basics of syntax under our belt, today will drill down into two important topics: word order and recursion.

For word order, start by watching two videos (about 13 min. total) from the "Miracles of Human Language" Coursera course on syntax and word order: [part a](#) and [part b](#). Then watch the language informant videos [from that same chapter](#). Try to see if you can figure out what the dominant word order patterns for those languages are. (As with the previous language informant videos, no need to turn this in.)

Next, go to the WALS [chapter on word order](#) and spend some time exploring the map. (Reading the chapter text is optional. If you are still confused about word order, it may be worth it). As you are doing this, I'd like you to check out the language informant videos from [week three](#) from the Coursera course. The instructions from the instructor are to figure out what the dominant word order for each language is by watching the videos. But you can go ahead and look them up in WALS, and then watch the videos and try to recognize the word orders (still hard enough). It'll help to know that another name for "Tarifit Berber" is "Rif Berber". Bonus points to anyone who can actually find Abruzzese in WALS (it seems to be an SVO Italian language).

Next, recursion. Recursion is the ability to apply a rule to its own output. So the rule that you can add an adjective before a noun ("red dog") can be applied recursively ("big red dog" or even "friendly big red dog"). Recursion has played a central role in theories of language, of the mind, and of what separates us from animals. So reports that a small society deep in the Amazon might lack recursion in their language have caused an enormous amount of debate (still unsolved). This extended New Yorker article provides [the details](#).

Recommended

A short video about the [Piraha language](#), featuring actual Piraha.

Readings:

1. Optional: World Atlas of Language Structures (WALS): [Order of Subject, Object and Verb](#)
2. [The Interpreter](#). John Colapinto, *New Yorker*

Videos:

1. "Miracles of Human Language" Coursera
 - a. [Lesson 31 – syntax and word order \(a\)](#)
 - b. [Lesson 31 – syntax and word order \(b\)](#)
 - c. [Language Informant video \(Week 3\)](#)

September 14 - What is Language: Typology and Universals

We have already learned about some of the ways languages can differ. In this final session on "What is Language", we'll dig into this a bit more. The study of differences across languages is (usually) called "Typology".

Watch this 20-minute [video](#) ("TYP 103- The Classification of Languages") on the classification of languages. From 8:20 to 14:10, the speaker talks about word order variation (SOV, etc.). If you feel comfortable with that already, you can skip that part.

Then read this Wikipedia article about [Greenberg's Universals](#). You don't need to memorize the list, but you should make a good faith effort to understand at least a few of them. (In case, for instance, you are asked on an exam to list a few of Greenberg's universals.)

Some of Greenberg's universals have proved contentious as linguists have analyzed more languages. Nonetheless, there is general agreement that languages are more similar to one another than would be expected by chance. The question is why.

Watch with this 3-minute [video by Noam Chomsky](#) (“Noam Chomsky: Language’s Great Mysteries”), giving his perspective on the ways in which languages are similar.

A somewhat different perspective comes from this [recent paper](#), which tries to apply the tools of evolutionary science to language. This article may use some concepts and terms that aren't familiar to you, particularly if you haven't had much background in psychology or biology. Wikipedia is your friend. Your friends are also your friend (that is, discussion may help since you can fill in pieces of knowledge for each other).

Finally, purely for fun, read my [open letter](#) to the creator of the Dothraki language for *Game of Thrones* and [his reply](#).

Recommended

You can find yet another perspective on linguistic diversity in the following paper, which focuses on the fact that languages are spoken by humans, and so will be constrained by how our minds work.

1. Sinnemåki (2014) “Cognitive Processing, Language Typology, and Variation,” *Cognitive Science*. 5(4), [477-487](#).

Greenberg's work is quite old. Researchers following in his footsteps have built the World Atlas of Linguistic Structure, trying to compile everything we know about what is similar and what is different across languages. We've already used WALS a few times. WALS has [144 chapters](#) on different aspects of language that may vary. I recommend spending some time skimming through it.

2. World Atlas of Language Structures (WALS): look over a few different [chapters](#) that you may find interesting

Readings:

1. Wikipedia- [Greenberg’s linguistic universals](#)
2. Levinson, S. C., & Gray, R. D. (2012). Tools from evolutionary biology shed new light on the diversification of languages. *Trends in cognitive sciences*, 16(3), [167-173](#).
3. Hartshorne (2010) [“Fantasy TV in the Service of Science: An Open Letter to HBO about “Dothraki”](#), *Scientific American*.
4. Emrys and Peterson (2010) [“The Dothraki Response to a Call for Science in a Created Language”](#) *Scientific American*.

Videos:

1. [“TYP 103- The Classification of Languages”](#)
2. [“Noam Chomsky: Language’s Great Mysteries”](#)

September 17 - What is Language: Semantics

Semantics is the study of what sentences mean. Pragmatics, which we'll study in the next session, is the study of what people mean when they use sentences. Your primary job for these two sessions is to understand the difference, and to understand some of the basic phenomena.

Start with this overview [video](#) from our friends at Coursera on "layers of meaning".

Then, watch their [video](#) on semantics.

Finally, read this selection from Pinker's *Stuff of Thought* (Chapter 4, Cleaving the Air, pp. 132-150)

Readings:

1. Pinker, S. (2007). Cleaving the Air. In *The stuff of thought: Language as a window into human nature*. (pp. 132-150). Penguin.

Videos:

1. "Miracles of Human Language" Coursera
 - o Lesson 42 – [Layers of meaning](#)
 - o Lesson 43 – [Semantics](#)

September 21 - What is Language: Pragmatics

First, get an overview of pragmatics from ["The Miracle of Human Language"](#).

Pragmatics as a field dates to a series of lectures by the philosopher H. Paul Grice, delivered at Harvard in 1966-1967. But there was relatively little work on pragmatics in psychology or linguistics until Ira Noveck took it up in the late 1990s. (There was intermittent work by Herb Clark at Stanford, but it never developed into a robust literature.) Read this [2008 article](#) on some of the phenomena Noveck and his colleagues were working on.

Since this pioneering work by Noveck and colleagues, the experimental study of pragmatics has grown considerably. Watch [this video](#) (“Why is Language Veiled”) by Steve Pinker

discussing some of the research in the first decade of the 21st century (you'll also get a little syntax review).

Recommended

If you are still confused about implicature, check out [this video](#) (“Language: Conventional Implicature”) by Khan Academy.

If you are interested in mathematical models of language, you may like this [recent paper](#).

Readings:

1. Noveck, I. A., & Reboul, A. (2008). Experimental pragmatics: A Gricean turn in the study of language. *Trends in Cognitive Sciences*, 12(11), [425-431](#).
2. Goodman, N. D., & Frank, M. C. (2016). Pragmatic language interpretation as probabilistic inference. *Trends in cognitive sciences*, 20(11), [818-829](#).

Videos:

1. "Miracles of Human Language" Coursera
 - o Lesson 45 – [Pragmatics](#)
2. [“Steven Pinker – Why is Language Veiled”](#)
3. [“Khan Academy- Language: Conventional Implicature”](#)

September 24 - What is Language: Dialects and Variation

We talk about "the English language" or "the Spanish language" as if everybody speaks English or Spanish the same way. But we know that there is of course a lot of regional and personal variation. Start with this discussion of [idiolects, dialects, and language](#) (“Language vs Dialect”). Then watch these videos about two of the more famous American dialects: [African American Vernacular English](#) (“ebonics”) [“John McWhorter on Black English (or AAVE)”] and [Appalachian English](#) [“Appalachian English”].

Of course, we can divide up dialects with a much finer grain. Take [this survey](#) to find out what American dialect you speak (if you are a non-native speaker of English or come from another English-speaking country, it may do funny things).

That said, American dialectal variation is fairly minimal. This comes partly from the fact that English-speakers spread across North America only very recently. You see much more

pronounced differences in places like the UK, as you can see from [this video](#) (“Anglophemia - One Woman, 17 British Accents”).

Finally, think about linguistic variation in the context of this video about [language evolution](#) (“Alex Gendler - How languages evolve”).

Recommended

While we often talk about Chinese "dialects", most linguists consider Mandarin and Cantonese to be distinct languages. These [two videos](#) (“Have You Eaten Yet - in 5 Chinese Dialects” and “Happy Chinese New Year in 8 dialects”) may give you a sense as to why.

For those of you with a literary bent, you may enjoy this [prose poem in three dialects](#) (“Jamila Lyiscott - 3 ways to speak English”).

However you feel about its politics, the poem does a good job of both demonstrating distinctions between dialects while also commenting on the social dimension of standard vs. non-standard dialects.

Along similar lines, [here is a video](#) (“Don't Judge My African American English”) in which African Americans discuss their relationship to AAVE (ebonics).

Videos:

1. [“Language Vs Dialect”](#)
2. [“John McWhorter on Black English \(or AAVE\)”](#)
3. [“Appalachian English”](#)
4. [“Anglophemia - One Woman, 17 British Accents”](#)
5. [“Alex Gendler - How languages evolve”](#)
6. [“Have You Eaten Yet - in 5 Chinese Dialects”](#)
7. [“Happy Chinese New Year in 8 dialects”](#)
8. [“Jamila Lyiscott - 3 ways to speak English”](#)
9. [“Don't Judge My African American English”](#)

September 26 - What is Language: Animal Communication

For our final substantive discussion, I'd like to return to animals. We've learned a lot about what language is and what makes it hard to learn. Now we are in a better position to consider how animal communication systems compare to human language. Start with this [recent review](#) (Zuberbühler, 2015).

Next, let's delve a bit more into birds and dolphins. Start with this [video](#) (“Bird Brains: Nova – Science Now”) about birds.

Next, a [paper](#) (Janik, 2013) about dolphin communication and a [video](#) (“Denise Herzing - Could we speak the language of dolphins?”).

Recommended

If you want to know more about dolphins, I also recommend:

1. King, S. L., & Janik, V. M. (2013). Bottlenose dolphins can use learned vocal labels to address each other. *Proceedings of the National Academy of Sciences*, 110(32), [13216-13221](#).

Dolphins and birds aren't the only animals that have communication systems. You may be interested in squirrels.

2. Wilson, D. R., & Hare, J. F. (2004). Animal communication: ground squirrel uses ultrasonic alarms. *Nature*, 430(6999), [523](#).

or Campbell's monkeys.

3. Ouattara, K., Lemasson, A., & Zuberbühler, K. (2009). Campbell's monkeys concatenate vocalizations into context-specific call sequences. *Proceedings of the National Academy of Sciences*, 106(51), [22026-22031](#).

Readings:

1. Zuberbühler, K. (2015). Linguistic capacity of non-human animals. *Wiley Interdisciplinary Reviews: Cognitive Science*, 6(3), [313-321](#).
2. Janik, V. M. (2013). Cognitive skills in bottlenose dolphin communication. *Trends in cognitive sciences*, 17(4), [157-159](#).

Videos:

1. [“Bird Brains \(Nova – Science Now\)”](#)
2. [“Denise Herzing - Could we speak the language of dolphins?”](#)

September 28 – The Language Instinct: Critical Periods 1

For this session, we will be discussing why children learn languages better than adults. Start by reading this 7-page excerpt from Pinker's *The Language Instinct* (pp. 290-296).

Next, watch this short [video](#) about Genie, the most famous case study of a child brought up without language:

Following that, watch the first 10:20 of this [video](#) from Patricia Kuhl (“The Linguistic Genius of Babies”), who has done the foundational work on critical periods in phonology. We saw some of this work earlier:

Next session's reading is *long*. I recommend getting a head start.

Readings:

1. Pinker, S. (1994). *The Language Instinct*. (pp. 290-296)

Videos:

1. [“Genie”](#)
2. [“Patricia Kuhl: The Linguistic Genius of Babies”](#)

October 01 – Exam

Nothing to submit. This is a placeholder so it shows in the calendar.

October 03 – The Language Instinct: Critical Periods 2

In Kuhl's video that we watched yesterday, she mentions some famous work by Newport & Johnson on critical periods in grammar. If you read about critical periods anywhere, you're likely to see that work discussed. In the following [paper](#) of mine (currently in the midst of revision, so apologies for any type-os), I argue against the findings of the Johnson & Newport paper, and I argue for a completely different chronology of the critical period for grammar. I don't expect you to be able to follow all the math. What I do want you to understand from this is a) why the study of ultimate attainment cannot tell us much about critical periods, b) what it means when I say that Johnson & Newport had insufficient statistical power, and c) what my new results say about when the critical period for grammar ends.

NOTE You do not need to read the supplementary materials. Just read up through the start of the bibliography.

Readings:

1. Hartshorne, J. K., Tenenbaum, J. B., & Pinker, S. (2018). A critical period for second language acquisition: Evidence from 2/3 million English speakers. *Cognition*, *177*, [263-277](#).

October 05 – The Language Instinct: Pidgins & Creoles

We learned previously that some hobbyists invent languages for fun. Children also invent languages -- not for fun, but for communication. These languages are called "creoles".

As we often do, let's start with a brief overview from *The Language Instinct*. (pp 32-39).

Also take a look at what the Ling Space has to [say](#) about pidgins and creoles ("Ling Space: Pidgins and Creoles").

The pioneering work was done by Derek Bickerton. Read this old *Scientific American* article he wrote.

Let's look at a couple examples of creoles. The first one, confusingly called "[Hawaiian Pidgin](#)" ("How to Speak Pidgin"), involves a lot of English vocabulary. You may get the sense that you should understand what she's saying because you recognize the individual words, but the whole makes no sense.

A number of creoles are heavily influenced by English. This doesn't mean they are the same. Compare the Hawaiian Pidgin you just heard with this discussion of [Jamaican Patois](#) ("No Bada Me Bwoy"). Note that the speakers are discussing Jamaican Patois, but in English.

Of course, not all creoles are heavily influenced by English. Check out this clip of [Haitian Creole](#), which is based more heavily on French. ("Haitian Girl Speaking French & Creole!"). You only need to watch the Haitian Creole section, which is from about 1:42 to about 3:45):

Recommended

If you haven't had enough of creoles yet, I recommend (but do not require) this very interesting interview with Nick Farmer, the language consultant who created "Belter Creole" *The Expanse*, which -- in case this comes up on the exam -- is the best current sci-fi drama on television. (Admittedly, it's a low bar. We're not seeing the best TV sci-fi at the moment.) In this show, "Belters" are asteroid miners who live primarily in the asteroid belt. This is dangerous, dirty work, and the people who do it are marginalized. Consider why they might speak a creole.

6. ["Ars talks with the creator of Belter Creole from 'The Expanse'"](#)
7. ["Creoles and Pidgins: A Focus on Haitian Creole"](#)

Readings:

1. Pinker (1994) *The Language Instinct*. pp. 32-39.
2. Bickerton, D. (1983). Creole languages. *Scientific American*, 249(1), [116-122](#).

Videos:

1. [“Ling Space: Pidgins and Creoles”](#)
2. [“How to Speak Pidgin”](#)
3. [“No Bada Me Bwoy – Jamaican Patois”](#)
4. [“Haitian Girl Speaking French & Creole!”](#)

October 10 – The Language Instinct: Sign Language

Something not always appreciated is that there are many, many different [sign languages](#) (we'll get to why in a moment) [[“Is Sign Language Universal? | ASL Stew”](#)].

[Here](#) (“Japanese American French Sign Languages”) is a demonstration of the differences between three common sign languages.

[Here](#) (“When I Was Your Man ASL-BSL”) is a musical take on the same issue.

[Here](#) (“Hand Talk - Science Nation”) is some information on a much less well-known sign language.

Sign languages are languages, with many of the features you are familiar with, including [poetry](#) (“What is SASL Poetry?”)

A baby learning sign language goes through many of the same stages as a hearing baby, including [babbling ... in sign language](#) (“From Cooing and Babbling to Utterance in American Sign Language”)

Where do sign languages come from?

Sign languages are often created through a very unusual process of creolization. The starting point is usually a home sign. Read about [home signs](#) on Wikipedia.

Little-known fact: My great-great aunt used a home sign.

So, when a deaf person lives with a hearing family, they will probably use some kind of home sign. When you bring a bunch of these people together, what happens?

That [video](#) (“The Birth of New Sign Language in Nicaragua”) was a nice overview of the phenomenon. Let's learn a little about the science. Read the Brentari et al. (2013) Cognitive Science [paper](#).

Highly Recommended

Academic discussions of sign language often focus on deprivation and hardship. I wanted something fun to balance this out. One of the things I learned in pulling together materials for this class is that deaf music [videos](#) (“D-PAN ASL Music Video: “We’re Going To Be Friends” by the White Stripes”) are a thing. It was something of a challenge to find a video that was upbeat, good, and PG. The more adventurous might check out this [list](#). I told you that apparently this is a thing. It's worth putting your psychologist hat on and thinking about why.

Readings:

1. [Home sign](#) – Wikipedia
2. Brentari, D., & Coppola, M. (2013). What sign language creation teaches us about language. *Wiley Interdisciplinary Reviews: Cognitive Science*, 4(2), [201-211](#)

Videos:

1. [“Is Sign Language Universal? | ASL Stew”](#)
2. [“Japanese American French Sign Languages”](#)
3. [“When I Was Your Man ASL-BSL”](#)
4. [“Hand Talk - Science Nation”](#)
5. [“What is SASL Poetry?”](#)
6. [“From Cooing and Babbling to Utterance in American Sign Language”](#)
7. [“The Birth of New Sign Language in Nicaragua”](#)
8. [“D-PAN ASL Music Video: “We’re Going To Be Friends” by the White Stripes”](#)

October 12 – The Language Instinct: Language Creation

For this class, we'll be discussing Nicaraguan Sign Language in depth. We already got some background by watching this [this video](#) (“The Birth of New Sign Language in Nicaragua”) and reading [this paper](#) (Brentari et al., 2013). Add to your knowledge by watching [this video](#) (Ann Senghas: “How Language Evolves: Rethinking Recapitulation: Structure in Nicaraguan Sign Language”, start at 2:00).

Next take a look at the following paper (Gleitman & Newport, 1995). It is long, but it's a classic. It ties together language acquisition and studies of language creation and in many ways sets the standard for this line of work.

Readings:

1. Brentari, D., & Coppola, M. (2013). What sign language creation teaches us about language. *Wiley Interdisciplinary Reviews: Cognitive Science*, 4(2), [201-211](#).
2. Gleitman, L., & Newport, E. (1995). Language: An Invitation to Cognitive Science. *An Invitation to Cognitive Science*, 1, 1-24.

Videos:

1. [“The Birth of New Sign Language in Nicaragua”](#)
2. [Ann Senghas: “How Language Evolves: Rethinking Recapitulation: Structure in Nicaraguan Sign Language”](#)

October 15 – The Language Instinct: Animals Learning Language

"If a lion could speak, we could not understand him." -- Wittgenstein

Why do humans have language and animals do not? One way scientists have tried to grapple with this question is to teach animals to speak. The early work did not go well, for a variety of reasons. Here is Pinker's overview of the landscape up through the early '90s (*Language Instinct*, pp. 335-342).

Don't just take his word for it. Here's a [transcript](#) of an online chat with Koko the gorilla. Koko's trainers clearly believe she is talking. Do you?

More recent work with primates has been a bit more careful, and a bit more impressive. Here is a pop-science [overview](#) (“Kanzi, the Bonobo talks to reporters”) of one of the more famous case studies, Kanzi.

This brief [video](#) (“Kanzi and Novel Sentences”) gives a bit more detail on evidence that Kanzi constructs novel sentences.

The trainers of these animals have good reason emphasize the animals' abilities, as do the TV producers who made these segments. So ask yourself, "What has Kanzi *not* been shown to do? What are Kanzi's limits in comparison with a human?" Ask yourself the same question as you go through the materials below.

Perhaps surprisingly, some of the more impressive recent examples come from non-primates. For instance, there is a lot of recent interest in [dog cognition](#) (Watch “The Dog Who Knows 1,000 Words”). Dogs evolved to cooperate with humans. Being able to commune with humans has been a guiding factor in their success. Not surprisingly, they seem pretty in tune with us.

There is work with [dolphins](#) (“The Language of Dolphins”) as well. In theory, anyway. It's very hard to find published scientific papers. I did find the following TV segment. We should probably be skeptical of anything that has a scanty scientific record. Nonetheless, this video is worth watching for the description of the experimental design, which seems pretty solid:

Perhaps the most surprising data, however, comes from [Alex the Parrot](#) -- the first non-human to merit an obituary in the *New York Times*. Dr. Pepperberg is certainly a parrot booster, but her work appears to be quite solid, and she has a large network of collaborators. Like the work with Kanzi, the Alex data has very much entered the scientific mainstream. Again, though, ask yourself what exactly Alex has been shown to do, and what he has not been shown to do.

It may be relevant to know that no other parrot has yet matched Alex's capabilities. Granted, not many parrots have been tested. This raises a general point worth considering: Are the animals in these studies representative of their species, or are they animal geniuses? (Consider any role for self-selection Wikipedia [link](#))

Incidentally, the message board system that Kanzi uses is closely related to the PECS system, which is often used for children with communication disorders. Here is a short promotional [video](#) (“Getting Started with Using PECS®”) from a company that makes PECS boards.

Here is a [video](#) (“Andy using PECS Part 1”) of a child who has cerebral palsy and autism using PECS to communicate:

Highly Recommended

Want more Kanzi? The [video](#) (“Kanzi with lexigram”) below gives a more detailed explication of how Kanzi's lexigram system works.

Whether or not parrots can speak English, they certainly have got some moves.

This is not just one exceptional parrot, either. [Dancing parrots](#) (Watch “Snowball (™) - Another One Bites The Dust”) are a thing. One of my friends from graduate school published a couple papers on animal dancing abilities. Bet you didn't know you work on *that* in graduate school!

Readings:

1. Pinker (1994) *The Language Instinct*. pp. 335-342
2. [Transcript](#) of the Chat with Koko, 4/27/98

Videos:

1. Michael Keller: "[Kanzi, the Bonobo talks to reporters](#)"
2. Iowa Primate Learning Sanctuary: "[Kanzi and Novel Sentences](#)"
3. ABC News: "[The Dog Who Knows 1,000 Words](#)"
4. "[The Language of Dolphins](#)"
5. "[Alex the Smart Parrot - Talking bird distinguishes colors, shapes, sizes, numbers](#)"
6. "[Getting Started with Using PECS®](#)"
7. "[Andy using PECS Part 1](#)"
8. Iowa Primate Learning Sanctuary: "[Kanzi with lexigram](#)"
9. "[Snowball \(™\) - Another One Bites The Dust](#)"

October 17 – Development: How do we know what children know?

In this next unit, we'll be returning to language development during childhood and digging in deeper. Before getting into the data, though, we should learn a bit about where the data come from. That is, how do we study child language?

This [video](#) (Ling Space: "How to Test Language in Babies") provides an overview of a few of the methods used with infants.

Next, watch this much older [video](#) (The Infant Language Lab: "Three procedures for investigating infant speech perception and language development") that goes into detail on the high amplitude sucking procedure. For those of you who are into history, notice how this research was actually carried out in the era before cheap consumer electronics.

The above videos left out one very common method that is used with slightly older infants, dishabituation. Here is a [video](#) (Mike Frank: "Habituation (Stanford Psych 60)") my friend Mike Frank made for his students at Stanford.

Next, here is an [overview](#) (Ling Space: "Child Language Experiments") of methods used with toddlers and pre-schoolers.

Finally, take a look at this review paper ([Ambridge & Rowland, 2013](#)), which goes through many of the same methods. I had you watch the videos first, because I think you'll follow the text better having seen some of these methods in action.

Recommended

Visual learners may find it useful to watch the first 2 1/2 minutes of the following [video](#), which provides a particularly clear demonstration of a habituation study.

1. [“Habituation: Studying Infants Before They Can Talk”](#)

Readings:

1. Ambridge, B., & Rowland, C. F. (2013). Experimental methods in studying child language acquisition. *Wiley Interdisciplinary Reviews: Cognitive Science*, 4(2), [149-168](#).

Videos:

1. Ling Space: [“How to Test Language in Babies”](#)
2. The Infant Language Lab: [“Three procedures for investigating infant speech perception and language development”](#)
3. Mike Frank: [“Habituation \(Stanford Psych 60\)”](#)
4. Ling Space: [“Child Language Experiments”](#)

October 19 – Development: Phonology

Required

Children are noticeably bad at pronouncing things. For instance, see [this video](#) (“Phonological speech error”) by a couple of amused parents. Such errors are [not easy to fix!](#) (“Phonological Processes”) You can get a sense of how long it takes children to learn to pronounce things correctly by watching this [time-lapse speech portrait](#) (“Nancy Grows Up-Time-Lapse Audio”).

One problem is that different languages have different phonemes, and children have to learn them. This [video](#) (“Infant Speech Discrimination”) has a very short description of the classic findings on phonology acquisition.

The next [video](#) (“The Baby Human – Weker – Ba/Da Study”) describes a more recent study in this line of work, and shows in detail how the study is actually run.

Prof. Werker and her colleagues describe this line of work in more detail in [this paper](#). (read up through the first half of p. 915).

The problem of learning phonemes doesn't explain everything (remember the kid who said 'turkey' instead of 'dirty?'). Check the Ling Space for [more on phonological development](#). (“Why Do Little Kids Make So Many Speech Errors?”)

Recommended

Especially if you find critical periods fascinating, check out [this recent paper](#) (Werker & Hensch, 2015) on the neuroscience of critical periods in speech perception.

Readings:

1. Werker, J. F., & Gervain, J. (2013). Speech perception in infancy: A foundation for language acquisition. *The Oxford handbook of developmental psychology*, 1, [909-925](#). (read up through first half of p 915).
2. Werker, J. F., & Hensch, T. K. (2015). Critical periods in speech perception: new directions. *Annual review of psychology*, 66, [173-196](#).

Videos:

1. [“Phonological speech error”](#)
2. [“Phonological Processes”](#)
3. Tony Schwartz: [“Nancy Grows Up \(Time-Lapse Audio\)”](#)
4. [“Infant Speech Discrimination”](#)
5. [“The Baby Human – Weker – Ba/Da Study”](#)
6. Ling Space: [“Why Do Little Kids Make So Many Speech Errors?”](#)

October 22 – Development: Semantics

The following [paper](#) is a 9-page summary of a book by the same name (“How children learn the meanings of words - Bloom, 2002”). It's far from the only (ahem) word on the subject, and in fact it only covers a subset of the issues in semantic development. However, it has the advantage of being very clear and easy to understand. (A lot of the work on semantics is very technical.)

You only need to read the main paper, which is the first 9 pages of this document.

Recommended

After the first 9 pages, there are several dozen 1-page commentaries by a wide variety of language researchers. They are worth looking at in order to get a sense of what the debates are, what other people are working on, etc.

Readings

1. Bloom, P. (2001). Précis of How children learn the meanings of words. *Behavioral and brain Sciences*, 24(6), [1095-1103](#). (Read the first 9 pages, main paper)

October 24 – Development: Syntax

Today, we'll take a more in-depth look at how children's understanding of syntax develops. Start with [this video](#) (“How Do Babies Build Sentences? The Stages of Child Syntax”) from Ling Space. Next, watch this very short video on the order of [acquisition of morphology](#) (“Early Childhood Grammar Milestones”). Don't worry about learning specific ages. It's more important to focus on the ordering.

Finally, for those of you who like learning through reading, here is an [overview paper](#) by Crain & Thornton. It covers some of the same issues, but starts getting into different theories of how children might actually do the learning. We're going to return to those theories in depth later, so this is just to get you ready.

Readings:

1. Crain, S., & Thornton, R. (2012). Syntax acquisition. *Wiley Interdisciplinary Reviews: Cognitive Science*, 3(2), [185-203](#).

Videos:

1. Ling Space: [“How Do Babies Build Sentences? The Stages of Child Syntax”](#)
2. [“Early Childhood Grammar Milestones”](#)

October 26 – Development: Pragmatics

One of the most basic aspects of language use is turn-taking. Conversations are hard if everyone is talking at the same time. Although pretty basic, this turns out to be surprisingly complicated. Here is an example of two twins [practicing taking turns in a conversation](#) (“Talking Twin Babies – Part 2 – Official Video”), even though they don't appear to have learned any actual words yet.

Readings:

Once you start digging into this behavior, it turns out to be pretty complex. Get a sense for this from [this special issue](#) (Research Topic: Turn-Taking in Human Communicative Interaction). Read through the abstracts (the first paragraph) for these papers:

1. Hilbrink, E. E., Gattis, M., & Levinson, S. C. (2015). Early developmental changes in the timing of turn-taking: a longitudinal study of mother–infant interaction. *Frontiers in psychology*, 6, [1492](#).
2. Gratier, M., Devouche, E., Guellai, B., Infanti, R., Yilmaz, E., & Parlato-Oliveira, E. (2015). Early development of turn-taking in vocal interaction between mothers and infants. *Front. Psychol*, 6(1167), [10-3389](#).
3. Lammertink, I., Casillas, M., Benders, T., Post, B., & Fikkert, P. (2015). Dutch and English toddlers' use of linguistic cues in predicting upcoming turn transitions. *Front. Psychol*, 6(495), [10-3389](#).
4. Clark, E. V., & Lindsey, K. L. (2015). Turn-taking: a case study of early gesture and word use in answering WHERE and WHICH questions. *Frontiers in psychology*, 6, [890](#).
5. Riest, C., Jorschick, A. B., & de Ruiter, J. P. (2015). Anticipation in turn-taking: mechanisms and information sources. *Frontiers in psychology*, 6, [89](#).
6. Levinson, S. C., & Torreira, F. (2015). Timing in turn-taking and its implications for processing models of language. *Frontiers in psychology*, 6, [731](#).
7. Henry, L., Craig, A. J. F. K., Lemasson, A., & Hausberger, M. (2016). Social coordination in animal vocal interactions. Is there any evidence of turn-taking? The starling as an animal model. *H., Casillas, M., Levinson, SC, eds.(2016). Turn-Taking in Human Communicative Interaction. Lausanne: Frontiers Media. doi: 10.3389, 4, 39*

My favorite phenomenon in pragmatics, however, is implicature. It turns out that children take a surprisingly long time to learn certain types of implicatures. [This paper](#), from Mike Frank's lab, is the latest word. It looks long, but it's double-spaced.

8. Horowitz, A. C., Schneider, R. M., & Frank, M. C. (2018). The trouble with quantifiers: exploring children's deficits in scalar implicature. *Child development*, 89(6), [e572-e593](#).

Videos:

1. ["Talking Twin Babies – Part 2 – Official Video"](#)

October 29 – Poverty of Stimulus: Syntax

(Fair warning: This assignment is longer than usual)

This is the first of two class sessions dedicated to the "Problem of the Stimulus". The readings and videos focus on the issues directly related to language acquisition, but I want to start by situating these issues in intellectual history.

Starting with (roughly) [Descartes](#) (Wikipedia link) in the early 1600s, a defining theme of intellectual culture has been a growing embrace of empiricism, the idea that we should arrive at knowledge through reason and fact. Here is a representative quote from my personal intellectual hero, [David Hume](#) (Wikipedia link).

If we take in our hand any volume; of divinity or school metaphysics, for instance; let us ask, Does it contain any abstract reasoning concerning quantity or number? No. Does it contain any experimental reasoning concerning matter of fact and existence? No. Commit it then to the flames: for it can contain nothing but sophistry and illusion.

This fairly incendiary quote is full-throated advocacy for making decisions based on logic (mathematical proof) and fact (scientific experiment). While the may seem like an obvious position for the modern college student, it was radical in its day and remains controversial in broad swaths of modern society, both in and outside of academia.

Perhaps the high-water mark of this line of work was Russell and Whitehead's [Principia Mathematica](#) (Wikipedia link), in which these two great mathematicians/philosophers tried to build up the entire foundation of mathematics from axioms and proofs (logic). The goal was to ensure that all knowledge was true *knowledge* and that there weren't any inconsistencies. The hope was to extend this type of work beyond mathematics to all of human thought.

The project failed in a number of fascinating ways. For one thing, it turns out that it's [impossible to make mathematics internally consistent](#) (Wikipedia link) in the way Russell and Whitehead hoped.

Just as important was the realization that Hume's embrace of scientific experiment was missing something crucial: If the point of an experiment is to test a hypothesis, where do the hypotheses come from? Hume (and pretty much everyone else) thought that hypotheses came from [induction](#) (New World Encyclopedia link) : inferring a general rule from a series of data. The problem is that there are typically an infinite number of hypotheses consistent with any set of data, no matter how large. This has resulted in the influential 20th Century philosopher Jerry Fodor quipping that scientists agree with each other far more than you'd expect based on the data. More formally, studies of science itself revealed that scientific advances tend not to result from the scientific method per se (that is, [induction followed by experimental verification](#) (Wikipedia link)).

While (some) post-modernists have treated this as a reason to abandon science, others have suspected that we are missing something really important. That is, Hume was a little too fast to go about burning books; there might be value in works that depend on neither deduction nor induction.

(My personal favorite possibility is [abduction](#) (Wikipedia link). Also called "inference to the best explanation", the idea is to choose the hypothesis *most* consistent with the data. Note that unlike deduction, there is no guarantee that the hypothesis you choose is actually right, only that it's better than the others you were considering. And, unlike induction, there isn't necessarily a method of creating new hypotheses. You can learn a lot more about abduction in my course Computational Models of Cognition.)

What does all of this have to do with language acquisition? In addition to being a proposal about the right way of obtaining knowledge, empiricism is also a theory about how humans learn. Harking back to Thomas Aquinas's dictum "nothing is in the intellect that was not first in the senses," -- which Aquinas attributed to the ancient Greeks -- the claim was that children, like any good little Humean, learned entirely through deduction and induction ... plus classical and operant conditioning (even hard-core empiricists found it difficult to explain learning without some recourse to some innate structure).

"Poverty of the Stimulus" arguments are arguments that children appear to know things that they could not possibly have learned through empiricism. Thus, just as philosophers came to realize the limits of induction in the search for truth, "Poverty of the Stimulus" arguments presented challenges to empiricism as a theory of how children learn language. Much of the research in language acquisition -- and developmental psychology in general -- over the last half century has been in response to this challenge.

In fact, everything we will be discussing after this week will be a response, in one way or another, to Poverty of the Stimulus arguments. So as you go through the materials this week, try to internalize this challenge to radical empiricism so as to better understand the responses.

Overview of Poverty of the Stimulus Arguments:

Start, as we often do, with Pinker (*The Language Instinct*, pp 39-45). After finishing Pinker's brief overview, let's dive into the details with the first three sections of this excellent [paper](#) by the philosophers Laurence and Margolis (only read through page 233).

One of the important empirical findings that challenged empiricism is that children do not always appear to respond to feedback the way you would expect. [Watch](#) Ling Space's "Is Correcting Your Kid's Language Helpful? Negative Evidence"

You may also remember [this video](#) ("Phonological Processes"), where correcting the pronunciation of 'dirty' had no effect.)

Special Case: Baker's Paradox

At this point, you should already have a sense as to the ways in which induction is under-informative, suggesting an overabundance of theories consistent with the data. On special case of this problem is Baker's Paradox. Baker's Paradox depends on the fact that some theories are strictly more complex than others. This is nicely illustrated by the Chomsky Hierarchy. [Watch](#) Ling Space's "How Complex is Natural Language? The Chomsky Hierarchy".

Now keep the Chomsky Hierarchy in mind as you watch this video -- made specially for this class! -- about Baker's Paradox. [Watch](#) this video on Baker's Paradox.

Recommended

I only assigned the first part of the Laurence and Margolis paper. The rest of it is pretty good, too, especially if you like philosophy.

Readings:

1. Laurence, S., & Margolis, E. (2001). The poverty of the stimulus argument. *The British Journal for the Philosophy of Science*, 52(2), [217-276](#).

Videos:

1. Ling Space ["Is Correcting Your Kid's Language Helpful? Negative Evidence"](#)
2. ["Phonological Processes"](#)
3. Ling Space: ["How Complex is Natural Language? The Chomsky Hierarchy"](#)
4. Joshua Hartshorne: ["Baker's Paradox"](#)

October 31 – Poverty of Stimulus: Semantics

In many cases, a baby's first word is "mama" (or the culturally appropriate equivalent). How does the baby learn to call her mother "mama"? A simple story is that the baby notices that whenever her mother is around, people say "mama" a lot, and she learns to associate the word with the person.

This simple story glosses over *a lot* of complexity. As with syntax learning, there are a lot more generalizations that logically could be made. Here is a brief [introduction](#) ("A grue gavagai counted to ten") to some a few of them.

There are other hidden generalizations. In my opening, we were just assuming that it's sensible to talk about "the mother" as if she was a single, coherent entity. Since the ancient

Greeks, [philosophers](#) (“Philosophy – Metaphysics: Ship of Theseus”) have known that it's not quite so simple.

In case mythical ships are too abstract for you, here an excerpt from [an interview with Chomsky](#), in which he applies a very similar analysis to the everyday concept 'river':

To illustrate, let's take the first case that was discussed in pre-Socratic philosophy, the problem posed by Heraclitus: how can we cross the same river twice? To put it differently, why are two appearances understood to be two stages of the same river? Contemporary philosophers have suggested that the problem is solved by taking a river to be a four-dimensional object, but that simply restates the problem: why this object and not some different one, or none at all?

When we look into the question, puzzles abound. Suppose that the flow of the river has been reversed. It is still the same river. Suppose that what is flowing becomes 95 percent arsenic because of discharges from an upstream plant. It is still the same river. The same is true of other quite radical changes in the physical object. On the other hand, with very slight changes it will no longer be a river at all. If its sides are lined with fixed barriers and it is used for oil tankers, it is a canal, not a river. If its surface undergoes a slight phase change and is hardened, a line is painted down the middle, and it is used to commute to town, then it is a highway, no longer a river. Exploring the matter further, we discover that what counts as a river depends on mental acts and constructions. The same is true, quite generally, of even the most elementary concepts: tree, water, house, person, London, or in fact, any of the basic words of human language. Radically, unlike animals, the items of human language and thought uniformly violate the representationalist doctrine.

Furthermore, the intricate knowledge of the means of even the simplest words, let alone others, is acquired virtually without experience. At peak periods of language acquisition, children are acquiring about a word an hour, that is, often on one presentation. It must be, then, that the rich meaning of even the most elementary words is substantially innate. The evolutionary origin of such concepts is a complete mystery, one that may not be resolvable by means available to us.

So what's going on? Let's turn to Pinker, who suggests that we've been tying ourselves in knots because we're trying to be too clever. People don't consider the possibility of meanings like 'grue' or 'undetached rabbit parts' because Darwin. (Read: *The Language Instinct* pp. 153-157).

That's a fairly mainstream view, but notice how to some degree it just shifts the problem from developmental psychologists to evolutionary psychologists. We still need to determine what assumptions babies make and why (and how) they make them.

And now for something completely [different](#) (“Bleen or grue”?)

Recommended

This [video](#) explains the importance of 'grue' and 'bleen' to philosophy and logic.

1. [“Philosophy- Epistemology: The Puzzle of Grue”](#)

Readings:

1. [Excerpt](#) from Noam Chomsky’s interview on the Evolution of Language: A Biolinguistic Perspective
2. Pinker (1994) *The Language Instinct*. pp. 153-157

Videos:

1. Joshua Hartshorne: [“A grue gavagai counted to ten”](#)
2. [“Philosophy – Metaphysics: Ship of Theseus”](#)
3. [“Bleen or grue?”](#)

November 02 – Exam 2

Nothing to do - this is another placeholder so the exam shows in the calendar

November 05 – Learning Mechanisms: Universal Grammar

The most famous response to Poverty of the Stimulus arguments is Noam Chomsky's theory of Universal Grammar (UG). We've discussed UG in passing a few times. We'll take a closer look at it for this session.

Not surprising given its name, theories of UG are tightly coupled to theories of grammar. If you are still feeling shaky on syntax, I strongly recommend you watch this [video](#) (“SYN104 – Generative Grammar”) to brush up before moving on.

While we talk about *the* theory of universal grammar, in reality there are many theories. The following [video](#) (“GEN120 – Universal Grammar – Part 1”) gives a nice historical overview.

Although the speaker describes this history as a natural progression, there's actually quite a lot of disagreement. While some have adopted Chomsky's more recent "Merge is innate" argument, others prefer earlier versions of Chomsky's theory or prefer other theories entirely. Next, read this section from the book *Chomsky's Theory of Universal Grammar*, which (mostly) takes a Principles and Parameters approach to the problem (memory test: what did the speaker in the previous video say about this?). This is probably the version of UG that has had the most impact on language acquisition research.

Be prepared to discuss in class how the theory (or theories) of UG relate to Poverty of the Stimulus arguments. What do they address well? Where do they fall short (if anywhere)?

Note: While we are focused on *theories* of UG, there is another understanding of the term "universal grammar", which is that UG is our innate linguistic knowledge and learning mechanisms, whatever they happen to be. This is not a theory but rather a definition (notice that it can't be right or wrong). So when discussing UG with others, it can be helpful to establish whether they are referring to a theory -- and if so, which one?

Readings:

1. Cook, Vivian J. and Mark Newson, Chomsky's Universal Grammar: An Introduction, 2nd Edition, pp. 1-40.

Videos:

1. ["SYN104 – Generative Grammar"](#)
2. ["GEN120 – Universal Grammar – Part 1"](#)

November 07 – Learning Mechanisms: Heuristics

In the last session, we talked about classic nativist accounts of how syntax might be learned. For this session, we'll look at classic nativist accounts of word learning. Again, the goal here is to address Poverty of the Stimulus arguments.

Much of the classic work was done by Ellen Markman. Read her [overview](#) of this work (Markman, 1990).

There's a lot of important information in that paper. This [video](#) (Ling Space: "Word Learning") covers gives you a second look at many of the highlights.

One of the classic heuristics is mutual exclusivity. This [video](#) (Jove: "Mutual Exclusivity: How Children Learn the Meanings of Words") walks through how such experiments are carried out (note that we have access to this through the BC library; you may need to be on campus to watch it).

Finally, this [experiment](#) ("The Baby Human – Amanda Woodward – Dax Learning") looks at the role of social cues (there are versions of this experiment that use a somewhat more natural manipulation and get the same result)

Readings:

1. Markman, E. M. (1990). Constraints children place on word meanings. *Cognitive science*, 14(1), [57-77](#).

Videos:

1. Ling Space: "[Word Learning](#)"
2. Jove: "[Mutual Exclusivity: How Children Learn the Meanings of Words](#)"
3. "[The Baby Human – Amanda Woodward – Dax Learning](#)"

November 09 – Learning Mechanisms: Unsupervised Learning

One important feature of many Poverty of the Stimulus arguments is that children do not get much information about whether they are correct. Over the last several decades, there has been a revolution in computer science in terms of our understanding of how to learn without explicit feedback. In CS, learning with feedback is called "supervised learning" and learning without feedback is called "unsupervised learning". We'll start with two short videos from a CS course describing supervised and unsupervised learning (see the two Georgia Tech videos on [supervised](#) and [unsupervised](#) learning below)

Language acquisition researchers have become extremely interested in how much babies might be able to learn through unsupervised learning (note that language researchers rarely use the term "unsupervised learning", but the relationship should be clear). This research area has really exploded since the original demonstration by Jenny Saffran that young infants could do a certain amount of unsupervised learning. Watch from 9:00 to 13:45 of this [interview](#) with Prof. Saffran, in which she describes the basic paradigm.

Now, take a look at this [paper](#) that provides an overview of the literature up through about 2010. (Read Romberg et al., 2010).

Interestingly, this kind of unsupervised learning isn't specific to language learning. Here's a brief [overview](#) (JoVe: Visual Statistical Learning) of the same phenomenon in vision.

The work described above usually goes under the rubric "statistical learning" in psychology. Closely related to statistical learning and other forms of unsupervised learning is cross-situational learning, which I describe in this short [video](#) ("Cross-Situational Learning")

Is cross-situational learning really unsupervised? Not exactly. In *supervised* learning, you are always presented with the correct answer (ie the object that goes with the word). In cross-situational learning, you are given multiple possible answers. What makes this a bit complicated is that people often talk about objects that aren't there ("Let me tell you about the

time I went to Disney World"). So cross-situational learning is really what is called semi-supervised learning: sometimes you are given the correct answer, and sometimes you are not. One of the problems the child has to face is they may not know whether they have been given the correct answer or not.

Chomsky is famously skeptical about all of the work described above, which he equates with Behaviorism. Listen to what he has to say in the following [video](#) ("Steven Pinker asks Noam Chomsky a Question") How might Saffran respond?

Recommended

Lila Gleitman -- one of the most influential language acquisition researchers of all time -- is deeply skeptical of cross-situational learning ([this interview](#) "Propose but verify – Lila Gleitman").

In our discussion of unsupervised learning, we focused mostly on word-segmentation: figuring out where a word begins and ends. Researchers have explored the role of unsupervised learning for a range of linguistic issues. See this (now somewhat old) overview.

1. Gómez, R. L., & Gerken, L. (2000). Infant artificial language learning and language acquisition. *Trends in cognitive sciences*, 4(5), [178-186](#).

Readings:

1. Romberg, A. R., & Saffran, J. R. (2010). Statistical learning and language acquisition. *Wiley Interdisciplinary Reviews: Cognitive Science*, 1(6), [906-914](#)

Videos:

1. ["Supervised Learning – Georgia Tech – Machine Learning"](#)
2. ["Unsupervised Learning – Georgia Tech – Machine Learning"](#)
3. [Interview with Prof. Saffran "Office Hours: Infant Learning and Intelligence"](#)
4. [JoVE: Visual Statistical Learning](#)
5. Joshua Hartshorne: ["Cross-Situational Learning"](#)
6. ["Steven Pinker asks Noam Chomsky a Question"](#)
7. ["Propose but verify – Lila Gleitman"](#)

November 12 – Learning Mechanisms: Neural Networks

Psychology and neuroscience are built on the assumption that the brain is a computational system. The brain processes incoming data, information is stored, decisions are made. There's not much debate about that, in part because there's no obvious alternative. What is debated is

what *kind* of computational system that brain is. Is it like a computer, relying algebra and symbol manipulation, or does it work some other way?

The brain-as-linear-algebra-device account had went largely unchallenged since Chomsky's pioneering work of the 1950s until the late 1980s, a group of psychologists at Stanford and Carnegie Mellon came across a new computational approach that was being developed within computer science, called "neural networks" or "Connectionism". (These days, computer scientists are more likely to use the term "[Deep Learning](#)" (Wikipedia Link), which describes the complex neural networks now used to power Google Translate, make self-driving cars, and play the board game Go). Watch this brief introduction to [neural networks](#) ("Very Basic Intro to Neural Networks").

Check out also this more recent [New York Times article](#) on Deep Learning.

Recommended

These days, language researchers interested in neural networks tend to use a specific architecture called a "recurrent neural network". This [very gentle introduction](#) ("A friendly introduction to Recurrent Neural Networks") explains how they work. Don't let the matrix algebra scare you.

This [video](#) ("How to Make a Language Translator- Intro to Deep Learning #11") explains how Google Translate uses Deep Learning to translate between languages. It does use a fair amount of Deep Learning jargon, so you may find it difficult if you don't have any background in neural networks or machine learning.

Readings:

1. [The Great A.I. Awakening](#), Gideon Lewis-Kraus, *New York Times*

Videos:

1. ["Very Basic Intro to Neural Networks"](#)
2. Jesus Suarez: ["A friendly introduction to Recurrent Neural Networks"](#)
3. ["How to Make a Language Translator- Intro to Deep Learning #11"](#)

November 14 – Interlude: The Great Past Tense Debate

To this day, the most intense debate about the plausibility of neural network models for understanding the mind occurred in the context of the study of language acquisition. In the 1980s, Jay McClelland and David Rumelhart developed neural network models for a wide range of psychological phenomena. Among the phenomena they took on was syntax.

Many/most theories of syntax involve algebraic rules. McClelland and Rumelhart argued that neural networks, which do not contain algebraic rules, could handle the phenomena of syntax. This was a highly controversial claim, and many linguists and language acquisition researchers (most prominently, Steve Pinker) pushed back, arguing that no, neural networks could not handle the phenomena of syntax, proving that algebraic rules are necessary. The high water mark of this debate is captured in the following exchange that played out over the course of a year in the journal *Trends in Cognitive Science*. The exchange begins with position papers by Pinker and Michael Ullman on the one side ([read](#) “The past and future of the past tense”) and McClelland and Karalyn Patterson on the other ([read](#) “Rules or connections in past-tense inflections: What does evidence rule out?”). In the same issue, both pairs of authors then replied to each others' papers (see Readings List).

These papers then prompted a number of replies from others in the field (see below).

In reading the four papers above, try to evaluate the evidence, but also think carefully about what these different theories are saying about the nature of language and the nature of learning language. It should not surprise you to learn that there is a lot of overlap between Constructivists and Connectionists and also a lot of overlap between proponents of Universal Grammar and algebraic rules (in fact, Pinker's first paper was an overview of the Chomsky Hierarchy for the benefit of language acquisition researchers).

Neither side ended up really winning this debate. Interest in Connectionism faded and there are very few people still working on Connectionist models of language acquisition. On the other hand, many of Connectionism's critique of algebraic rules stuck, and researchers continue to grapple with them. Recently, Bayesian models have emerged as a possible third way, maintaining the power of algebraic rules while providing a better account of learning. If you are interested in Bayesian models, I cover them in my course "Computational Models of Cognition."

Recommended Reading

As mentioned, the four papers above prompted a number of replies, published in the same journal, which are worth reading:

1. Seidenberg, M. S., and Joanisse, M. F. (2003) “Show us the model”, *Trends in Cognitive Sciences*, 7(9), [106-107](#).
2. Ramscar, M. (2003) “The past-tense debate: exocentric form versus the evidence”, *Trends in Cognitive Sciences*, 7(3), [107-108](#).
3. Pinker, S. and Ullman, M. (2003) “Beyond one model per phenomenon”, *Trends in Cognitive Sciences*, 7(3), [108-109](#).
4. Marslen-Wilson, W. D., and Tyler, L. K. (2003) “Capturing underlying differentiation in the human language system”, *Trends in Cognitive Sciences*, 7(2), [62-63](#).

5. McClelland, J. L., and Patterson, K. (2003) "Differentiation and integration in human language", *Trends in Cognitive Sciences*, 7(2), [63-64](#).
6. Fun trivia: My first paper was one of the last salvos in the Great Past Tense Debate.- Hartshorne, J. K., and Ullman, M. (2006) "Why girls say 'holded' more than boys", *Developmental Science* 9, [21-32](#).

Readings:

1. Pinker, S. and Ullman, M. (2002) "The past and future of the past tense", *Trends in Cognitive Sciences*, 6(11), [456-463](#).
2. McClelland, J. L., & Patterson, K. (2002). Rules or connections in past-tense inflections: What does the evidence rule out?. *Trends in cognitive sciences*, 6(11), [465-472](#).
3. Pinker, S., & Ullman, M. (2002). Combination and structure, not gradedness, is the issue. *Trends in Cognitive Sciences*, 6(11), [472-474](#).
4. McClelland, J. L., & Patterson, K. (2002). 'Words or Rules' cannot exploit the regularity in exceptions. *Trends in Cognitive Sciences*, 6(11), [464-465](#).

November 16 – Interlude: The semantics of syntactic frames

The next three learning mechanisms we'll discuss make use of the relationship between syntax and semantics, called "argument structure". Because argument structure is the key to these theories, I waited until this point in the semester to cover it, so that it will be fresh in your minds.

[Here](#) is a fairly detailed overview by Steve Pinker ("What our language habits reveal", watch only the first 10min, 15sec). We can narrow in on a couple of these mappings between syntax and semantics. Here are a couple videos that my lab produced for our [VerbCorner](#) project: a description of the [dative alternation](#) and a description of the [causative alternation](#).

Finally, take a look at this [recent paper of mine](#). It is long, so you should feel free to skim (or just not read) the description of the experiments. What I want you to get out of this paper is the introduction and conclusion (that is, everything except the experiments themselves, though of course those are worth reading if you have the time).

Recommended

Although everybody agrees that syntax and semantics are related somehow, there's little agreement about what that relationship is. [This paper](#) by Ed Kako and Laura Wagner does a nice job of briefly describing several types of theories.

Kako was partial to David Dowty's theory, and produced what has to be the most thorough and careful test to date (Read his [2006 paper](#)).

Readings:

1. Hartshorne, J. K., O'Donnell, T. J., Sudo, Y., Uruwashi, M., Lee, M., & Snedeker, J. (2016). Psych verbs, the linking problem, and the acquisition of language. *Cognition*, 157, [268-288](#).
2. Kako, E., & Wagner, L. (2001). The semantics of syntactic structures. *Trends in Cognitive Sciences*, 5(3), [102-108](#).
3. Kako, E. (2006). The semantics of syntactic frames. *Language and Cognitive Processes*, 21(5), [562-575](#).

Videos:

1. Steven Pinker: [“What our language habits reveal”](#) (watch only the first 10min. 15sec)
2. VerbCorner: [dative alternation](#), [causative alternation](#)

November 19 – Learning Mechanisms: Constructivism

(Warning: There is more material for this session than usual.)

Nativist theories like Universal Grammar or the Language Instinct aren't the only games in town. There are a number of alternatives, the most famous of which usually go under the rubric "Constructivism", which has been influential since at least the 1970s. In this session, we'll cover this alternative approach. One of the things you should notice is that our sources for this session dispute some of the claims made by sources in previous sessions. So you should not necessarily try to reconcile what all the different sources say. Instead, try to understand where (and why!) Constructivism differs from other theories.

Last year, Adele Goldberg gave a great keynote talk across the river at a conference, providing a fantastic, in-depth (but someone long) discussion of Constructivist approaches to language acquisition. Watch it [here](#) (“Goldberg CUNY 2017”).

Next, read two sections of Ben Ambridge and Elena Lieven's 2011 textbook on language acquisition. The first describes Construction Grammar in more detail. Construction Grammar is an alternative theory as to the nature of syntax that takes a very different approach from the generative grammar approaches we've discussed previously.

The second section drills into the concepts of preemption and entrenchment, which were referenced in Goldberg's interview. These are core components of Constructivist theories of language acquisition.

Readings:

1. Ben Ambridge and Elena Lieven (2011) *Child Language Acquisition*. pp. 123-136 (Constructivism), and pp. 252-256 (Preemption and Entrenchment)

Videos:

1. [“Goldberg CUNY 2017”](#)

November 26 – Learning Mechanisms: Syntactic Bootstrapping

The earliest version of the theory of syntactic bootstrapping was formulated by Roger Brown in the middle of the 20th Century, but wasn't formulated into a major theory until the work of Lila Gleitman and her students in the early 1990s. The basic idea of syntactic bootstrapping is that if children understand something about the relationship between verb syntax and meaning, they could use the syntax in which a verb appears to make guesses as to the verb's meaning. (read Fisher et al.'s 2010 paper [“Syntactic bootstrapping”](#))

Next, watch this [video](#) about the Human Simulation Paradigm, an experimental method that is often used to inform theories of language acquisition, especially syntactic bootstrapping.

Readings:

1. Fisher, C., Gertner, Y., Scott, R. M., & Yuan, S. (2010). Syntactic bootstrapping. *Wiley Interdisciplinary Reviews: Cognitive Science*, 1(2), [143-149](#).

Videos:

1. Joshua Hartshorne: [“Human Simulation Paradigm”](#)

November 28 – Learning Mechanisms: Semantic Bootstrapping

Syntactic bootstrapping is focused on using syntax-semantics correspondences to learn the meanings of words. Semantic bootstrapping does the opposite, using syntax-semantics correspondences to learn syntax. Start with this brief description from [Wikipedia](#).

Next, watch this [video](#) (“Semantic Bootstrapping”), which goes through the ideas in more depth

Recommended

Constructivism, Semantic Bootstrapping, and Syntactic Bootstrapping all focus on exploiting the relationship between semantics and syntax. Another theory, Prosodic Bootstrapping,

instead uses the relationship between syntax and prosody to help aid learning. If you need a quick refresher, read through the [Wikipedia page](#) on prosody.

Here is a [paper](#) (Christophe et al., 2003) that lays out how Prosodic Bootstrapping would work (the evidence has been shakier for Prosodic Bootstrapping than many of the other theories).

Readings:

1. [Semantic bootstrapping](#) – Wikipedia
2. [Prosody \(linguistics\)](#) – Wikipedia
3. Christophe, A., Nespors, M., Teresa Guasti, M., & Van Ooyen, B. (2003). Prosodic structure and syntactic acquisition: the case of the head-direction parameter. *Developmental Science*, 6(2), [211-220](#).

Videos:

4. Joshua Hartshorne: [“Semantic Bootstrapping”](#)

November 30 – Putting it all together I

One of the core questions in language acquisition in the late 1990s and early 2000s was whether Constructivism or Syntactic Bootstrapping provided a better framework for thinking about language acquisition. Like the Great Past Tense Debate, this played out in a series of influential papers that do a great job of highlighting the key issues.

In 2000, Michael Tomasello summarized recent work by him and others questioning basic assumptions of Nativist theories of language acquisition (reading comprehension question: Why is Syntactic Bootstrapping considered "nativist"?). The key paper is [this one](#) (Tomasello 2000 – Do you children have adult syntactic competence?), However, it is really, really long, so I recommend you read this [shorter version](#) instead (Tomasello, 2000 – The item-based nature of children’s early syntactic developments”).

Tomasello argues that children do not have adult-like linguistic categories (like subject, object, agent, patient, etc.). If so, then they cannot possibly know enough argument structure for Syntactic or Semantic Bootstrapping to work. (Maybe Constructivism would still work; I’m more skeptical than he is.)

Cindy Fisher, who we met before, replied in this [2002 article](#), marshaling the best arguments of the day for Nativism in general and bootstrapping in particular.

At this point, you should probably go back to your notes on my "psych verbs" paper, which will hopefully make more sense. Think of the psych verbs paper as one of the latest updates in this debate. Conversely, you could see the talk by Adele Goldberg as an updated version of the Tomasello position. Taking the time to do this now should help you internalize the information better.

Readings:

1. Tomasello, M. (2000). Do young children have adult syntactic competence? *Cognition*, 74(3), [209-253](#).
2. Tomasello, M. (2000). The item-based nature of children's early syntactic development. *Trends in cognitive sciences*, 4(4), [156-163](#).
3. Fisher, C. (2002). The role of abstract syntactic knowledge in language acquisition: a reply to. *Cognition*, 82(3), [259-278](#).

December 03 – Putting it all together II

We have learned about a lot of different theories. All of them have some things going for them, but also striking weaknesses. Today, in our final content session, we'll try to put this all together. First, though, we need one more phenomenon on the table, so watch this short [video](#) discussing "Core Knowledge".

Next, read this overview I've been working on that tries to tie together some emerging trends in the study of language acquisition (An Emerging Consensus on How Children Learn Language). Notice how basic ideas from unsupervised learning, syntactic bootstrapping, and semantic bootstrapping are woven together. Consider whether you see a room for Constructivism or prosodic bootstrapping.

Recommended

For a somewhat different take on similar issues, read this [paper](#) by Deb Roy, which takes goes even farther in trying to tie the structure of language to the structure of thought.

Readings:

1. Hartshorne, J. K., & Snedeker, J. (2015). An Emerging Consensus on How Children Learn Language. Draft presented as part of a special symposium for the Boston University Conference on Language Development.
2. Roy, D. (2005). Grounding words in perception and action: computational insights. *Trends in cognitive sciences*, 9(8), [389-396](#).

Videos:

1. Michael Frank: [“Core Knowledge \(Stanford Psych 60\)”](#)

December 05 – Free Discussion: Ask Me Anything Day

Please turn in at least one question you have about language research, psychology, artificial intelligence, graduate school, or anything else I might be an "expert" on.

December 07 – Language in the World: Natural Language Processing

For our final meeting, we will be discussing language technologies in industry. Language technologies (Siri, Dragon Dictate, Alexa, Google Translate, etc.) are increasingly important. Our first speaker, Marjorie Freedman, used to work at BBN technologies, a private research institute and subsidiary of Raytheon. Now she works at a USC-affiliated research institute in Waltham. Both of her institutes have worked on a variety of language-related technologies.

Please come with questions!

December 10 – Language in the World: Career Services

When people think of what a (psycho)linguist does for a living, they often think of "professor" or "translator". But it turns out that the science of language is relevant to a wide range of modern careers.

Today, we'll be hearing from Career Services. You don't need to turn in a question this week. I do want you to use this opportunity to think about how what you are learning is relevant to the "real world".

December 12 – Second Replication: Writeup

Turn in a complete writeup of your second replication.

1. Your group should turn in a single writeup, listing all authors. If your group is doing two replications, this applies to both write-ups.
2. The writeup should include **all analyses described in the original paper**. If the professor gave you permission to not do one of the analyses, then you should describe it in the write-up as something done in the original paper but not included in the replication.
3. Include a section in the results that describes which findings replicated and which did not, including any speculation as to why.

4. When you are done, commit and push your work. Every member of your group must have made at least one substantial commit. This is **in addition** to any commits during the last assignment.

5. Then submit below what percentage of your group's work you feel you did. **This won't affect your grade.** It's simply feedback that will help me make adjustments to the course in the future if necessary.

Lab Assignments

August 31 - Problem Set 1: Research Ethics & Intro to Shell

Part 1

Most scientific software cannot be accessed through the point-and-click GUI ("Graphical User Interface") that people commonly use to interact with their computers. Instead, it has to be run through the shell. To do our research this semester, we will need to use several programs that can only be used (or are most easily used) through the shell.

If you've never used the shell before, it'll be intimidating at first. But after a few weeks, you will see that using it unlocks most of the power of your computer, which is largely hidden away if you only use the GUI. (This is why scientists use the shell so much.) Once you are comfortable with it, though, you'll wonder where it was all your life. (Answer: It was on your computer. You just didn't know.)

Get started with this brief tutorial. [[PS1_Shell.pdf](#)]

You may also find this cheat sheet useful. [[UnixLinuxCommands.pdf](#)]

Part 2

Open up the shell.

1. Check what folder you are in.
2. Create a new folder
3. Navigate to that folder
4. Check to see what files are in the folder
5. Make a new file.
6. Navigate back to the folder you were originally in.
7. Use Finder to delete your folder.
8. Use terminal to show that your folder and file are now gone.
9. Use the menu bar to print the content of your terminal window (Shell->Print). Upload the result.

Part 3

To do research in the United States, your research must be vetted by an Institutional Review Board, which is made up of academics, IRB professionals, and members of the community. The Boston College IRB asks that all researchers go through an ethics training program.

To complete this assignment, do the following:

1. Go to [the CITI program site](#). Create a user name and password. On the main menu, add the following: Basic Courses in the Protection of Human Research Subjects: Social and Behavioral Focus. Then complete those courses and submit your certificate here to Canvas.
2. Create an account on <https://www.cyberirb.us/BC>. Send your username to info@l3atbc.org (subject line: CyberIRB)

Part 4

We will be doing part of a course at DataCamp.com. Make sure you have an account and can access this [link](#).

We will frequently use Data Camp in this class. We are using DataCamp both because I think their instructions are very clear, but also because they allow for a “choose your own assignment” system. **That way, students who need to start at the absolute beginning can do so, whereas students who already have some experience can choose more advanced topics.**

Part 1 of today's assignment is Chapters 1-2 of "[Introduction to Shell for Data Science](#)."

You will see them under "assignments" in data camp.

Students who are very experienced with the shell can choose another DataCamp course from "assignments". DataCamp courses that I think may be useful are listed with due dates in January.

September 07 - Problem Set 2: More Shell + Starting Git

NOTE: Part 3 requires adding you to the class Bitbucket account. Make sure to get through that step of Part 4 before the end of class Friday, or you will be unable to complete the problem set.

As usual, students who have prior experience in the topics covered in the DataCamp assignments can assign themselves a different DataCamp chapter from those listed in 'assignments'.

Part 1.

In this session, we'll continue to get comfortable using the shell.

Part 1 of today's assignment is Chapters 3-4 of "[Introduction to Shell for Data Science](#)"

Part 2

Write a batch program in the shell to do something. Save it as a text file and upload it to Canvas.

Part 3

One of the powerful programs we'll use the shell for is Git. Git is widely used in computer science, and is increasingly used in laboratory sciences, such as Psychology. It simplifies sharing and collaborating, making it possible to do projects that would otherwise be impractical.

Like the shell, it can be intimidating at first. However, with some practice, it will seem very natural. Start with this tutorial, which goes through using Git with Bitbucket:

[BitbucketTutorial.pdf](#)

Part 4:

Now get more practice using Chapters 1-4 of "[Introduction to Git for Data Science](#)." at DataCamp.com.

You may also find this overview of how to use git useful:

[VersionControl.pdf](#)

Completion

When you are done, submit this problem set with the message 'complete'

September 14 - Problem Set 3: Git with Bitbucket; Making stimuli

Part 1

I have created a repository that we'll be using to make our first experiment. You can find it [here](#). **One** person in your group should fork this repository (see [this link](#) for instructions). **Name the repo as follows: Project1_NAMES**(where NAMES are the last names of the members of your group). One of the members of your group should be the owner. That person then needs to share the repo with the other members of your group and with me (jkhartshorne). To share, be looking at the repo in Bitbucket. Then click Settings->User and group access.

Part 2

Many students who are new at Git are terrified of merge conflicts: that is, when two different people make contradictory changes to the same repo, making it impossible to pull and push automatically. However, git was actually built to solve exactly this problem. So let's practice it some more.

In your Git groups, create a new file called "Broken.txt" and add it to your repo. Then, cause a merge conflict and fix it. Then cause another merge conflict and fix it. Then cause a third one and fix it. Be sure to push the final, fixed version. When you submit this assignment, be sure to explain the merge conflicts to me.

Part 3

The repo contains a file 'guide.pdf'. Follow the instructions to make the stimuli for our experiment. STOP WHEN YOU GET TO "Making the training stimuli". This final step requires knowledge of R, so we'll do it later.

Part 4

Please read the paper that the students in LAAD1 wrote. As I am writing this, the paper is still under review, but you can access the submitted version [here](#).

Completion

When you are done, submit this assignment with the message "complete"

September 21 - Problem Set 4: Intro to stats in R

Part 1

We are going to be doing statistical analysis using a free program called R. Go through Chapters 1 & 2 of "[Introduction to R](#)" and Chapters 1 & 2 of "[Introduction to Statistics with R](#)".

Part 2

[Introduction to Statistics with R](#): Chapters 4 & 5

[Introduction to R](#): Chapters 4 & 5

Part 3

[Working with the R Studio IDE](#): Chapter 1

Part 4

Using R Studio, create an R file that does something. It should contain 10-15 lines of code. This should *not* simply be a printout of you interacting with RStudio. It should be an actual .R script file. (If after going through Part 3, you don't know what I mean here, ask!)

Upload the file.

You can do this project with a partner, but you should each upload your own copy of the file.

Completion

When you are done with this problem set, submit with the message "complete"

September 28 - Problem Set 5: Statistics in R

Part 1

First, practice a little more with data types in R

[Introduction to Data \(Links to an external site.\)](#): Chapter 1

Part 2

Learn about t-tests in R

[Introduction to Statistics in R: Student's T-test](#) (both chapters)

Part 3

Continue learning how to use RStudio

[Working with the R Studio IDE \(Part 1\)](#): Chapter 2

Part 4

We'll use a tutorial called "swirl" to get some extra practice with R. This will help you consolidate some of what you've learned.

1. Open RStudio.
2. Type `install.packages("swirl")` and press Enter.
3. Type `library("swirl")` and press Enter.
4. Type `install_course("R Programming E")` and press Enter
5. Type `swirl()` and press Enter.

Follow the instructions to start the R Programming E course. **Finish through Part 8.** When you finish each part, you will be prompted to send me an email. **Only send an email for finishing Part 8.**

Completion

Submit this assignment with the message "complete"

October 05 - Problem Set 6: Practise with data analysis in R

Do this assignment in your Git groups.

For this assignment, you will replicate some of the analyses of the second replication of Saffran, Newport, & Aslin (1996) Exp. 1 that were reported in

[repSaffranNewportAslin1996_Exp1.pdf](#) (This document is more complete than the summary in the paper we looked at before).

There should already be a file called 'ProblemSet6.R' in your repo. That file describes the analyses you should do. Just replace all the 'FUBAR's with the relevant code. Your results should match what is shown in write-up above on pages 1 (the description of the subjects) and 3 (the description of the t-tests involving all subjects). Note that I only asked you to do a subset of those analyses.

Feel free to replicate other analyses for practice. You'll have to do most of these for the first paper in any case.

Completion

Be sure to commit and push your work. Then submit this assignment with the message 'complete'.

October 22 - Problem Set 7: R Markdown

Part 1.

You are probably used to writing papers in Word. However, Word is not very good for writing scientific papers. Why not? Because you have to copy and paste statistics from your R document into Word. And if you make figures, you have to make them in R (or another graphic program) and then copy and paste into Word. And then, if anything changes, you have to do it all over again. This can -- and frequently does -- result in copying errors.

You don't want to make copying errors. It's bad science. Also, your grade will be dinged.

R Markdown allows you to do your analyses and write your paper entirely within R. This eliminates any possibility of copying errors. Although this will look tricky at first, you already know most of what you need to know.

Go through Chapters 1-3 of "[Reporting with R Markdown](#)". **Earn at least 2,500 XP.**

Part 2

Next, you will rewrite your R document from the last problem set so that it is an R Markdown file.

1. Rename the file so that the ending it '.Rmd' rather than '.R'.
2. Add the following code to the beginning, modified as necessary:

title: "[INSERT A TITLE]"

```
author: "[LIST YOUR NAMES]"
```

```
date: "[INSERT DATE]"
```

```
output:
```

```
html_document:
```

```
toc: true
```

```
toc_float: true
```

```
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```

```
`` {r setup, include=FALSE}
```

```
knitr::opts_chunk$set(echo = TRUE)
```

```
library(tidyr)
```

```
library(dplyr)
```

```
[LIST ANY OTHER LIBRARIES YOU PLAN TO USE]
```

```
``
```

3. Now, write a paper with a method and results section that presents the results and graphs you made previously. You can copy the text you need from Pages 1 & 3 of the original write-up. Just be sure that all your numbers are actually calculated in R, rather than "[hard-coded \(Links to an external site.\)](#)" in.

Here is a nice example of an R Markdown paper: [analysis.Rmd](#) 

4. In the last problem set, we did only some of the analyses. Edit your R Markdown paper to include all the analyses described in the paper under "original analyses". You do *not* need to do the analyses in "revised analyses", which are a bit more advanced. (Though you can do them for extra credit.)

You will need to know that the high transition probability words are "dutaba", "pidabu", and "tutibu", and the low-probability words were "babupu", "bupada", and "patubi".

5. Compile your R Markdown file. Commit and push.

NOTE:

Once the paper is knit, it should look like a *paper*. Although you'll be using R code to calculate all the numbers, once the paper is knit, that code should not be visible. In essence, it should end up looking a lot like the original write-up, just shorter.

Completion

Submit this assignment with the message 'complete'.

October 29 - First Replication

1. Make any necessary changes to the 'method' section of your RMarkdown file, reflecting the experiment you actually designed (there should be some differences relative to the prior replication).
2. Be sure to address the "differences compared to original" section.
3. Knit with the new data.
4. Double-check everything for errors.
5. Submit the PDF through Canvas.

November 09 - Second Replication Checklist

The second project consists of replicating additional statistical learning experiments. You can do this alone, but it is recommended that you work in groups. Groups of 2 will replicate a single experiment. Groups of 3 or 4 will replicate 2 experiments. Groups larger than 4 are not allowed.

Once you have formed your groups, you will be assigned your experiment(s) by the professor.

Look through the experiment you have been asked to replicate. Make a **complete** list of **everything** that has to be done, including both methods but also analyses. Mark everything that you don't already know how to do.

There's two reasons for this assignment.

First, this checklist will help you when you are making the experiment. You don't want to accidentally turn in an incomplete assignment and get marked down simply because you overlooked something.

Second, it allows us to see whether there is anything you don't yet know how to do. If I judge some aspect of the experiment to be too difficult, I won't ask you to do that part. But **only** if that issue is identified now, during this assignment. (To be clear, I've tried to identify already anything you may have difficulty with. But I could have missed something.)

November 27 - Second Replication: Methods

To complete the first part of the project, you should:

- Create the stimuli and code to run your replication.

- Write up the introduction and method in R Markdown.
- Include a section that details any known or possible differences between the replication and the original.

Be sure to address every aspect of the method in your checklist.

When you submit, include a link to your repo, which should contain both code and the write-up. Every member of the group needs to have made at least one substantial commit.

Note the unusual due date.

December 12 - Second Replication: Writeup

Turn in a complete writeup of your second replication.

1. Your group should turn in a single writeup, listing all authors. If your group is doing two replications, this applies to both write-ups.
2. The writeup should include **all analyses described in the original paper**. If the professor gave you permission to not do one of the analyses, then you should describe it in the write-up as something done in the original paper but not included in the replication.
3. Include a section in the results that describes which findings replicated and which did not, including any speculation as to why.
4. When you are done, commit and push your work. Every member of your group must have made at least one substantial commit. This is **in addition** to any commits during the last assignment.
5. Then submit below what percentage of your group's work you feel you did. **This won't affect your grade**. It's simply feedback that will help me make adjustments to the course in the future if necessary.